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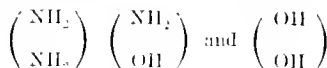
Feb. 1st:—

Messrs. J. A. Wanklyn and W. Johnstone, "The Acids of the Fatty Series and certain of their Derivatives."

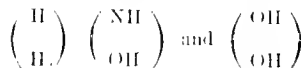
Mr. Watson Smith, "The Stability of certain Organic Nitrogen Compounds occurring in Coal-Tar Pitch."

ERRATUM.

In the December number of this Journal, 1891, page 983, col. 1, line 30, the formulae in brackets ought to read as follows:—



instead of



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MR. IVAN LEVINSTEIN IN THE CHAIR.

THE PURIFICATION OF SEWAGE BY PRECIPITATION.

BY J. BARROW.

THE origin of this paper is from some experimental work which I was requested to undertake, as to the action on sewage of a new precipitant, technically known as "Clarine." The material is in the form of a solution which consists mainly of a very basic perchloride of iron, absolutely free from ferrous salts. That is to say, it is a ferric chloride, supersaturated with ferric hydrate.

I have not made a sufficiently minute chemical examination of the iron compound contained to be able to state whether it is an oxychloride or not, but such is probably the case.

I have made a large number of experiments, both quantitative and qualitative, on many samples of sewage and works effluents of various descriptions, including among others the sewages of Salford, Pendleton, Moston, Newton Heath, Failsworth, Gorton, Clayton, and Acerington, effluents from bleach works, paper works, dye works, sizing and finishing works, jail washings from the Manchester Corporation Cleansing Department, and also the water from the Manchester Ship Canal Docks.

I may make the following observations on the action of Clarine:—

1. As a general rule what I should call the worst sewages are the most easily purified, that is to say, those sewages containing the most fecal or similar putrescible matter.

2. It is most essential to observe the exact condition of the sewage as to neutrality, alkalinity, or acidity before adding the precipitant. Most descriptions of sewage and effluent waters are best precipitated in a neutral solution, many are efficiently acted on in alkaline, whilst in a certain number the precipitate does not easily subside unless the sewage or effluent is acid.

3. It is almost essential to add exactly the right quantity of "Clarine," any deviation from this usually interfering with the clarification and subsidence of the precipitated matters. The quantity I found suitable to most sewages is about 15 grains per gallon, that is to say about one ton to the million gallons. This quantity I found to work admirably with Salford sewage.

4. The "Clarine" has a remarkably quick action, rendering the albuminous matters in solution insoluble, and the flocculent precipitate thus formed, as a rule subsides with great rapidity. This may be owing to the excess of iron it contains.

I will now proceed to a consideration of the numerical data bearing on the subject of the paper.

For the purposes of comparing the action of "Clarine" with that of other precipitants and processes, I have been

able to obtain figures ready to hand which are the work of Mr. Carter Bell, Dr. Burghardt, Dr. Angus Smith, Dr. Wallace, and others in relation to the "International," "Electrical," and "lime" processes. These are the only processes which can be said to be in the field for the purification of sewage.

The major part of my attention has been devoted to the analysis of effluents produced by the action of "Clarine" under varying conditions.

I will first quote, however, one special series of experiments which I made with four different methods of precipitation, viz., "lime," "ferrous sulphate," "alumino-ferric cake and lime," and "Clarine."

These experiments were performed on Salford sewage with chemically equivalent quantities of ferrous sulphate and sulphate of alumina and 15 grains per gallon of lime.

These experiments illustrate the chemical action of the processes above enumerated, as the precipitation portion of the "International" and "Electrical" systems is the addition of soluble ferrous compounds to the sewage in what I venture to say an unnecessary expensive form.

The figures which I have chosen as the best indication of the amount of noxious polluting material in sewage is the amount of albuminoid ammonia. The reasons for this we can discuss if time permits. I merely remark here, that the adoption of this figure is as fair to one process as another.

To summarise my results, the average amount of albuminoid ammonia contained in the raw sewage was 0.12 parts per 100,000, which, after treatment, was reduced as follows:—

	Parts per 100,000.
Ferrous sulphate	0.045
Alumino-ferric cake and lime	0.03
Lime	0.03
"Clarine"	0.02

The above figures give the following average percentages of purification—

	Per Cent.
Ferrous sulphate	62
Alumino-ferric cake and lime	75
Lime	75
"Clarine"	83

as indicated by the loss in albuminoid ammonia. The percentage of purification by the lime is considerably higher than is often the case, being generally about 40 per cent.

This appears certainly in favour of the last-named process. The sewage at the time was apparently in a very dilute condition, owing, no doubt, to the heavy rain we were having, but I am of opinion that with more concentrated sewage "Clarine" would remove proportionally larger amounts of noxious matter. I am proceeding with further work, which will decide this.

The following are a few results obtained from sewages of various descriptions before and after treatment with 15 grains per gallon of Clarine:—

	1891.	Free Ammonia.	Albuminoid Ammonia.	Percentage of Albuminoid Ammonia removed.
		Parts per 100,000.		Per Cent.
Sewage	Salford, 19th November	0.45	0.16	.. ..
Effluent	Salford, after treatment	0.36	0.025	84
Sewage	Salford, 1st October	0.5	0.50	.. ..
Effluent	Salford, after treatment	0.4	0.05	90
Sewage	Salford, 5th October	0.6	0.60	.. ..
Effluent	Salford, after treatment	0.6	0.02	96
Water	Ship Canal, 17th November	0.1	0.05	.. ..
Effluent	Ship Canal, after treatment	0.1	0.005	90
Sewage	Heaton Mersey, December 18 90	1.5	0.8	.. ..
Effluent	Heaton Mersey, after treatment	2.00	0.15	81
Sewage	Moston Brook, 2nd December .....	.. ..	0.2	.. ..
Effluent	Moston Brook, after treatment .....	.. ..	0.03	85

The samples taken from Heaton Mersey were taken before and after treatment on the large scale.

The following table contains a number of determinations of albuminoid ammonia contained in the effluents from the different processes under consideration.

ALBUMINOID AMMONIA IN SEWAGE EFFLUENTS OF VARIOUS DESCRIPTIONS IN PARTS PER 100,000.

Authority.	" Inter-national."	Authority.	Electrical.
Dr. Burghardt....	0.8 0.7	Mr. Carter Bell..	0.25 0.11
"	0.15 0.1	" ..	0.32 0.17
"	0.5 0.64	" ..	0.27 0.1
"	0.3 0.07	" ..	0.13 0.12
"	0.11 0.31	" ..	0.092 0.25
Mr. Carter Bell...	0.2 0.03	" ..	0.23 0.27
" ...	0.17 0.12	Dr. Burghardt...	0.1 0.27
" ...	0.15 0.11	" ...	0.26 0.21
" ...	0.16 0.12	" ...	0.1 0.1
" ...	0.05 0.105	" ...	0.3 0.1
" ...	0.06 0.15	" ...	0.15 0.17
" ...	0.01 0.24		Alumino-ferrie.
" ...	0.41 0.18	Dr. Burghardt...	0.5 0.3
	Lime Process.	" ...	0.46 0.32
Mr. Carter Bell...	0.27	" ...	0.36 0.3
" ...	0.395	" ...	0.1 ..
Dr. Angus Smith..	0.66		Clarine.
" after irrigation..	0.21	J. Barrow.....	0.025 0.02
Dr. Wallace.....	0.4-0.24	" ..	0.05 0.02
" ..	0.35	" ..	0.00 0.03
		" ..	0.15 ..

THE COST OF SOME OF THE PROCESSES OF SEWAGE TREATMENT.

BY HARRY GRIMSHAW, F.C.S.

THE consideration of cost in relation to sewage matters is, as we all know, not only important but absolutely vital. In the case of any process otherwise fairly effective we must ascertain what the expense of working it will be, for, of course, the process may be put out of court simply on account of the prohibitive cost of working it. All studies therefore of the chemical bearings of the different methods of dealing with sewage must of necessity run concurrently with the study of the cost of those processes. Now, as many of you know, the different materials which have been used for the so-called purification of sewage are in number legion. I will just run through a few of them for the amount of chemical interest an enumeration of the names may contain. Lime has been used, chloride of lime, gas-tar, chloride of magnesia, sulphate of alumina, otherwise called aluminiferous, phosphates of lime and other phosphates, sulphate of iron, and black-ash waste. Then we have the "A, B, C" process with its alum, blood, and clay; but to the "A, B, C" they did at one time add magnesia, manganate of soda and potash, charcoal (animal and vegetable), magnesian limestone, carbon waste (from prussiate works), and coal-dust.

Coming down to recent times, there is herring brine, an extraordinary compound to my mind, and perchloride of iron. Most of these substances are what, I venture to say, most chemists would call absurdities with regard to their purifying action on sewage. I would only remark in relation to them that probably those of them I have named which are added in a liquid form are rather better than those which are added in a solid form, because they do not gratuitously add weight to the sludge which is subsequently precipitated. Very luckily for me, and for you also, in considering the question this evening, the possible processes for sewage purification appear to me to be few, and I think barrow in the previous paper enumerated almost all of them.

These processes are principally, I might say, precipitation processes, or they are processes of precipitation followed by subsequent filtration. I have thought it well this evening to leave the treatment of sewage by irrigation out of consideration for the moment, because it would have caused my address to assume an undue length had I done otherwise; and another reason is that we find as a rule that processes of irrigation are not by any means suited to towns in crowded manufacturing districts, and certainly not for the district of which Manchester may be said to be the centre. Of course that is in consequence of the very large area of land which is apparently required for the effectual treatment of sewage by irrigation. In England, as far as I can judge from the data furnished by experiments tried in various parts of the country, about 200 acres of land are required for a million gallons of sewage per day, if you are to be safe under all contingencies. It is true that in France they appear to be able to do with less land. From Paris it is reported that they have fairly successfully treated one million gallons of sewage per day on 90 acres of land. It may be that the climate of France is more suitable for irrigation systems than that of England, which, as we all know, is very continuously wet. For nearly half of the year, in consequence of the incessant rainfall, we have our land in a water-clogged condition, independent of any sewage effluent we may pour upon it. Another reason why I have not gone into the cost of irrigation is that the sewage in manufacturing towns is not at all adapted for farm irrigation. I fancy a good deal of it is much better adapted to kill grass and various kinds of vegetation than to nourish it. Yet another reason is that it is difficult to get reliable data of the cost of irrigation. Premising the incidental matters I have thus indicated, the real purpose of my paper is to present in a condensed and simplified form a comparison of the cost of some of the chemical processes which have been tried or are likely to be adopted on a large scale for the purifying of sewage. The processes between which the comparison of cost are made in my paper are mainly, as I said before, those which formed the subject of the paper of Mr. Barrow; but they will also, of course, contain references to what I might call other than chemical processes. The data on which the present study of the question of cost is based, in so far as I could possibly base it, on the results of actual working or of trials on a very large scale, and I will proceed to an examination of the cost of about six processes, which, so far as I can judge, are the only ones that appear likely to come into actual practice on a large scale. The six processes I refer to are the lime treatment, the aluminiferous process, the Barry Company's process, the electrolytic process, the international process, and the Clarine process, which last is the newest of the series and will shortly, I am informed, be put into operation on the whole of the Salford sewage. In the first place, I will call your attention to figures in connexion with—

THE LIME TREATMENT.

At this stage I think I ought to acknowledge my very great indebtedness to the report of the Salford Sewage Committee, which I think I am not far wrong in saying forms by far the largest and most significant attempt extant in this country to obtain a definite conclusion in regard to those different processes of sewage treatment, and of course in this case the figures are based on actual working of the process or on very large experiments which have been carried on at Salford. I need scarcely say that I have

checked these figures wherever possible by comparison with data from other districts. I take now the annual cost of the lime treatment as at Salford. The actual amount of sewage which I believe has been treated at Salford regularly is something like 8,000,000 gallons per day, and I have been able to obtain the figures for the treatment of that amount of sewage, so that the figures I give you first relate to the treatment of 8,000,000 gallons per day. I have summarised the figures, so that I shall not detain you by unnecessary wandering in a maze of detail. The cost of the actual lime treatment, including the cost of the lime and the labour of putting it in, is 54*l.* 10*s.* per week, which is equivalent to 2,854*l.* per annum. The pumping of the sewage costs about 36*l.* per week, which is over 1,800*l.* per annum. The manipulation of the sludge costs about 29*l.* per week, which is a little over 1,500*l.* per annum. Taken together, the sums I have mentioned give a total of 6,248*l.* per annum. Well, in order to make that figure complete—of course I hope that my way of getting at the figures will be criticised as freely as possible—in order to make that estimate complete, I have added to that what appears to me to be the expense of the sinking fund in connexion with the sewage accounts, and that I have taken the liberty of culling from a letter of Mr. Councillor Corbett, in the "Manchester Guardian," where he states that amount to be 3,626*l.* The total, therefore, of these items for the lime treatment of 8,000,000 gallons is 9,874*l.*; you may say within a shade of 10,000*l.* Now on my own account I have added to that the cost, as ascertained from the Salford figures, of filtering the effluent, which would be 1,020*l.* So that if you filtered the lime-treated sewage you would have a cost of 10,894*l.* In following these comparisons out I have calculated the foregoing figures, and the figures for the other processes, on 10,000,000 gallons per day, and increasing the cost at Salford to 10,000,000 gallons per day, I get for the lime treatment at the above rate—materials and labour and incidental cost of operations—3,567*l.*, and for filtration through sand filters, six acres and works thereto, taken on the authority of the Salford engineer, 23,500*l.* at 5 per cent. per annum, 1,275*l.*, or a total of 4,842*l.* In order to make sure that I was not deceiving myself, and to make sure that the Salford figures were not deceiving me in any way, I have looked up the report of the Bradford sewage works, where they also use the lime process, and I have obtained very exhaustive figures indeed from this report. I have obtained separately the cost of management, labour, rates, lime, coal, coke breeze and coke, oil, grease, and tallow, gas water, cotton waste, repairs to boilers and machinery, repairs to tools and implements, blacksmith and ironmonger, charge for railway siding, and miscellaneous expenses (See Table No. 2.) This appears to me to be a very exhaustive summary, and the figures given for the quantity which is purified at Bradford agree very fairly well with the Salford figures, that is, of course, without taking into consideration any question of sinking fund, because that is a matter of local arrangement, and would vary very much. Allowing for the fact that the lime is a little cheaper at Bradford, the figures given in the Bradford report agree well with those in the Salford report.

The cost of the lime and the cost of putting it in, and the cost of the filter at Salford come to 4,842*l.* for 10,000,000 gallons, and this agrees well with the figures for the Bradford lime process in 1878, viz., 4,670*l.* We next have the cost of manipulating the sludge—I have a table with regard to this which I will quote later on—at Salford from 10,000,000 gallons and taking their own 8,000,000 gallons as the basis of the calculation of the cost of manipulating the sludge it is 1,902*l.* Now in order that I may convey the figures to you more precisely, and in order that you may be able to follow me in these comparisons, I have calculated the cost per annum down into cost per million gallons per annum for precipitation, for filtration and manipulation of sludge, and then I have calculated the actual cost for one million gallons only. The cost per million gallons per annum for precipitation in Salford is 217*l.*, the cost of filtration 270*l.*, and the cost of manipulating the sludge 190*l.*, making a total of 677*l.* per million gallons per annum. That gives us an actual cost per million gallons of 37*s.* 1*d.* Now then we will take the so-called—

ALUMINO-FERRIC PROCESS.

It is really the sulphate of alumina process, because the only thing which can dignify it as "ferric" at all is the presence in it of a trace of sulphate of iron. It is really sulphate of alumina. Here again I am basing my figures on actual experiments carried on at Salford. I find that aluminoferric cake, 4,500 tons at 2*l.*, costs 9,000*l.* Then you add to that 1,600 tons of lime at 10*s.* a ton, 800*l.* Labour is put down at 1,700*l.*, depreciation and repairs 150*l.*, and sand filters, six acres and works—the same ground as before—25,500*l.* at 5 per cent., 1,275*l.*; total 12,925*l.* That gives us a cost per million gallons per annum for precipitation 1,022*l.*, filtration 270*l.* as before, manipulation of sludge almost the same as for the lime process, 200*l.* instead of 190*l.* If we refine this down to the cost per million gallons we get a cost of 81*s.* 9*d.* if the sewage is filtered. If it is not filtered, and they do not at Salford, the cost becomes 67*s.* per million gallons. Then I come to the so-called—

BARRY PROCESS.

though it is really rather a work of supererogation to discuss this process, because according to a report I saw in the newspapers the company was liquidated a week ago. Nevertheless, I will make the comparison. The Barry Company as it appears to me, has made a very bad attempt at establishing what in my opinion might have been a fairly good process. The figures are these:—Ferric liquor, 7,150 tons at 1*l.* 15*s.*, 12,510*l.*; spent lime, which I understand is spent lime from the gas works or similar material (whether they sometimes use the waste from the alkali works I do not know), of that there is 7,700 tons at 3*s.* per ton, 1,185*l.* Labour I have taken from the Salford figures the same as before, 1,700*l.*; depreciation and repairs 150*l.*, the same as before; and sand filters the same as before, also 1,275*l.* Then there is a figure added here for royalty and necessary building 50,000*l.* at 5 per cent., 25,000*l.*, making the total cost for this process 19,320*l.* Without running through the other figures the above amount for 10,000,000 gallons per annum brings this rather inferior process up to a charge of 116*s.* 10*d.* per million gallons. The next system that I have the figures for is—

THE ELECTROLYTIC SYSTEM.

And here again we have very good figures supplied from the Salford experiments. The figures are these:—

Iron electrodes, 5,400 tons, renewed every five years, 4,500*l.*; labour, 1,800*l.*—this, you will notice, is 100*l.* more than the other, and I should think it is somewhat understated even then. For depreciation and repairs we must add considerably more for this process as the machinery necessary to produce the chemical effect desired in working the process is very costly, making a sum of 1,250*l.*; coal for working engines, 1,900*l.*; sand-filters as before, 1,275*l.* Without paying any royalty (what the royalty is I do not know, or whether there is any royalty) the total cost per annum for dealing with 10,000,000 gallons of sewage is 11,725*l.* The cost per million gallons per annum for precipitation is 902*l.*; for filtration, 270*l.*; and for manipulation of sludge, which, of course, varies according to the quantity of sludge the process produces, 115*l.* Total, 1,287*l.* This works out to a cost per million gallons of 70*s.* 6*d.* The next process I come to is—

THE INTERNATIONAL PROCESS.

In this case we have to begin with seven grains per gallon of ferrozene, which amounts to 1,630 tons at 50*s.*, 4,075*l.*; labour the same as in the electrolytic process, 1,800*l.* The filters are different, they are the so-called polarite filters, six acres, and other works, which are put down to cost 52,000*l.* at 5 per cent., 2,600*l.*, which makes a total for the three items of 8,625*l.* In all the other processes the amount of precipitant which is added I have calculated into chemical equivalents, that is to say, I find, for instance, that in the "Clarine" process, to which I shall allude later, the amount of iron used, 15 grains per gallon of sewage, is chemically almost equivalent to the amount of

alumina in the alum cake used in the alumino-ferrie process, and, curiously enough, so is the iron which is dissolved in the "electrolytic" process. They are in that respect on all fours—they all add chemicals equal to this 15 grains solution of iron per million gallons. Of the ferrozone seven grains is used per gallon. If you added 11 grains to make it 18, that would make the actual amounts of iron equivalent in all cases. You would have to add one and a half times more of this ferrozone to produce the same result, so that you see it is an absolutely vital question how much of this precipitant you are going to use, because if you use seven grains you get a cost of 8,625*l.*, but if you add an amount equivalent to what is used in the other processes you get an additional 6,103*l.*, or a total of 15,028*l.* Therefore with regard to this process I have taken out the cost per million gallons as before, and I arrive at the figure of 5*ls.* 1*d.*, but if I add a larger quantity of ferrozone the cost would be 90*s.* per million gallons. This includes the cost of the filter. If you added that amount of ferrozone there would be rather more sludge. I am quite sure that if you use only seven grains you will get a very imperfect precipitation, and you are relying almost entirely on your filter for the purification of your sewage. The last of the figures I have taken out relate to—

THE "CLARINE" PROCESS.

(Of course the figures I shall give here are, I believe, quite reliable. They have been arrived at after the same fashion as the others, and the price I have taken is the price per ton at which I am informed the makers are prepared to supply the iron solution. Of this so-called Clarine 15 grains are used per gallon of sewage, or one ton per million gallons, which gives 3,650 tons at 30*s.*, 5,475*l.* The labour I have taken at 200*l.* per annum less than the alumino-ferrie and the lime, because this substance is a liquid and simply requires running into the sewage. It does not require any mechanical mixing. Depreciation and repairs I have set down at 150*l.*, as before. The cost of filters is the same, 1,275*l.* To this I have added 365 tons of lime at 10*s.*, because in some of my experiments I found I had to add lime for neutralising. Therefore I have added 183*l.* for lime. Dividing the total out in the same way, without going into details, the cost per million gallons by this process, if filtered by the same filters as before, is 5*ls.* 2*d.*, but if filtration is not employed, which I am informed is not considered in most cases to be necessary, the cost will be 40*s.* There is a certain area of sand filters, such as are commonly used by sewage engineers.

A summary of the method by which these figures are arrived at will be found in the tables appended:—

	<i>s.</i>
Barry Company (no filtration).....	116
International with the equivalent amount of ferrozone (filtration).....	90
Alumino-ferrie (filtration).....	81
Alumino-ferrie (no filtration).....	75
Electric (filtration).....	70
International (filtration).....	54
Clarine (filtration).....	
Clarine (no filtration).....	40
Lime (filtration).....	

All except the first and last processes propose to filter. The only figures I shall trouble you with now are some relating to the cost of disposing of the sludge, which is a very important matter, as we all know. Taking again the figures given by Mr. Newton in the Salford report we have these data. Raw or crude sewage contains matter in suspension amounting to probably 25 grains per gallon, which in 10,000,000 gallons per day equals:—in dry state, 16 tons; in pressed cake, 32 tons; as wet sludge, 160 tons. The following is an estimate of the weights per annum which is, I think fairly accurate, that is on 10,000,000 per day of Salford sewage. I will only cite the dry weights (the others are given in the table appended): Raw sewage gives 5,840 tons; the International process, 7,500 tons; the Electric, 6,900 tons; the Barry Company's process, 12,000 tons; the Alumino-ferrie process, 12,000 tons; the lime treatment, 11,420 tons; and the Clarine, 6,751 tons.

These are my own figures from the data given in the Salford report, and I have arrived at them after taking the amount of sludge from the raw sewage and adding the amount of ferrie hydrate, alumina, or lime salts formed by the quantity of precipitant added. In the case of lime I have assumed that it would mostly be converted into carbonate of lime. Some of it may be converted into sulphate, which of course would increase the weight, but a little of it would dissolve. So that if I take the lime as entirely converted into carbonate I think I get a fair estimate of the quantities of sludge from the lime process. The cost of manipulating the sludge is for treating it as is done at Salford, namely, running it on to draining beds and afterwards removing it, simply allowing it to accumulate. If it were collected and pressed the cost would be very considerably more, probably double, and this would naturally tell in favour of those processes which produce the least sludge.

SLUDGE PRODUCED BY VARIOUS PROCESSES.

	Dry Sludge.	Pressed Cake.	Wet Sludge.
	Tons.	Tons.	Tons.
Raw sewage.....	5,840	11,680	58,400
International.....	7,500	15,000	75,000
Electric.....	6,900	13,800	69,000
Barry Co.....	12,000	24,000	120,000
Alumino-ferrie.....	12,000	24,000	120,000
Lime.....	11,420	22,840	114,200
Clarine.....	6,751	13,502	67,509

I am sorry to have had to give so many figures, but my apology is the very obvious one that you cannot possibly treat questions of cost without so doing.

TABLE I.

ANNUAL COST AT SALFORD. (REPORT, JANUARY 1891), AND OTHER AUTHORITIES.

LIME TREATMENT (ABOUT 8,000,000 GALLONS).

	£	s.	d.		£	s.	d.
Lime treatment.....	51	10	0	per week	2,851	0	0
Pumping sewage	36	0	0	"	1,872	0	0
Manipulation of sludge ..	29	0	0	"	1,522	6	0
					<hr/>		
					6,248	0	0
Sinking fund (Councillor Corbett, Nov. 21st, 1891—letter to "Manchester Guardian"....)					<hr/>		
					3,026	0	0
					<hr/>		
					9,574	0	0
Filters for 8,000,000 gallons of effluent					<hr/>		
					1,020	0	0
					<hr/>		
					10,594	0	0

LIME TREATMENT FOR 10,000,000 GALLONS PER DAY.

	£	s.	d.
Lime treatment at above rate (material and labour?).....	3,567	0	0
Sand filters, six acres and works—25,500 <i>l.</i> at 5 per cent.....	1,275	0	0
	4,842	0	0
The above cost agrees well with the figures for the Bradford lime process in 1878 (see note *), viz.....	4,670	0	0

* Cost of lime treatment at Bradford, Yorkshire, calculated on 10,000,000 gallons, in the year 1878:—

	£	s.	d.
Lime, 7½ tons per day (27½ tons at 10 <i>s.</i>).....	1,370	0	0
Salaries and wages.....	2,198	0	0
Repairs.....	203	0	0
Miscellaneous expenses.....	799	0	0
	4,670	0	0

	£	s.	d.
Cost of manipulation of sludge produced from 10,000,000 gallons, equal to 11,120 tons, dry, see Table 9, sludge from various processes.....	1,992	0	0
Cost per million gallons per annum for precipitation.....	217	0	0
Cost per million gallons per annum for filtration.....	270	0	0
Cost per million gallons per annum for manipulation of sludge.....	190	0	0
	<u>677</u>	<u>0</u>	<u>0</u>

Cost per million gallons 37s. 1d.

In Table II. will be found a full statement of the expenses at Bradford in the year 1883 on 8,450,000 gallons of sewage, which, on allowing for slightly less cost of materials, also agrees fairly well with the Salford estimate (1891 Report), the comparison being perhaps a little in favour of Bradford.

TABLE II.

ANNUAL COST OF WORKING THE LIME PROCESS AT BRADFORD IN THE YEAR 1883.

	£	s.	d.
Management.....	308	17	0
Labour.....	1,151	13	10
Rates.....	37	7	2
Lime.....	995	7	10
Coal.....	120	19	2
Coke-breeze and coke.....	56	16	9
Oil, grease, and tallow.....	50	8	0
Gas.....	33	5	7
Water.....	50	17	0
Cotton waste.....	6	12	10
Repairs to boilers and machinery.....	60	12	10
Repairs to tools and implements.....	48	19	2
Blacksmith and ironmonger.....	25	0	6
Charge for railway siding.....	11	5	7
Miscellaneous.....	31	19	1
	<u>3,302</u>	<u>2</u>	<u>1</u>

If the daily flow be taken at 8,450,000 gallons, the cost of treatment would be 2s. 2d. per 100,000 gallons.

The cost of the principal materials used are as follows:—

	£	s.	d.
Lime.....	0	10	per ton
Coke-breeze.....	0	11	"
Coal.....	6	1	"

The reduced cost of working in comparison to that of Leeds is due to the fact that the sewage flows to the works by gravitation, whereas at Leeds pumping machinery is required. Coal and lime are also cheaper than at Leeds. The materials are conveyed to the works by the railway, with which they are in communication by means of a siding.

Some of the above advantages are also in favour of Bradford as compared with Salford.

TABLE III.

ANNUAL COST AT SALFORD (NEWTON'S REPORT, &C.).

ALUMINO-FERRIC PROCESS (10,000,000 GALLS. PER DAY).

	£	s.	d.
Alumino-ferric cake (1,500 tons at 27).....	9,000	0	0
Lime (1,500 tons at 10s.).....	800	0	0
Labour.....	1,700	0	0
Depreciation and repairs.....	150	0	0
Sand filters, six acres and works (25,000l. at 5 per cent.).....	1,275	0	0
Manipulation of sludge.....	2,000	0	0
Total.....	<u>14,925</u>	<u>0</u>	<u>0</u>
	£	s.	d.
Cost per million gallons per annum for precipitation.....	1,022	0	0
Cost per million gallons per annum for filtration.....	270	0	0
Cost per million gallons per annum for manipulation of sludge.....	200	0	0
	<u>1,492</u>	<u>0</u>	<u>0</u>

Cost per million gallons 81s. 9d.

" " unfiltred 1. 75s.

TABLE IV.

ANNUAL COST AT SALFORD (NEWTON'S REPORT, &C.).

BARRY COMPANY'S PROCESS (10,000,000 GALLS. PER DAY)

	£	s.	d.
Ferrie liquor (7,500 tons at 17. 15s.).....	12,510	0	0
Spent lime (7,500 tons at 3s.).....	1,185	0	0
Labour.....	1,700	0	0
Depreciation and repairs.....	150	0	0
Sand filters, six acres and works (25,000l. at 5 per cent.).....	1,275	0	0
Royalty and necessary buildings (50,000l. at 5 per cent.).....	2,500	0	0
Manipulation of sludge.....	2,000	0	0
Total.....	<u>21,320</u>	<u>0</u>	<u>0</u>

£ s. d.

Cost per million gallons per annum for precipitation.....	1,662	0	0
Cost per million gallons per annum for filtration.....	270	0	0
Cost per million gallons per annum for manipulation of sludge.....	200	0	0
	<u>2,132</u>	<u>0</u>	<u>0</u>

Cost per million gallons, 116s. 10d.

TABLE V.

ANNUAL COST AT SALFORD (NEWTON'S REPORT, &C.).

ELECTROLYTIC PROCESS (10,000,000 GALLS. PER DAY).

	£	s.	d.
Iron electrodes, 5,100 tons, renewed every five years.....	4,500	0	0
Labour.....	1,800	0	0
Depreciation and repairs.....	1,250	0	0
Coal for working engines.....	1,900	0	0
Steam engines, dynamos and works (20,000l. at 5 per cent.).....	1,000	0	0
Sand filters, six acres and works (25,500l. at 5 per cent.).....	1,275	0	0
Manipulation of sludge.....	1,150	0	0
Total (see royalty).....	<u>12,875</u>	<u>0</u>	<u>0</u>

£ s. d.

Cost per million gallons per annum for precipitation.....	992	0	0
Cost per million gallons per annum for filtration.....	270	0	0
Cost per million gallons per annum for manipulation of sludge.....	115	0	0
	<u>1,287</u>	<u>0</u>	<u>0</u>

Cost per million gallons, 70s. 6d.

TABLE VI.

ANNUAL COST AT SALFORD (NEWTON'S REPORT, &C.).

INTERNATIONAL PROCESS (10,000,000 GALLS. PER DAY).

	£	s.	d.
Ferrozone, seven grains per gallon (1,630 tons at 50s.).....	4,075	0	0
Labour.....	1,800	0	0
Polarite filters, six acres and other works (52,000l. at 5 per cent.).....	2,600	0	0
Manipulation of sludge.....	1,250	0	0
	<u>9,725</u>	<u>0</u>	<u>0</u>
*Add 11 grains ferrozone per gallon to make 18 grains per gallon.....	6,403	0	0
	<u>16,128</u>	<u>0</u>	<u>0</u>

	£	s.	d.
Cost per million gallons per annum for precipitation	462	0	0
Cost per million gallons per annum for filtration	100	0	0
Cost per million gallons per annum for manipulation of sludge	125	0	0
*Cost of additional ferrozone	987	0	0
" " " manipulation of sludge therefrom, 1,500 tons	610	0	0
	25	0	0
	1,652	0	0
Cost per million gallons, 54s. 1d.			
" " " with added ferrozone, 20s.			

TABLE VII.

ANNUAL COST OF WORKING "CLARINE" PROCESS
(10,000,000 GALLONS PER DAY).

	£	s.	d.
Clarine, 15 grains per gallon of sewage, or one ton per million gallons (3,650 tons at 30s.) ..	5,475	0	0
Labour (less on account of precipitant being a liquid)	1,500	0	0
Depreciation and repairs	150	0	0
Sand filters, six acres and works (25,500l. at 5 per cent.)	1,275	0	0
	8,390	0	0
Lime (possibly required for neutralising), 305 tons at 10s.	183	0	0
Manipulation of sludge	1,120	0	0
	9,693	0	0
	£	s.	d.
Cost per million gallons per annum for precipitation	607	0	0
Cost per million gallons per annum for filtration	270	0	0
Cost per million gallons per annum for manipulation of sludge	112	0	0
	989	0	0
Cost per million gallons, 51s. 2d.			
" " " unfiltered, 19s.			

DISCUSSION.

Mr. JAMES RICHARDS gave the results of some experiments he had recently made. He stated that he had experimented with the salts of many metallic oxides, including ferrous and ferric oxides, and he had obtained about 80 per cent. of purification from albuminoid ammonia in all cases where the sulphates were used. The bichloride of mercury removed a large quantity of free ammonia as well.

Dr. CARL OTTO WEBER said that as to the "International" process he could not quite agree with Mr. Grimshaw's calculation of cost. He gave it at 90s. as compared with 54s. for the Clarine, assuming the same quantity to be used for each, but the International process employed the polarite filter, which to a certain extent assisted the action of the precipitant. A great deal of the albuminoid matter was actually removed, not by the precipitant in the International process, but by the polarite filter. He could not in any way bear out the remarks of Mr. Richards with regard to ferrous and ferric salts respectively, as he found that ferric salts were in every respect superior. This was shown in Mr. Richards' own admission that the oxygen absorbed was greater in the effluents from the treatment by ferrous salts. Other metallic oxides besides oxide of mercury absorbed free ammonia. This was notably the case with ferric hydrate.

COUNCILLOR CORBETT (Salford): I will only give you a few facts in relation to Salford such as I think may be of use. Mr. Grimshaw has quoted figures to show that the cost of the lime process is 37s. per million gallons, but that is burdening the process with filtration. Taking the lime process as carried on now at the Salford sewage works, and

allowing for the night and day treatment, the cost, as near as I can make out, is 25s. per million gallons. Last summer we had been carrying on the lime process in a rough and ready way, not trying to perfect the apparatus until we decided on our future course. In very hot weather our pumping engine broke down and at this time our other engine was being altered. The works were stopped, and we left the sewage in the tanks, on the top of the mud, which had not been cleared out for a number of weeks, and, according to all precedent, the mixture should have fermented, and given off offensive gases. But it did nothing of the kind. It lay for weeks in our tanks and we have the clearest evidence that at no time was there any perceptible nuisance. Samples of the effluent sent to several chemists without telling them what it was, showed on analysis that the effluent was an excellent one. That being so, what is a committee to do? Again, in the last few months we were working with the lime process. We got a request from the Ship Canal Company to cease operations for a time. We did so, and again under the same circumstances, except that it was a cold instead of a hot summer. Again there was no nuisance. The effluent, though at first it was alkaline, very soon became neutral so far as our rough tests would tell. Possibly the manufacturers that are being carried on in Salford may be discharging iron, or some other chemical that is required to complete the lime process. Well, if the manufactures of the borough are providing for us what is sufficient to purify our sewage we shall be well content. I take a special interest in what Mr. Grimshaw has said because I first proposed these experiments. Large experiments are now again being tried. We are going to try oxidising the lime effluent, but, beyond that, it has occurred to us that the sulphurous compounds, the chemicals in smoke, are possibly the very things wanted to neutralise the lime effluent, and we are going to try the comparative effects of aerating the effluent with the smoke of our boiler chimneys, and aerating with pure air.

The CHAIRMAN: If lime alone will purify the sewage, I do not see what need there is for further experiments, because, according to Mr. Corbett's statement, the lime process costs only 25s., and the "Clarine" process cannot beat that figure.

Mr. ARTHUR BOWLS, A.M.I.C.E.: It appears to me that the comparison of various systems cannot be made in such an off-hand fashion as Mr. Grimshaw has attempted. Of course, he explains that he has had to make various hypotheses. He has put on costs for manipulation of sludge and other matters, but it must be remembered that there are various points which have never yet been ascertained. For instance, who can tell you what the "Electrical" system has cost? The amount of coal used for the boilers to drive the dynamos has never yet been measured or weighed. The electricity has been measured, as it was at Salford, and their engineers would tell you, I have no doubt, that you can convert electricity into its horse-power equivalent by some calculation, and that you can get so many horse-power for so much coal. So you do with a certain efficiency of boiler, but then what kind of boilers have we? The only actual way of arriving at the actual cost is to weigh the coal in. That is a considerable item to be considered in arriving at correct figures on this question. I weighed every iron plate in the first experiment myself. We got at the amount of iron to a few grains, but the coal was not arrived at. I give that just as a sample of the points which have not been accurately determined, and not in disparagement of the "Electrical" system. Then there are much bigger assumptions Mr. Grimshaw had to make to bring the different processes to the same basis. By one method he makes out that the International system costs 54s. per gallon, but he says that, if you put the same amount of iron in as is used in other systems it will cost 90s. per gallon. But why should you put more iron in if it already gives a better effluent than most of the other systems on the board. That brings us to the vital question, have the systems been compared for efficiency? If the figures of Mr. Grimshaw are to be regarded as reliable, there ought to be the same purity of effluent from each. The Barry Company is put at the top as costing 116s. per gallon, but

to get efficiency you might have to spend 500s. per gallon. As a matter of fact I do not think that with that process you could get efficiency at any price. So far as possible, the conditions ought to be the same throughout, as to manipulation of sludge, filters, and other matters. Filtration was used in providing effluents from the International process, for instance, and also from the Electrical Company's process—that is to say, the results that were described in the Salford report were obtained, in some cases, after filtration. Mr. Barrow gave us the figures, and he also said that the effluents from this "Clarine" process had been filtered, but were filtered through filter-paper. It is hardly fair to compare filtration through filter-paper with filtration through sand or polarite. I would like to know whether the Clarine system has been patented, and whether there is anything to prevent a corporation or local board from using it. Is there any royalty to pay?

Mr. BARROW, in reply, said the result of his experiments conflicted with the opinion of Mr. Richards and agreed with that of Dr. Weber. The purification effected by the particular iron salt which was the main subject of his paper, had been invariably greater than the 80 per cent. obtained by Mr. Richards. It seemed to him altogether wrong to add a reducing agent like a ferrous salt to sewage when oxidation was the object aimed at.

Mr. GRIMSHAW, in his reply, said he wished to say just one word with regard to the polarite filters and the ferrozone. He would like to be as fair as he could to all the processes, and he would say that if they used the smallest quantity of the precipitate they must use a very efficient filter, which they must rely on to do the work, because seven grains of ferrozone would not do much to clarify the sewage. He would say that the "International" working with an equivalent quantity of precipitant to the other processes, and using an ordinary sand-filter instead of the polarite, would probably give as good results as with the present way of working. There was no doubt the "International" filter was a good one, and there was no doubt that so far as results went their precipitant was a bad one. Mr. Corbett should not lay too much stress on an isolated lime effluent. Untreated sewage, if allowed to stand some months, would purify itself very considerably, but of course in practice this could never be the case. In most cases lime alone did not give an effluent fit to be run away without filtering. In relation to the interesting remarks by Mr. Arthur Bowes, none of the figures were assumptions of his (Mr. Grimshaw's) own, but were in most cases estimates formed by the engineer on whom the Salford Corporation relied in their sewage report, and really those items of cost which were at all open to be called assumptions (*i.e.*, estimates), were common to the whole of the systems of sewage treatment alluded to. With regard to efficiency, he said it appeared that the systems which cost the least gave the best result, with the exception of the lime process, which, whilst it was cheapest, gave about the worst result as to quantity of sludge and quality of effluent. Of the processes he had dealt with, he put the "Clarine" first for efficiency, the "International" second, and the "Electrolytic" third. The remaining processes might be grouped together.

The discussion was then adjourned.

ADJOURNED DISCUSSION.

The CHAIRMAN reminded the meeting that the treatment of sewage had formed the subject of several papers which had been brought before the Section during the past twelve months, and, with the exception of the lime process, iron was used in some form in all the systems referred to, even in the electrical process, and the question was:—What salts of iron would be the best, and at the same time the most economical?

Dr. DREYFUS thought that in any process for the purification of sewage the two main points to be considered were: first, the cost, and secondly, efficiency. According to Mr. Grimshaw's figures Barrow's process was more costly than the lime process. He would have been glad if

Mr. Grimshaw had been prepared to show how much free ammonia was left in the sewage after the lime treatment, and how much permanganate it would take to oxidise it. This would have shown the efficiency of the Clarine process as compared with the lime process.

Mr. GEORGE E. DAVIS said that when a regular and continuous supply of a proto-salt of iron could be mixed with the sewage of any town without detection, that should be a fair test of the value of such a process, yet he had had samples of sewage from a certain town where large quantities had been added without the knowledge of the authorities, and still the effluent had not been satisfactory. With regard to the cost of the lime process, Mr. Grimshaw in his summary gave $1\frac{1}{2}$ tons to every million gallons of sewage per day. He had pointed out over and over again that this was less than one-half of the quantity necessary to destroy the albuminous matters in the sewage of any town, and was often merely sufficient to form carbonate of lime, but in exceeding the $1\frac{1}{2}$ tons great care was necessary to prevent the effluent becoming very offensive. He had found per-salts of iron more effective than proto-salts. He thought the crux of the whole question was the disposal of the sludge, and he should like to know what Mr. Barrow intended to do with it in his particular case.

Dr. GERLAND said that some 40 or 50 years ago a per-salt of iron was used to purify the London sewage, but discontinued on account of a black deposit in the River Thames. He did not think, however, that any settling backs or filtration were employed.

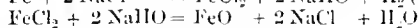
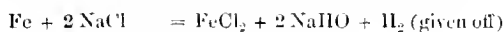
Mr. McCULLUM: Under heading No. 5 (International) Mr. Grimshaw gave ferrozone 18 grains per gallon, whereas he knew of places where only 9 grains were used, and this considerably reduced the cost.

Mr. BARROW, in reply, said that he had made some comparative tests, and in each case he had obtained better results. The per-centage of purification by the "Clarine" process was 73 as against 35 by the lime process. He might also remark that the effluent from the lime process was also capable of being further purified to a very considerable extent by treatment with "Clarine." It might interest some of those present to know that the albuminoid ammonia in the water of the ship canal dock was reduced some 90 per cent. by the iron process.

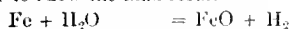
Mr. GRIMSHAW, in reply, said: I am pleased to find that the opinions expressed by the gentlemen who have spoken this evening are so nearly in accord with results arrived at in the two papers under discussion that I need say very little in reply to the speakers, and I therefore direct most of my attention to the criticism of the papers at the meeting when they were read. My object in my paper was to institute as close a comparison of modern results as to cost of sewage treatment by different processes as possible. It has been my impression for some time that a simple addition of a "cheap" per salt of iron together in some cases with a little lime was bound to be the precipitation process of the future. There is so little complication possible about such a process that the figures of cost are easily obtainable, with very little loophole for inaccuracy. With regard to the lime process the same may be said as also to the alum process, so far as estimates of cost are concerned. The three above-named processes, together with the international and possibly the electrical, appear to be the only possible processes at present before the public, or known in the chemical world. There are no figures which I am aware of published by the proprietors of the Electrical or International processes, and therefore I considered it the most advisable thing to take the figures given by the engineer who reported on the exhaustive and considerable trials of these two processes by the Salford Corporation. The report of this corporation is, I maintain, a very valuable contribution to our exact knowledge of the effectiveness and cost of sewage processes. As neither the International nor the Electrical Company demur to the Salford figures as in any way over-estimates of cost, I take those figures as fair to those processes. For my own part I am of opinion that they are more than fair, and that the cost to Salford of

either of those processes is likely to be more than the amounts arrived at in their report. I contend, therefore, that my conclusion that treatment with a cheap per-salt of iron of the right chemical composition is the least costly and very probably the most efficient, certainly as efficient as any known method of purifying sewage, is strengthened by any allowance we may make for what I may call the possible error of experiment in my method of comparison. Simple treatment with lime is, of course, less costly initially than by any metallic salt which is known, and even when the extra cost of manipulating the great quantity of sludge produced by lime is taken into account the same may perhaps hold good. But I hope I am not to be asked to slay the slain and vanquish the defeated by proving the utter inadequacy of lime alone to produce day by day a satisfactory effluent. Advocates of the simple lime process must produce some good modern authority for its retention before calling upon its opponents to disprove its supposed efficiency. Chemists to-day do not grant that it has any. In order to be just I would remark here that the "Davis" lime process would appear chemically to be a distinct advance on the ordinary crude lime treatment, but unfortunately it does not seem possible, on account of the very complex mechanics of the process, to give any fair approximation of the cost, and no trials of it have been made. With regard to Salford as a typical case I am prepared to show experimentally, on the large or small scale, that it is on some days perfectly impossible to precipitate the sewage with lime, whilst with a per-salt of iron and a little lime you get a clear effluent in a very short time. Occasionally in the Salford sewage you have so large a trace of iron compounds that the lime gives a very fair effluent (in appearance). With lime alone, therefore, you can do nothing satisfactory. With a basic ferric chloride you can do almost everything possible in sewage precipitation, and with such an iron salt and a little lime in special cases you can do all that is possible in the present state of our knowledge. Sulphate of alumina is a good clarifier of many kinds of sewage, but it requires a large quantity of lime for a proper decomposition, and small quantities of it do not appear to act so efficiently as small quantities of per-salts of iron. The reason of this may perhaps be found in its want of catalytic power, so to speak, in regard to acting as a carrier of oxygen to the oxidisable organic matters of sewage. It would not be contended by any chemist that this property of transferring oxygen, so marked in the ferric hydrate, is possessed at all by alumina hydrate. On the contrary, we all know that it is the intense tenacity with which the element aluminium retains its oxygen which hinders the economical production of the metal, alumina only parting with its oxygen under the intense action of the electric arc, or of metals like sodium. The great affinity of iron for sulphur is absent also in alumina compounds, there being no sulphide of aluminium, whereas the immediate combination of oxide of iron with sulphur compounds with subsequent rapid oxidation to sulphates is well known to the chemist. The only other processes which it appears possible to consider alongside that of a simple addition of a per-salt of iron, as in the so-called "Clarine" process, are the International and Electrical processes before alluded to.

These processes are what may be called "indirect" iron processes. The last named is practically a method of treating the sewage with ferrous chloride. My own suggestion of what takes place chemically is represented by the following equations:—



or to show the final result—



or



Ferrous hydrate being precipitated and hydrogen gas given off, the action being one of reduction, not oxidation.

It is claimed in this process as an advantage that the ferrous hydrate is in the nascent state, but so are all such compounds when precipitated *in situ* whether precipitated chemically or electrically, so that the same advantage is

common to all the processes under consideration. The precipitation part of the International process is in effect the addition of a very crude ferrous sulphate with some sulphate of alumina to the sewage. The so-called "ferrozone" is a very crude material produced by treating a low class mixed iron ore with vitriol. The very large amount of foreign matter in the insoluble state may, like excess of lime, assist the subsidence a little, but is certainly matter in the wrong place in the sewage sludge. This brings us to the point of the question of efficiency as between per-salts and proto-salts of iron, and in regard to this point I will only say that, with the exception of Mr. Richards, all the speakers appear to agree with me that for many reasons the per-salts are to be preferred.

The great objections to the proto-salts of course are their reducing action on the sewage and the muddy or milky effluent they tend to produce. I look on the presence of excess of ferric hydrate in the perchloride of iron as beneficial from its tendency to lay hold of the sulphur compounds, and as a neutralising body to traces of per-acid. It also probably gives density to the precipitate. Of the processes treated of, the "Electrical" and the "Clarine" processes appear to give the least amounts of sludge, but the question of sludge and its disposal is worthy of a special paper. Having said so much in general reply to the whole discussion I will briefly notice a few of the questions asked this evening. Dr. Dreyfus asked for information as to comparison of cost and efficiency of the processes. I think the two papers show clearly that the ferric process is certainly as effective, to say the least, and is apparently less costly than any process except the lime treatment. With regard to the oxygen absorbed, for my own part I certainly place more value on the albuminoid ammonia test as an indication of the impurity of sewage, and in fact consider the amount of oxygen absorbed in many cases misleading. Sewage and potable waters are not on all fours in this relation, objections in the former case not applying in the latter. Mr. Davis agrees that the proto-salts of iron are not nearly so well adapted for the precipitation of sewage as the per-salts, and I am certainly inclined to agree with Mr. Davis that such a quantity as $7\frac{1}{2}$ tons of lime to a million gallons is altogether inadequate for the proper purification of ordinary sewage, and that 10 to 20 tons is more like the right quantity. Of course the difficulty is that if sufficient lime is added for proper precipitation a most objectionably alkaline effluent results, the effect of which state of things has been that the lime treatment as generally carried out is only an apology for a process, or an attempt to satisfy the authorities. It is quite clear that in the old experiments in London with iron-salts, alluded to by Dr. Gerland, the sewage and precipitant were run away together without any attempt at previous subsidence. It did not appear to be realised at that time that the black sediment was caused by the beneficial combination of the iron with sulphur compounds in the sewage. Mr. McCullum's inquiry with respect to the quantity of "ferrozone" in the table is explained in the table itself. The just amount is that of a chemical equivalent of "ferrozone" calculated on its analysis to make it equal, chemically, to the weight of precipitant per 10 million gallons in the other systems.

The cost according to the smaller amount of ferrozone said to be necessary is also given. The International system has a very poor precipitant, but apparently a good filter. Whether a filter as good or better could not be made at a less cost is open to a good deal of discussion, and what is the actual cost of the polarite filter would first require to be accurately ascertained. In conclusion I hope that my reply will have cleared up any points in the paper which were in any way obscure.

ON AN AUTOMATIC APPLIANCE FOR RECORDING THE PRESENCE AND DENSITY OF BLACK SMOKE IN FACTORY CHIMNEYS.

BY WILLIAM THOMSON.

SOME years ago it suggested itself to me that if some simple method could be devised of actually recording the density of smoke passing up the chimney, and the length of time during which that smoke was passing, by an automatic apparatus, it would give some tangible means of aiding in the prevention of black smoke from factory chimneys. It is evident that if such a record could be obtained the diagram of the smoke produced during the working day might be pasted on to a board and compared with the results of other days, when the question of carelessness in firing would be definitely shown. This would thus form a check upon the firemen in working the furnaces, and the best record might be taken as a standard of what is possible in each furnace or series of furnaces. With a view of making this possible I have made a number of experiments in different directions, and at last succeeded in getting what I thought would be an accurate record of the density of the smoke, together with a record of the lengths of time during which it was passing, by exposing in the chimney strips of ordinary writing paper exposed in front of a slit against which the flue gases impinged. On placing a piece of paper into a smoky chimney and withdrawing it after a few seconds I obtained a dark mark on the paper, which approximately corresponded with the amount of smoke passing up; but on fixing this in an apparatus provided with a slit behind which the paper was drawn I found that a mark was given to begin with, but little or no mark produced afterwards when the paper became very hot. It was evident therefore that the high temperature prevented the deposit of the soot on the paper.

By taking two strips of paper, heating the one over a Bunsen burner and leaving the other cold, and passing both through a smoky flame, I observed that the cold paper became more deeply marked with black deposit than the strip which had been previously heated. In obtaining these diagrams, therefore, it would be necessary to have arrangements for keeping the paper comparatively cold.

The apparatus which I have devised is by no means perfect, but I submit it to the Society as it is, with the hope that others who have more time and opportunity of working these things may take up and continue this investigation, with a view of arriving at a comparatively perfect appliance by which to get a record of the time during which smoke is passing up the chimney, and of the density of such smoke. The appliance which I have devised consists of two brass tubes about 5 ft. long, the one $1\frac{1}{2}$ in. and the other $\frac{5}{8}$ in. internal diameter, placed the one within the other, leaving an annular space of about a quarter of an inch between them. A cut is made lengthwise through both tubes to a distance of about 3 in. from the end, the circles of both tubes being thus bisected, at the end of which another cut is made at right angles to the first one. A semi-circular plate is then soldered, so as to join both tubes at the end of the 3-in. cut, and another semi-circular plate is fixed in the opposite direction at the bottom, the two spaces left between the two tubes and the two semi-circular pieces having flat plates soldered so as to join the two longitudinal tubes and to make them watertight. A plate of metal is arranged to slide on to the cut portion of the two tubes in which a slit is made at right angles to the length, and a strip of paper is held against this slit by a roller and spring, the end of the strip of paper being connected with a chain which is pulled up at a regular velocity by means of clockwork. The apparatus which I have devised pulls about 4 in. of paper past the slit during each hour.

To work the apparatus the paper is adjusted, and a pencil mark drawn along the slit from the outside, so as to mark the position of the paper at the beginning of the experiment. The apparatus is provided with a narrow piece of copper tube which passes down the annular space to the bottom, and another small piece of wider tube is fixed into the outer tube about 6 in. from the top. Cold water is delivered

at the bottom of the apparatus by the narrow copper tube, the hot water produced by the hot flue gases being allowed to flow away by the small tube inserted in the top of the outside tube of the appliance. By allowing a constant flow of water through the apparatus it is kept comparatively cool. The clockwork is set going as soon as the end of the tube is inserted into the flue, preferably by a hole through the top of the flue, and the apparatus allowed to work during the time it is desired for obtaining the diagram.

A number of diagrams obtained by the apparatus were exhibited.

Yorkshire Section.

Chairman: Sir James Kitson, Bart.

Vice-Chairman: Dr. H. F. Bowman.

Committee:

A. H. Allen.	J. Lewkowitsch.
W. Beelitt.	C. Rawson
F. Fairley.	Jas. Sharp.
A. Hess.	A. Smithells.
R. Holliday.	Geo. Ward.
J. J. Hummel.	Thorp Whitaker.

Hon. Local Secretary and Treasurer:
H. R. Procter, Yorkshire College, Leeds.

Notice of Papers and Communications should be addressed to the Hon. Local Secretary.

SESSION 1891-92.

March 7th.—Mr. Sidney Lupton, "Criticisms and Suggestions towards the Improvement of British Measures."

Meeting held Monday, December 7th, 1891.

MR. JAMES SHARP IN THE CHAIR.

FAST AND FUGITIVE DYES.

BY PROF. J. J. HUMMEL.

(This Journal, 1891, 832.)

DISCUSSION.

THE CHAIRMAN said that it was most important that the colours imparted to textile, and especially to woollen fabrics, should be fairly fast, but there was still a large demand for what were called "steamed colours," which were well known to be loose, although the difference in cost was very trifling, not amounting to more than 1s. or 2s. per piece. In 1858 he was present at the reading of Dr. Perkins' paper in which the discovery of the aniline colours was announced, and soon obtained samples and dyed goods with them. These colours were branded as fugitive, but the value produced at the present time was not less than 7,000,000*l.*, and taking the cost of applying them at thrice, and the value of the fabrics at 10 times this amount, they had, for this "vagabond" trade, a commercial turnover of nearly a hundred millions sterling, a business which was not to be despised. Some of the natural dyes were not less fugitive, and if a colour were discovered which took the eye of the public the inventor was sure of his reward, whether the colour was permanent or not. It should be remembered that a large proportion of the loose work which had been referred to was exported to

the East, where little expense in tailoring was incurred, and the goods were only worn for a short period and cast aside.

He was of opinion that without new processes of manufacture, and probably new materials also, it was utterly impossible to make these colours fast enough to resist either exposure or chemical reagents. The lighter bodies as a rule produced the most fugitive colours, and their life was less in proportion to the number of sulphonic groups introduced. Many points were involved in the question of exposure. The condition of the dyes and mordants employed had considerable influence, and the results would vary materially with the weather and the seasons. He could not understand the deep brown shade taken by the pattern of picric acid yellow, and thought some other than the ordinary atmospheric conditions must have been present, since in the course of his large experience as a manufacturer he had never seen such a reaction. He was also surprised that Professor Hummel should class Prussian blue as a fast and Nicholson's blue as a fugitive colour. These dyes were both colourless in the bath, and developed by acids, and in his experience neither would stand the action of alkalis.

Mr. LUTON hoped that in a later paper Professor Hummel would deal with the important question of resistance to scouring, as well as to exposure to light and air.

Professor SMITHILLS thought that the chemical reactions involved in the fading of the various dyes were of the greatest importance, although scarcely anything was known about the subject, and he hoped that, notwithstanding its extreme difficulty, Professor Hummel would take it up in the near future, and in due course communicate the results to the Society. With regard to the supposed action of ozone and hydrogen peroxide, recent researches had shown that their presence in the atmosphere was very doubtful, and that the reactions which had been attributed to them were in reality due to nitrous acid.

Mr. THORP WHITAKER, secretary of the Society of Dyers and Colourists, inquired whether the quantity of mordant employed with those colours which required mordanting was the same in all cases, or varied with each colour. He was surprised at the marked fading of gallocyanin, which was generally regarded as a fairly permanent colour. There was no doubt that in many cases the coal-tar colours were faster than the vegetable ones they had replaced.

Mr. UNDERHILL inquired whether barwood should be used in conjunction with indigo. He said that vat-dyed indigo shed very much on the body and underclothing, and inquired whether there was any means of fixing it more securely on the fabric.

Mr. SYDNEY LUTON inquired whether the copper mordant of which Professor Hummel had spoken was a solution of cuprous or cupric oxide in ammonia, or whether both oxides were present, and what proportion of copper was fixed on the fibre.

Dr. LEWKOWITSCH would have been glad if Professor Hummel had said more about the influence of the chemical constitution of a colouring matter on its permanency.

Mr. WILKINSON was surprised that Professor Hummel should have classed catechu as a colour which did not require a mordant, since copper, or some other oxidising agent was always used with it, and though very fugitive without such treatment, he considered that, with it, it was was one of the fastest of colours, and compared very favourably with indigo. He mentioned that Prussian blue, though generally a fast colour, was fugitive in limestone districts.

Dr. COHEN was not aware that aniline black was applied to silk and wool, and inquired in what way it was dyed on these fibres.

The CHAIRMAN said that although it could be fixed on wools, it was not very satisfactory, but that it was largely used on silk. The process was regarded as a trade secret.

Professor HUMMEL in reply said, that in his opinion both fast and fugitive colours had their legitimate uses. He did not quite concur with the Chairman's view that sulphonation necessarily diminished the fastness of colours to light, but that this was rather influenced by the general constitution of the colour, and the position of the sulphonic group. Comparing the fastness of the acid azo-reds with those fixed direct on the fibre, in which in general no sulphonation had taken place, it would be noted that this point had little influence on their permanency. His experiments must at present be regarded as merely preliminary, and designed to test the permanency of the colours actually in use in a practical way, and he hoped later to be able to answer many of the further points which had been raised. He intended to examine the chemical effects produced on some pure colouring matters when exposed to light in India, but he feared that this would by no means give a complete answer to Professor Smithell's question, since in many cases the fibre had an important influence on the permanency of dyes, as in the instance of tartrazine, which was fast on wool but fugitive on silk.

In reply to Mr. Whitaker's question as to the amount of the various mordants employed, Professor Hummel said that they were varied in accordance with the results of a long series of experiments made in the Yorkshire College to determine the most advantageous quantity in each case. Though gallocyanin was undoubtedly a useful colouring matter, it was not to be compared in permanency with members of the true alizarin group, and it was to be regretted that it was frequently sold under the misleading name of "Alizarine purple." In reply to Mr. Underhill's question as to the propriety of using barwood as a preliminary to vat-indigo, although there was no doubt that in itself it was a fugitive colour, it appeared to enable the indigo to penetrate the fibre better, and to render it less liable to rub off. As the dyers said, "the indigo follows the wood." In addition it counteracted the greenish tinge of the indigo, and produced a richer and more "bloomy" colour. The effect seemed to be largely due to the mere boiling of the wool, which softened the hard and horny keratin, and enabled the indigo to penetrate more freely. If the purplish shade were really necessary, it might be obtained more rationally by the use of faster colours, such as alizarin. Objection might be taken to the use of bichrome mordants, with Alizarine red, but other chromium and aluminium mordants might be substituted. Alizarine red was already being used for the purpose with beneficial results, and if the fastest possible colour were required, it was difficult to suggest any other means. Alizarine blue was at least as fast as vat-indigo, but the Government had discovered that when it was employed the wool fibre was considerably weakened, owing presumably to the oxidising action of the bichromate, which certainly had a tendering effect if carelessly used. In one case, however, which had come under his knowledge it was discovered that the rotting action which had been attributed to bichromate used in conjunction with Alizarine blue, was due to quite another cause. His colleague, Mr. Liechti, was at present engaged on minute investigation of the action of chromium mordants on the wool fibre, and hoped before long to bring the results before the Society.

In reply to Mr. Sydney Lutton's question as to the exact character of the ammoniacal copper solution employed by Scheurer in his experiments, Professor Hummel said that it consisted of cupric hydrate dissolved in ammonia, and would therefore have some solvent action on the cellulose of the fabric, and possibly coated the colours with a parchment like protection.

Referring to Dr. Lewkowitsch's inquiry as to the relation of molecular constitution to fastness, he stated that his investigations were not as yet sufficiently advanced to allow of generalisation, but that in the case of the eosins, the introduction of an ethyl or methyl group into a particular part of the molecule increased its fastness to light.

With regard to Mr. Wilkinson's remarks as to catechu, Professor Hummel regarded the action of the bichromate as mainly oxidising rather than mordanting, although some chromium-oxide was undoubtedly fixed on the fibre along with the brown japonic acid. He had himself been rather surprised at the want of fastness of the sample, and thought

it possible that this was due to the fact that no copper sulphate, but only potassium bichromate had been used in this particular experiment. He agreed with Mr. Wilkinson's remarks with regard to Prussian blue.

He confirmed the Chairman's reply to Dr. Cohen with regard to aniline black, and said that though it was not generally known, it was perfectly true that aniline black could be fixed on wool, while it was already largely applied to silk. Although he could not enter into the details of the process, he might say that the principle consisted in the use of somewhat unstable metallic chlorates, which exerted the requisite oxidising power under the influence of steam heat.

Referring generally to the subject of fugitive dyes, he hoped on a future occasion to be able to give more definite and detailed replies to some of the questions than he had been able to do that evening.

Glasgow and Scottish Section.

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Hon. Local Secretary:

Dr. G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1891-92.

March 1st (Glasgow):—

Prof. W. Dittmar, "The Availability of Metallic Vessels for Chemical Operations in the Laboratory."

Mr. G. Watson, jun., "The Preparation of Pure Phosphoric Acid from Phosphate of Soda."

Mr. W. J. A. Donald, "On Bauvaite."

April 5th (Glasgow):—

Mr. C. A. Fawsitt, "The 'Dry Heat' Vulcanisation of Rubber, with Special Reference to the Use of an improved Vulcaniser."

Meeting held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, 5th January 1892.

MR. C. A. FAWSITT IN THE CHAIR.

NOTES ON THE PRODUCTION OF CYANIDES.

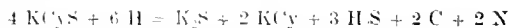
BY D. J. PLAYFAIR.

IN 1878 Messrs. Tcherniac and Gunzburg took out a patent for a process for making ferrocyanides from sulphocyanides. This consisted in heating to redness a mixture of six equivalents of sulphocyanide of potassium, five of lime, five of carbon, and one of iron. The iron used was in a spongy form, obtained by reducing the iron of pyrites to a metallic state by a reducing atmosphere in a specially constructed furnace. As the result of the reaction, they claim that the sulphur of the sulphocyanide combines with the calcium and iron leaving the potassium all as cyanide, which is converted into ferrocyanide on lixiviating. Without being aware of this patent, I tried a similar experiment,

modelling it on the reaction of a black-ash furnace, but obtained only a very small yield of prussiate. At best the product would only be ferrocyanide, which would require purifying and a subsequent furnacing operation before cyanide could be arrived at, so I did not follow up this experiment.

In studying the decomposition of sulphocyanides one experiment consisted in heating a mixture of the sulphocyanides of sodium and potassium in an atmosphere of hydrogen. The sulphocyanides were placed in a glass combustion tube, and heated to redness, while a constant stream of dry hydrogen gas was passed through the tube. At the outlet from the tube sulphuretted hydrogen began to be evolved as soon as the heat attained to redness, and continued coming off freely for more than half an hour, although the amount of sulphocyanides experimented upon did not exceed a very few grammes. The experiment was interrupted and the contents of the tube examined.

About 80 per cent. of the sulphocyanides was found to be decomposed, resulting in the formation of sulphide and cyanide of potassium and sodium. Sulphide and cyanide were found to be present in nearly equal quantities, or about 20 per cent. less cyanide than would be required for the equation—



Apparently not more than half the sulphocyanide can be expected to be obtained as cyanide by this method, and it is in a very impure state, being mixed with a large quantity of sulphide, the separation of which would be troublesome and costly.

The above experiment was varied by using an atmosphere of hydrocarbons instead of hydrogen. Vapour of naphtha was employed, and as before, when the heat was raised sulphuretted hydrogen was freely evolved. At the end of the experiment the contents of the tube were examined, but no cyanide was found. The decomposed sulphocyanides were converted into sulphides, with traces of formates.

Sulphocyanide of sodium heated along with charcoal in a crucible at a bright redness was found to yield a small quantity, not much more than a trace of cyanine and a large quantity of sulphide.

More satisfactory results were obtained when a metal was employed to deprive the sulphocyanide of its sulphur. The only two metals, which I have found suitable, are lead and zinc.

Without detailing the preliminary experiments in crucibles, with charges varying in size from a few grammes up to 8 or 10 lb., and in which the metals were used in a granulated state, sometimes so fine as to be able to pass through a fine sieve, it will be sufficient to describe the method now employed, which is as follows:—

An oblong vessel with rounded bottom, in fact the shape of an inverted muffle, made of plumbago, with a well-fitting lid is used. The muffle is placed in a sort of cradle, which is attached to a rope passed over a pulley fixed to a beam above a small furnace. In the top of the furnace is a hole just large enough to admit the muffle. The muffle is lowered down into the furnace, and rests on bearers so that its bottom and sides are exposed to the heat, but its top is an inch or two above the top of the furnace. The metal, say zinc, is first put into the muffle, along with a slight sprinkling of charcoal to maintain a reducing atmosphere, and the cover is put on till the zinc is melted. As soon as the zinc is melted an equivalent quantity of sulphocyanide of soda is added. The sulphocyanide is put in either cold in a dry state, or from an adjoining pot, in which it is maintained in a state of fusion.

As the heating proceeds, the sulphocyanide becomes very fluid lying above the melted zinc. The charge is well agitated to stir up the zinc into the sulphocyanide. As soon as the required temperature is reached, the charge suddenly becomes very thick, and begins to glow, especially in the track of the stirrer.

When this occurs, it is the sign that the reaction is complete. The cover is put on the muffle and the whole is hoisted out of the furnace and allowed to cool. A good deal of heat seems to be evolved in the reaction, because if there be an excess of zinc, it is given off in vapour and

bursts into flame at the edge of the cover a few minutes after the muffle is removed from the furnace. If the sulphocyanide be in excess, no zinc flame appears.

When cool the charge comes away from the muffle easily, and there is no appearance of the material of the muffle having been acted upon. The fused mass should be of a uniform pearl-grey colour throughout, in which case it will yield a solution free from soluble sulphides. If the charge be over-fired, part of it will have a dull brown or even a reddish appearance. Such will yield a solution containing sulphides of the alkali. When using the muffle above described, the charge is so much under control, and the reaction can be so closely watched, that generally no alkaline sulphide or only a trace of it is found in the charge. In the earlier experiments in large crucibles this was a difficulty that presented itself, as the portion of the charge next the bottom frequently got over-fired, producing sulphide of soda, sometimes to the extent of 15 parts per 100 of cyanide. The reaction that goes on in the muffle is expressed thus:—



The loss in weight of the whole charge in the furnacing operation is about 5 per cent., half of which is accounted for by the moisture in the sulphocyanide used. Some cyanate and a trace of carbonate are formed in the process.

When a slight excess of zinc is used, no sulphocyanide remains undecomposed, but there is a slight loss of zinc as vapour, and some double cyanide of zinc and sodium is formed, in a badly burned charge to the extent of 15 parts of cyanide of zinc per 100 of cyanide of sodium. Using, however, a slight excess of sulphocyanide instead, the amount of cyanide of zinc formed is reduced to about two or three parts per 100 of cyanide of sodium. The finished product in that case contains a little undecomposed sulphocyanide, but the loss of zinc is avoided, and the result is a better article.

The lixiviation of the fused mass, which is the next operation, presents no difficulty. It is lixiviated in the ordinary way in a set of vats, like black-ash vats, except that in this case the lixiviation is intermittent, as the solution does not filter downwards through the insoluble matter. The crude cyanide is stirred up at each lixiviation, and, on the insoluble matter settling, the clear solution is decanted or pumped from one vat to the next one. In this way a solution from the strong vat is obtained of about 35° Tw., containing 24 grms. of cyanide of sodium per 100 cc., while the last washing of the weak vat is 0° Tw., and contains under 4 per cent. NaCy.

This last weak liquor is quite clear, but, on attempting to wash out the last traces of cyanide of sodium from the sulphide of zinc, one gets a milky solution that does not settle clear, till it is mixed with a stronger solution of cyanide of sodium. It is quite possible to have a 30 per cent. solution from the strong vat, but this does not settle so well as one of 24 or 25 per cent.

If the liquor contain any cyanide of sodium, it is agitated with cyanide of lead, which is easily formed by precipitating a portion of the solution with chloride of lead, settling and decanting off the solution of chloride of sodium.

The insoluble matter, consisting of sulphide of zinc, amounts to about 65 per cent. of the fused mass.

An analysis of the solution ready for evaporating is as follows:—

Expressed in grammes per 100 cc.

Cyanide of sodium	22.0
Cyanate of sodium	3.66
Double cyanide of zinc and sodium	1.55
Carbonate of soda	0.71
Sulphocyanide of sodium	1.8

The strong solution of cyanide of sodium is now put into a vacuum pan, and evaporated to the consistency of a thick paste, which solidifies on cooling.

The finished cyanide contains about 26 per cent. of water, and about 55 per cent. of cyanide of sodium, not including that existing as double cyanide.

This contains the same amount of available cyanogen, or hydrocyanic acid, as a cyanide of potassium of 73 per cent.

By subsequent heating the whole of the water can be driven off without much loss of cyanide.

An analysis of the product of the vacuum pan is as follows:—

Cyanide of sodium	54.7
Cyanate of soda, including formate	9.45
Double cyanide of zinc and sodium	3.9
Sulphocyanide of sodium	1.3
Carbonate of soda	1.65
Water	27.0
	<hr/> 100.0

In the above described process the yield of available cyanide averages about 70 per cent. of the possible yield according to theory. In the evaporation in vacuo, the loss of cyanide, due to the decomposition of its solution when heated, is from 2 to 4 per cent. of the cyanide present, provided that the vacuum be good, say, equal to 26 in. of mercury, and provided also that the strength of the solution be about 33° Tw. If the solution be half that strength to start with, or the vacuum poor, the loss is more than doubled.

Instead of zinc as above described, lead may be used to decompose the sulphocyanide. It has the disadvantage, that, owing to its high equivalent, more than 3 lb. of lead are necessary to do the work of 1 lb. of zinc, also that in the fusion it does not stir up into the sulphocyanide so easily as zinc. On the other hand, it has the advantage, that it does not form a double salt with the alkaline cyanide, even although cyanide of lead is soluble to some extent in cyanide of sodium.

Whichever metal is used, the resulting sulphide may be treated by ordinary processes to reduce it to the metallic state again, or, in the case of zinc, zinc salts may be made direct from the sulphide.

Other metals were tried in place of lead and zinc, but not with satisfactory results.

Tin, for instance, reduced the sulphocyanide to cyanide, but the sulphide of tin, which was formed, dissolved to a large extent in the alkaline cyanide.

Copper is also unsuitable, as the product is a cuprocyanide.

Other sulphocyanides, such as the sulphocyanides of potassium and barium, behave like sulphocyanide of sodium, and give similar yields, about 70 per cent. Sulphocyanide of sodium has the advantage of being cheaper than the others, and, on account of the low combining weight of sodium, gives a cyanide of a higher strength.

The sulphocyanides may be manufactured directly, or may be obtained as by-products in gas-making. Dr. Lunge states the amount of sulphocyanide of ammonia in English gas-liquors at about 25 lb. per 160 gallons.

In no gas-liquor, of which I have been able to get samples, has the quantity reached anything like that figure. In Scotch gas-liquor, after it has been treated for the extraction of ammonia, I have found only about 1 lb. of sulphocyanide of lime per 100 gallons. The refuse lime from gas purifiers contains sulphocyanides in larger proportion, but even this gas-lime from Scotch gasworks I find to contain under 20 lb. of sulphocyanide of lime per ton. In gas-lime there is a large amount of hyposulphite of lime, which would require to be entirely removed from the sulphocyanide, as the presence of oxygen compounds is prejudicial to the formation of cyanides from sulphocyanides. The small quantities in gas residues above mentioned are not worth the cost of recovering, so it is preferable to make the sulphocyanides by direct processes.

DISCUSSION.

The CHAIRMAN considered the paper was one of much interest and importance, as the cheapening of cyanides would have a beneficial effect on several industries, notably the extraction of gold by cyanides; and seeing the sulphocyanide, from which the cyanide was prepared, would be an outlet for bisulphide of carbon, it would come as a boon to manufacturers of this article, as in some districts the consumption had been gradually decreasing, owing to the

india-rubber manufacturers having stopped using it in the manufacture of waterproof cloth. He agreed with the author as to the extraction of sulphocyanides from gas residues entailing considerable expense, as the amount of material which would have to be dealt with would be very large for a small return of sulphocyanide, and the finished article would not be easily purified; whereas in the case of bisulphide of carbon a pure sulphocyanide could be prepared with comparatively little trouble. As regards the fixation of nitrogen by alkalis carbon, although a large amount of money and trouble had been expended in testing it at different times, its success had never been accomplished, and he thought the chief reasons were: First, the high temperature required; 2nd, the serious wear and tear of the apparatus; 3rd, the large percentage of cyanate produced, which could not be reduced economically to cyanide. Some trials he had made a few years ago produced very little cyanide, and that at a prohibitive cost. He was somewhat surprised to hear that the cyanide survived the fusion in contact with melted zinc so well, but no doubt it was conducted out of contact with the atmosphere. The fusion of the sulphocyanide of potassium with metallic iron seemed to be the weak point in the process which was patented by Gölis, which he had tested and found to work smoothly until this point was reached, when he only obtained 25 per cent. of the theoretical yield of cyanide. In the evaporation of cyanide solutions at ordinary pressures it was well known that a serious loss occurred, and it was a new idea to him to use a vacuum pan, but it commended itself as a good way out of the difficulty. Instead of converting sulphocyanides into cyanides by fusion, it seemed to him far more rational to try and get an economical method whereby it could be done in solution. It was well known that in acid solutions sulphocyanides could be converted into cyanides by using permanganate of potash, and he had tried peroxide of hydrogen which acted equally well, but the cost was prohibitive in both cases, and the fact of it taking place in an acid solution was inconvenient, as the hydrocyanic acid would require to be condensed, besides the unpleasantness of working an apparatus containing such a poisonous gas. He had tried one or two experiments in an alkaline solution, but they gave practically a negative result as far as cyanide was concerned, the nitrogen coming off principally as ammonia. No doubt cheaper oxidising agents, such as manganate of soda and manganese dioxide in acid solutions would give good results, and there would be produced sulphate of manganese which is a saleable by-product, but the condensation of the HCN would have to be faced. He further said that the item of cost was the most important factor in Mr. Playfair's process, and he would ask him if he had formed any idea as to the cost at which he could produce cyanide compared with the method now in use.

In concluding the Chairman congratulated Mr. Playfair at having grappled with a difficult subject, and hoped he might be rewarded by the complete success of his process.

Dr. J. B. READMAN desired to know if Mr. Playfair had made any attempts at carrying out Bunsen and Playfair's results by trying to manufacture cyanide in the blast furnace. In these experiments it appeared that the potash was derived from the coal, while it was not certain whether the nitrogen was derived from the air or from the fuel. They were all familiar with Mond's work on the preparation of barium cyanide, but why should not potassium cyanide be manufactured in the blast furnace under suitable conditions? There appeared to him great hope of success in that direction.

Mr. E. RODGER said that the question he had intended to ask had been anticipated by Mr. Readman. He believed that certain experiments carried on recently in the Durham district in the manufacture of cyanide in the blast furnace pointed to hopeful results. He would suggest the use of a water-jacketed furnace for such work, as in this way the silicious lining, which would of course be attacked by the alkaline mixture necessary for the production of cyanide, could be dispensed with and the furnace could be used very economically.

Mr. W. FOULIS thought that the recovery of sulphocyanides from the waste lime of gas-purifiers could not be carried on profitably. He had found that the cyanides produced in the manufacture of coal-gas were decomposed when the gas was passed through the lime purifiers and appeared as ammonia. He had recently instituted a number of experiments, and had been successful in removing the cyanides from the coal-gas before it reached the purifiers. The cyanide was obtained in considerable quantity, and his results had been so encouraging that further experiments were being prosecuted. He had no doubt that a large quantity of cyanide would before long be obtained from coal as a by-product in the manufacture of coal-gas.

Mr. PLAYFAIR, in reply, said that he had not tried to repeat or follow up Bunsen and Playfair's experiments in the way of manufacturing cyanide in the blast furnace, because he considered that later experiments on the fixation of nitrogen at high temperatures by the action of alkalis carbon—none of which had been conspicuously successful—were, generally speaking, founded on Bunsen and Playfair's results. Besides this, the experimental use of a blast furnace for the manufacture of cyanides would have involved him in much expense. The quantity of sulphocyanide in all the lime residues from gasworks which he had examined was so low as not to make them worth working. He presumed that Mr. Foulis recovered his cyanides as sulphocyanides, or in some other form, which would require further treatment. He could not give any exact figures as to the cost of his process, but estimated it to be at least 25–30 per cent. less than the cost of the other processes in use at present.

THE ENGLISH PROCESS OF ANTIMONY SMELTING.

BY EDWARD RODGER.

The smelting of antimony is one of those processes about which little trustworthy information is to be obtained from those text-books which profess to afford instruction upon metallurgical operations. I do not know what the case may be with regard to the generality of metallurgical processes, but I can say that, so far as those with which I am practically acquainted are concerned, the text-books almost always may be taken as teaching anything rather than the processes by which metals really are obtained from their ores.

There are some honourable exceptions, of course, but the vast proportion of so-called metallurgical works simply copy the errors and repeat the obsolete processes which previous authors have committed to writing; as a rule there is far too little original inquiry, and too much convenient faith amongst compilers of these works.

I need not here point out the errors which are committed in almost every work regarding the process of antimony smelting. I may only say that during a not inconsiderable study of the published processes, I have never seen a complete account of the real method, and therefore I hope that the few notes which I have the honour to bring before you to-night will not be without interest and value.

I presume that it is needless for me to give any account of the ores of antimony, nor of its history. These things are so well known that any reference to them would be superfluous. Suffice it to say that the one which I have seen smelted is a sulphide mixed with quartz, the "stibnite" of the mineralogists, and which contains about 52 per cent. of metallic antimony.

The ores for smelting by the English process must be free from lead and arsenic, neither of which metals can be eliminated, and an ore of such a poor quality as that which I have mentioned is costly and unsatisfactory to deal with.

The ore arrives in this country generally in smallish pieces, rather larger than ordinary road metal, and is packed in bags holding various weights: about a hundredweight

may be taken as a rough average. The ore is ground under edge runners, and passed through a coarse screen, the largest pieces which are allowed to pass being about the size of hazel nuts, while the great bulk of the ore consists, of course, of smaller particles, varying from the size of peas to fine dust.

After grinding, a sample is prepared which is analysed or assayed in order to ascertain how much iron is required for proper reduction.

The process of smelting consists in reducing the sulphide of antimony by means of metallic iron, the fusion taking place in crucibles which are heated in a very long reverberatory furnace.

In dealing with the process, we may first of all consider the furnace and the crucible, then passing on to the details of the actual operation of smelting.

The furnace is a curious structure, and differs from any other species with which I am acquainted. It consists of a bed 54 feet long, including the fire-places, and 7 feet 4 inches broad (inside size), covered by a low arch which springs almost from the surface of the ground, the bed itself being sunk below the level of the ground. This long gallery is heated by means of a fire-place at each end, the two fires drawing into a common flue in the middle of the furnace. The flue is arranged below the bed of the furnace, and the ports are in the bed, this arrangement being to prevent the heat being drawn to one side, as would be liable to happen were the flue to start directly from the side of the furnace. The sides of the furnace and the top of the arch are covered with 1-inch cast-iron plates, while a 2-inch square malleable iron bar runs on each side the whole length of the furnace under the upright binders, which are, of course, tied over the top of the arch by tie-rods.

The floor of the furnace-room along the whole length of each side of the furnace is covered with cast-iron plates, coming out about 3 feet from the walls of the furnace, the remainder of the floor of the furnace-room being paved with granite "setts."

It will be seen from this description that the furnace is very little above the ground level. It is, in fact, sunk into the ground, so that it is quite easy to step on to its iron-covered roof. The fire-places being below the ground level, suitable fire-pits are, of course, required.

The crucibles are lowered into their places from above through holes in the arch, with corresponding apertures in the iron binding plates, the workmen standing on the roof of the furnace while handling the crucibles. Indeed, practically all the work is done by the furnacemen while in this position. The holes referred to are circular, 14 inches in diameter, and are 42 in number, 21 on a side, in such a furnace as is here described. In addition to the "pot-holes," there are two holes in the furnace roof at each end of the bed, which are 4 inches in diameter, and are used for cleaning away clinker, &c. from the ends of the bed. The "pot-holes" are each provided with a circular fire-clay cover clamped round with an iron ring, which serves to protect the covers, and also to bind them when they split, as they generally do.

The crucibles stand 20 inches high and 11 inches outside across the mouth. They are constructed of a mixture of good fire-clay and plumbago. The clay may be either Stourbridge or Hexham, the former for choice; and the plumbago, whatever its source, must be free from iron, &c. Below are analyses of the two classes of clay referred to:—

	Stourbridge.	Hexham.
Water (H ₂ O).....	7.00	7.44
Silica (SiO ₂).....	69.00	59.05
Alumina (Al ₂ O ₃).....	22.00	25.61
Protoxide of iron (FeO).....	1.50	2.20
Lime (CaO).....	0.39	0.88
Magnesia (MgO).....	0.51	0.75
Potash (K ₂ O).....	0.41	1.97
Soda (Na ₂ O).....	0.18	0.28
Titanic acid (TiO ₂).....	..	1.53
	101.12	99.71

The crucibles weigh 12 lb. dry, and consist, as nearly as need be, of—dry clay, 35 $\frac{1}{2}$ lb., and plumbago, 6 $\frac{1}{2}$ lb. The amount of clay and plumbago made up at one time is 5 cwt. of clay and 3 qr. 11 lb. plumbago. This mixture is ground under edge runners in a damp state, and then thoroughly incorporated by treading with the bare feet in the usual manner of preparing clay for crucible-making, this part of the process calling for no remark. The crucibles are made in the usual way by hand, and are considered to cost, using the above proportions, about 2s. 6d. each, or thereabouts. They are dried and stoved in the ordinary way, steam pipes being used for the first drying, while the waste heat from the antimony furnace is employed for the final drying. After thorough drying they are carefully heated to redness, in suitable kilns, before being placed in the furnace. These kilns are simply upright chambers, provided with a high door in front, and communicating with a chimney at the top. Below is a fire-place, over which is built a low arch whose top is levelled by means of fire-clay covers, and is pierced with a number of pigeon-holes, so as to provide for the passage of the flame from the fire-place below into the upper chamber. The crucibles are placed upon the floor, leaving the holes clear. When the chamber is full the door is closed and luted; a gentle fire is made, which is cautiously augmented until the crucibles are at a cherry-red heat, at which temperature they are kept until required, when they are withdrawn as needed.

I have said that the furnace contains 42 holes in two rows, 21 holes in each row. The pair of crucibles nearest the fire-places at each end of the furnace is kept for "starring" or refining the crude metal, while the remaining holes are divided as is found suitable for the first and second meltings of the crude metal. The charge for each crucible consists of 42 lb. of ground ore, 16 lb. of wrought-iron scrap, 4 lb. of common salt, and 1 lb. of skimmings from the next operation or else the same weight of impure slag from a previous melting. Of course these weights vary with every ore, but the above will be true for an ore of 52 per cent.

The iron scrap used must be wrought not cast iron; tinned scrap is preferred, the small trace of tin being generally believed, I know not with what truth, to whiten the resulting antimony. Part of the tinned scrap is beaten up into a round ball, large enough to fit the top of the crucible loosely. Such a ball weighs about 13 lb., and one is used for each charge, the remaining iron required being added in the form of turnings or borings, and is mixed through the ore, along with the salt, in the weighing scoop.

The mixture of ore, salt, and iron is dropped into the crucible through an iron funnel, the lump of beaten scrap being thrown in last of all, so as to form a kind of lid; the furnace hole is then closed with its cover for about half an hour, when the crucible is again examined. In the meantime a fresh charge is weighed out ready for the crucible the moment it is empty. As the charge melts the ball of iron on the top falls down and is gradually absorbed, the iron reducing the antimony to the metallic state, it being itself converted into sulphide. The salt assists the separation of the slag, and tends to promote the fusion of the siliceous matters of the ore.

The workman from time to time examines the crucible with a view to ascertain whether fusion is taking place properly, and presses down the ball of scrap on the top with a bar of iron. The length of time required for fusion and decomposition varies with the position occupied by the crucible, those far from the fire requiring longer time than those close to it, but as a rule about four meltings are got from each crucible per 12 hours, so that allowing for charging, and occasional changing of crucibles, &c., a little less than three hours may be taken as an average, but it must be borne in mind, that the richer the ore, the shorter time is required to melt it. Opposite to each crucible, except those used for the final refining, is placed a conical cast-iron mould, which stands close by the furnace side, it is large enough to hold the contents of the crucible, and is furnished with a cast-iron lid. The fusion being complete, the crucible is withdrawn, balanced on the edge

of the furnace wall, and the contents poured into the mould, which is at once covered with its lid; the crucible is examined, scraped out if need be, replaced, and at once recharged with the mixture.

The mould is pierced at the bottom with a circular hole about three-quarters of an inch or less in diameter; the metal does not escape through this, as the first portion which reaches the mould chills and prevents the escape of the remainder; the object of this hole being to enable the fused mass, when cool, to be knocked out by means of a hammer and a punch. When the mass is removed from the mould the reduced antimony which collects at the bottom is knocked away from the slag, which slag, if the fusion is carefully conducted, should be quite clean enough to be thrown away. The metal obtained by this process is known as "singles," and below is an analysis of a sample of such metal:—

Antimony	91.63
Iron	7.23
Sulphur	0.82
Insoluble matter .....	..
	<u>99.68</u>

It is seen by the analysis that the "singles" contain a large quantity of iron, this arises from the necessity of using an excess of iron in order to reduce the whole of the antimony in the ore, and the next operation consists in removing this large excess of iron, and thereby practically purifying the metal. This is accomplished by melting the "singles" with a small quantity of pure sulphide of antimony, the liquated sulphide being used for this purpose. I have here a sample of liquated sulphide such as is used in this process, and also in the preparation of the "antimony flux," to which I shall refer later.

The charge for the second fusion consists of 84 lb. of singles broken small (about the size of road metal) and 7-8 lb. of liquated sulphide of antimony, with 4 lb. of salt added as a flux. Sometimes kelp salt is used in place of ordinary salt in this fusion, and is found to be very suitable. The reaction in this fusion is similar to that in the last operation, the excess of iron in the metal reducing the pure sulphide of antimony to the metallic state, being itself converted into sulphide of iron. The fusion is narrowly watched, and great care taken that the metal and the sulphide of antimony shall mix thoroughly, but much stirring with iron tools should be avoided at this stage as the object is to remove iron so far as possible. When stirring is required it is done as quickly as possible in order to expose the iron stirrer as little as may be to the action of the sulphide of antimony. When the fusion is complete, the fused mass is carefully skimmed by means of a cast-iron ladle placed on a long shaft, this skimming being carried out as completely as may be in order that the metal should be as clean as possible before pouring. When the skimming is over the metal is at once poured into moulds identical with those used in the previous operation. The resulting metal from this melting is known as "star bowls," and each fusion yields a lump of about 80 lbs. The skimmings go, as I indicated before, to the first operation.

I have here samples of this second metal, which yielded on analysis:—

Antimony	99.53
Iron	0.18
Sulphur	0.16
	<u>99.87</u>

As you will see, the surface of the crystals of this metal are covered with tiny bright specks. These specks are a certain sign of the presence of sulphur in the metal, and this appearance is known as "flouring," metal showing these specks being said to be "floured." As in the first melting it is necessary to add an excess of iron in order to remove all the antimony, so in this case it is necessary to add an excess of sulphide of antimony in order to remove all the iron, and hence the presence of sulphur in the antimony

obtained. In order to remove this sulphur, and finally to purify the metal, another melting is required, and the custom of the trade being that antimony shall be sold in flat ingots, each "starred" or crystallised on the upper surface, it is necessary to take precautions so as to obtain this "star" or crystallised appearance, by means of which the buyer judges of the purity of the metal. These two results are achieved by melting the metal along with a peculiar flux known as "antimony flux," and this antimony flux is a body not easily prepared, and one which is often difficult to obtain at first, but having obtained it, it is easily kept in order.

The process of making this flux is a rule-of-thumb one, and is carried out something in this way:—Three parts of ordinary American potash are melted in a crucible, and two parts of ground liquated sulphide of antimony are mixed in. When the mixture is complete and the fusion quiet the mass is poured out and tried on a small scale in order to see whether it yields a good "star" or not; if it does so the ingot of metal obtained is broken, and the metal examined in order to judge whether or not it is free from sulphur. Should this prove the case the flux is considered satisfactory, and may be put in use, but otherwise the flux is remelted and more of one ingredient or the other is added as experience dictates, the forming of a good flux being a matter of some difficulty, and one in which experience is the only guide.

The process of refining and starring the star-bowls is as follows:—The lumps of metal when cold are removed from the mould and carried from the furnace house to an adjoining room, where they are thoroughly cleaned from the adhering skin of slag by chipping with sharp hammers, this part of the work being sometimes done by women, who become very expert in rapidly and completely removing every trace of slag. Unless this cleaning process is carefully carried out it is hopeless to attempt to obtain a good star on the finished metal, the presence of the adhering slag completely ruining the appearance of the ingots, rendering them dull and lustreless and quite unlike what they should be. The chippings are of course collected and returned to the second melting. The star-bowls having been cleaned they are broken small as in the case of the singles, and a charge weighed out for refining. The charge used is 84 lb. of star-bowls, and a sufficiency of the antimony flux. Enough flux is added to surround the ingots completely, and for this less or more is needed according to the shape and thickness of the ingots, for ingots of the ordinary shape about 8 lb. are required. The melting takes place in the crucibles next the fire-places, that is to say, in those which are hottest and in which the fusion will be most rapid.

The charge of metal is thrown into the crucible and narrowly watched, and whenever it begins to melt, the flux is added. As soon as the fusion appears to be complete the furnaceman stirs the mixture once round only with an iron rod, and the charge is at once poured out. The ingot moulds are placed side by side, having between them a wedge-shaped frame of cast iron, called a "saddle," the edge of which points upwards, and upon which the charge is poured, when the stream divides, one half finding its way into each mould. These moulds are left to cool quite undisturbed, and as they cool the flux which covers the surface cracks, and when quite cold can be easily knocked off. The flux is used over and over again, a piece of carbonate of potash being thrown in each fusion when old flux is used. In this way it will be seen that the flux keeps on increasing as a little potash is added and a little sulphur and antimony are picked up at each fusion. The ingots must be completely surrounded by flux, there must be a thin layer of it between the mould and the metal, and also the whole surface of the ingot must be covered to the depth of perhaps a quarter of an inch. Under the circumstances the metal should always give a good star and preserve a good colour.

The traces of flux which adhere are removed by washing in warm water with the assistance of a little sharp sand, water by itself being insufficient to remove the flux, which is practically insoluble in water.

The personnel of such a furnace as I have described consists of about 36 men and three women, this total being made up as follows:—

2 Firemen, one each fire, day and night.....	4
8 Furnacemen, 4 on each side, day and night ..	16
2 Men, cleaning metal, day and night	4
2 Men, breaking metal, day and night	4
1 Man, weighing charges, day and night	2
	30
On day-shift only—	
3 Men, labouring, grinding ore, &c.....	3
1 Smith, repairing tools, &c.....	1
1 Packing and washing, 3 women, and.....	1
1 Engine and boilerman.....	1
	36

Of course this does not include the making of crucibles, &c., but generally speaking one crucible-maker and one labourer can make enough crucibles, working during the day only, to keep the furnace going. The coals used, including those used for firing the kilns, amount to about 22 tons per week, or a little more than one ton and a half each shift.

About 11 crucibles are used per ton of refined metal produced, but this might be reduced by careful working, and the yield of finished metal from such a furnace as I have described working a 52 per cent. ore is about 14½ tons, or a little more, perhaps 14 tons 12 cwt. per week.

A great deal of volatilisation takes place from the melted metal in the pots, and the fume thus produced is condensed in the flues of the furnace, which are built for that purpose in a winding manner, passing backwards and forwards under the floor of the crucible drying stoves, so as to dry the pots at the same time as condensing the fume. The total amount of fume varies very much; the richer the ore the less fume there is in proportion to the antimony produced, although the absolute amount of fume is greater than when a poorer ore is worked. I suppose, taking one case with another, that I am not far from the truth when I say that about 10 per cent. of the total antimony contained in the ore is volatilised, and of this the greater part is condensed in properly constructed flues, but, of course, some part is inevitably lost. The fume is a whitish body, heavy, and rather crystalline, not very unlike white arsenic in appearance, but of a greyer colour, and, as you will readily believe, generally more or less blackened with soot. It contains about 70 per cent. of metallic antimony, one sample, of which I have an analysis, taken from about 7 tons of fume, gave 72·60 per cent. metallic antimony. The smelting of this fume is conducted as follows:—A test experiment is made in order to ascertain the amount of carbon in the form of coke or anthracite necessary to reduce all the antimony present in the fume. This having been found, the fume is mixed by grinding under edge-runners with the proper quantity of carbonaceous matter, and of the mixture so produced a few pounds weight is added to each charge of ore and iron when melting for singles. This process of smelting fume is no favourite with the workmen, as the gases given off in the process are apt to cause the mixture in the pots to overflow, and the “boiling ore,” as they term the mixture of fume and coke, is therefore looked upon by them with great disfavour; but beyond the mechanical difficulties, there is no trouble whatever in smelting the fume. The flues require cleaning out at intervals, sometimes once every two or three months, sometimes less frequently, according to circumstances.

The ingots, which are known in the trade as “French metal,” after being wrapped in straw, are packed in kegs holding about 6 cwt. nett, and which are about the size of ordinary butter firkins.

The value of any sample of antimony is judged, not by analysis, but by its appearance, and a good sample of metal should exhibit the following characteristics:—The star should be bold and defined, standing well up on the metal, the edges of the ridges sharp and straight; the metal itself should be lustrous and white, not dull and leaden-looking. Lastly, on breaking the ingot, the crystals should be large, and the surfaces of them free from specks, which are a sign of sulphur in the metal, a most undesirable

impurity; and on this last point, perhaps more than on any other, depends the value placed on the sample under consideration.

I regret that I cannot offer any idea of the costs of working, as, unfortunately, I have lost or mislaid the notes bearing on that part of the process. I have thought it best, therefore, to confine myself solely to a description of the process as it is carried out in practice, leaving out of sight the commercial considerations altogether. I must not forget to acknowledge the kindness of Dr. Readman, who placed his notes and analyses at my disposal, in order to fill up some blanks in my own memoranda.

DISCUSSION.

The CHAIRMAN said that the thanks of the Section were due to Mr. Rodger for his instructive and practical paper, and all the more so as he had come forward with it on very short notice to supply the place of another which had been postponed. He quite agreed with Mr. Rodger that the information which could be got from ordinary text-books on this subject was of little practical value, as he had lately to look up this subject, and could not get the desired information. He would like to ask if any special quality were required or if any great difficulty was experienced in grinding metallic antimony, as he had occasionally to use it and found it difficult to obtain and the price very high. He would also like to know what the average life of a crucible was, and if the process he had described was worked in Scotland.

Dr. J. B. READMAN could say from experience that Mr. Rodger had given a very accurate description of the smelting of antimony. The process was, he thought, defective so far as the use of crucibles were concerned. These should be dispensed with, for the use of crucibles for smelting was a very costly method, each crucible costing 2s. 6d., and all of them filling only a small proportion of the heated area of the furnace. Why should not a reverberatory furnace or some other form of furnace be employed, and the enormous expense of crucibles be got rid of? Some time ago a method had been proposed for smelting antimony in a water-jacketed blast furnace, but he did not know if it had been successful. He thought a blast furnace of that description might be adapted to serve the purpose. On the whole he thought there was great room for improvement in the process of refining antimony.

Mr. RODGER, in reply to Mr. Fawsitt, said that any antimony could be ground in an iron mortar, but it was very difficult, almost impossible, to get it chemically pure. However, a good sample of antimony as it left the smelter's hands was a very pure commercial product. The cost of the crucibles was immense. In the work with which he had been connected they calculated that eleven crucibles were used for every ton of refined metal produced. The average life of a crucible depended on what it was used for. Crucibles used for “sturring” were very short lived, and could not be employed more than three or four times, being rapidly destroyed by the flux, while crucibles for “singles” would stand for a long time and could be used twenty times or more. A blast furnace, he believed, had been used for smelting antimony, but the furnace was worked very low, with poor ores, the object being to produce as much “fume” as possible, this fume being condensed and afterwards reduced with carbon. He had, however, no practical experience of this. He agreed with Dr. Readman that a vast amount of heat and space was lost by the use of crucibles for smelting. A reverberatory furnace had been tried but did not seem to work. Antimony was not now smelted in Scotland, the work with which he had formerly been connected having been stopped for want of ore. Newcastle was at present the seat of the industry.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Manufacture of Glass Pipes of Large Diameter. L. Appert. Bull. Soc. d'Encouragement l'Industrie Nationale, 1891, 6, 114—121.

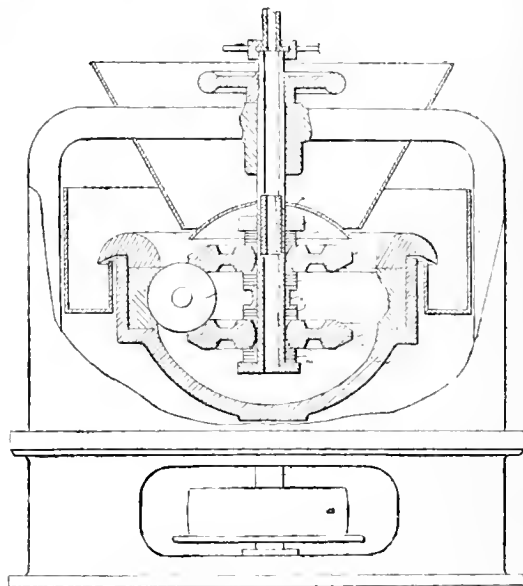
See under VIII., page 38.

PATENTS.

Improvements in Machinery and Apparatus for Grinding or Crushing Mineral, Vegetable, and Animal Substances. W. H. Thompson, London. Eng. Pat. 19,061, November 24, 1890. 11d.

This invention relates to improvements in the class of grinding mill in which a ball is held between two discs surrounded by a cylindrical casing, so that rotary motion applied to the discs causes the ball to travel along the inner circumference of the casing, thereby exerting a reducing and grinding action upon any materials enclosed therein. The principal point of novelty claimed consists in securing the two discs each to an independent shaft placed axially in line with the other, each shaft being capable of separate adjustment laterally as well as axially, and of being driven at independent speeds. In another arrangement the two discs are secured to the same shaft, and fitted with springs for self-adjustment. Or a rotary casing may be employed, the discs being held stationary and in elastic contact with the ball, an arrangement specially applicable when the

casing is placed horizontally and the discs fitted to a vertical spindle. The accompanying drawing shows one of the



GRINDING APPARATUS.

latter arrangements, suitable for wet grinding, with the driving pulley placed underneath.

There are seven claims and four sheets of drawings. —B.

Improvements in Filtering Machinery. E. Martin, Watford. Eng. Pat. 19,600, December 2, 1890. 6d.

The apparatus consists of a horizontal cylinder, with perforated circumference, carried on hollow trunnions, which is immersed nearly to its full depth in a cistern filled with the liquid to be filtered. The trunnions pass through the sides of the cistern by means of stuffing-boxes, and over the whole circumference of the cylinder, except for the small portion projecting above the liquid, is laid an endless filtering cloth, which runs thence over secondary small cylinders or rollers and passes through another cistern, in which are provided means for cleaning off any deposit that may have collected. The liquid passes through the cloth surrounding the cylinder, leaving its impurities on the outer surface of the cloth, whilst the clean liquid is withdrawn through the trunnions. On motion being imparted to the cylinder and the filtering cloth, the deposit is removed as the latter passes through the second cistern.

Claim is made for the whole arrangement. —B.

Improved Method of and Apparatus for Treating Smoke and Gases from Furnaces and other Fires. A. S. Davy, Sheffield. Eng. Pat. 179, January 5, 1891. 8d.

See under II., next page.

Improvements in or Connected with Compression Pumps for Gaseous or Vaporous Fluids. W. H. Webb, Bootle. Eng. Pat. 1540, January 28, 1891. 8d.

The patentee makes the suction or lift-valve of a pump removable by securing its seat in a round plug, which can be inserted through a suitable opening in the pump casing.

Four claims and two illustrations. —B.

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	½d.
Above 8d., and not exceeding 1s. 6d.	1d.
" 1s. 6d., " " " 2s. 4d.	1½d.
" 2s. 4d., " " " 3s. 4d.	2d.

Improvements in Apparatus for Concentrating Acids. W. C. Herrens, Hanau, Germany. Eng. Pat. 2499. February 11, 1891. 4d.

See under VII., page 36.

Improvements in or relating to Means or Apparatus for Treating Gases, Smoke, and Products of Combustion so as to render them Innocuous. R. Wainwright, Leeds. Eng. Pat. 10,427, June 19, 1891. 8d.

See under II., page 22.

II.—FUEL, GAS, AND LIGHT.

PATENTS.

Improvements in Appliances for Producing Light by Incandescence. T. Heskin, Preston. Eng. Pat. 16,821, October 22, 1890. 8d.

THESE improvements relate to the production of light by heating magnesia or other refractory earthy substances to incandescence by means of Bunsen or other gas burners, and to the automatic supply and renewal of such substances. Hitherto mantles or hoods, which, owing to their fragile natures, are liable to be fractured and broken, have been used. Further, the light-giving properties of such are found to deteriorate, necessitating frequent renewal.

The principal feature of this invention is the preparation of a mixture of a salt of a refractory earth with glycerin, "which, when suitably applied to the flame of the burner, evolves a continuous supply of the refractory earth."

The burner used is preferably one giving a low, short, but hot flame, about half an inch in height.

Fig. 1.

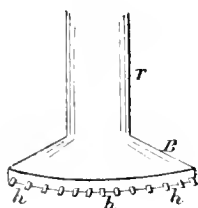
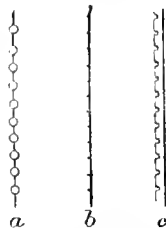


Fig. 1 shows one way of applying the mixture. T is a metallic or earthenware vessel, 4 in. high by 2 in. in diameter, extending to 6 in. or other suitable size, at the base for attachment to a Bunsen burner. The base B is fixed about $\frac{1}{4}$ of an inch above the central air-way of the burner, and is about $\frac{1}{2}$ an inch less in diameter than that of the flame, to allow a clear annular space for the air to ascend. h h h is a circle of small tubes of thin platinum, nickel, or silver, fixed at right angles to the base, each $\frac{1}{4}$ in. long and $\frac{1}{8}$ in. in bore, about $\frac{3}{16}$ th of an inch apart, and which almost touch the flame of the burner at a point $\frac{1}{16}$ th of an inch below its extreme height. T is filled with the pasty mixture, which eventually appears as a bead at each end of tubes h h h. When the burner is lighted, the mixture decomposes, the bead swelling out and immersing itself in the body of the flame—a residue of refractory earth being left generally in the form of a small cone. If the ends of the tubes actually touch the flame, the oxide is left in a light porous condition, not so well adapted for illuminating purposes as the denser form.

The reservoir T may be placed above or below the Bunsen and wires of platinum nickel or silver may be drawn through the pasty mixture and brought in contact with the flame. Fig. 2 shows suitable shapes of wire, which in case

of (a) is $\frac{1}{32}$ nd of an inch thick and $\frac{1}{16}$ th in the other two (b), (c). When heated, decomposition occurs, and tufts of oxide are left adhering. When the burner is not in use,

Fig. 2.



ATTACHMENT FOR INCANDESCENT GAS LAMPS.

the mixture in the tube being deliquescent, absorbs moisture from the air and forms another bead, which in turn evolves a further supply of oxide when decomposed. The chloride or other suitable salt of magnesium, lanthanum, zirconium, yttrium or thorium may be used.—D. A. S.

Improvements in Incandescence Gas Lamps and Apparatus in Connection therewith. C. Clamond, Paris, France. Eng. Pat. 60, January 1, 1891. 8d.

ACCORDING to these improvements the gas first passes through a regulator, consisting essentially of a disc with small holes the area of which can be regulated by means of tapering pins; it is claimed that in this way the quantity of gas can be varied without altering the speed of the gaseous current through the holes, and hence without altering the mixture of gas and air. After passing through the regulator disc, air mixes with the gas, being drawn in through lateral perforations in the conducting tube, and the mixture is heated on its way to the burner, which consists of a metal chamber having at its underside a group of small tubes extending downwards. The air and gas are here intimately mixed, and on issuing from the lower ends of the tubes meet a further supply of highly-heated air, sufficient to ensure perfect combustion. The flame so produced plays downwards through an inverted magnesia hood, which it raises to incandescence, the products of combustion then passing upwards to the regenerator for heating the preliminary mixture of air and gas and secondary air supply. By these means, it is claimed, there can be no clogging of orifices by particles of soot or carbon. For powerful lamps of this class the burner as described above is somewhat modified in order to ensure an even distribution of air and gas supply to the tubes, while in order to avoid the inconvenient radiation of heat from the glass globe, the latter is cooled by being surrounded by a second glass globe, an air space being left between the two, through which the air supply passes on its way to the regenerator and thus undergoes a preliminary heating.

For details of the regenerator and mode of fixing these lamps, the specification and drawings must be consulted.

—O. H.

Improved Method of and Apparatus for Treating Smoke and Gases from Furnaces and other Fires. A. S. Davy, Sheffield. Eng. Pat. 179, January 5, 1891. 8d.

IN this method the smoke and gases are caused to pass through a fan, blower, or exhauster, in the interior of which they are brought into contact with water in the form of spray, the solid matter being precipitated and subsequently carried off. The water is led in to the vane spindle and projected by centrifugal force through holes therein. The spindle is hollow or tubular, and partially divided longitudinally by ribs. There may also be holes through the boss, or through the arms of the vanes, or the water may be supplied through the easing to the interior of the fan or exhauster, and so dashed into spray by the revolving vanes.

—D. A. S.

Improvements in or relating to Means or Apparatus for Treating Gases, Smoke, and Products of Combustion so as to render them Innocuous. R. Wainwright, Leeds. Eng. Pat. 10,427, June 19, 1891. *Sd.*

IN this invention it is proposed to render gases and smoke "innocuous" by drawing them from the chimney or flue through a cooling pipe or tube into a purifier in the form of a tank partially filled with water, and thence into the atmosphere. The chimney being closed with a damper, the products of combustion are withdrawn by means of an exhaustor, cooled by being passed through a tube surrounded with water, and discharged beneath the surface of water in a closed tank. They are thus efficiently washed without the use of any mechanical agitator. From the purifier the gases are allowed to escape into the atmosphere direct, or are returned to the chimney above the damper, or to the furnaces again. A drawing is attached to the specification showing the application of this system to a Cornish boiler.—D. A. S.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Origin of Petroleum. R. Zoloziecki. Chem. Zeit. 1891, 15, 1203—1205.

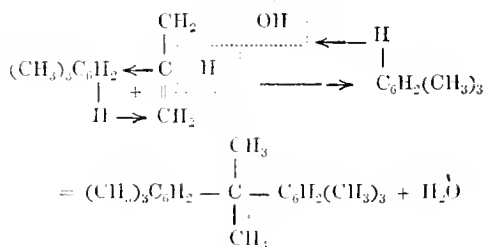
THE author disputes the validity of the hypothesis of Okenius concerning the origin of petroleum, the chief features of which are the assumption that the formation of petroleum has been brought about by the action upon the fatty matter of decomposing animal remains of certain salts, notably alkaline bromides and aluminium chloride, and the contention that this view is borne out by the composition of the saline constituents of the natural waters commonly found associated with petroleum. The chief grounds for his rejection of this theory are that petroleum and the said saline deposits belong to different geological epochs, and that little or no nitrogen in any form is found in the waters accompanying deposits of mineral oil. Moreover, cases are known in which the water accompanying petroleum is free from saline constituents, and further, the syntheses of hydrocarbons of the aromatic series effected by the aid of small quantities of alkaline bromides and iodides and aluminium chloride, take place under conditions widely differing from those that would occur in the production of petroleum in contact with an aqueous solution of these bodies. In consequence of these considerations he adheres to his belief that the function of the saline constituents of waters accompanying petroleum has been rather to restrain the putrefactive changes of the original animal matter, than to cause a specific alteration of its fatty constituents into hydrocarbons of such series as are generally found in crude petroleum.—B. B.

Artificial Mineral Lubricating Oils—the Condensation Products of Allyl Alcohol with Methylated Benzenes. G. Kraemer and A. Spilker. Ber. 1891, 24, 2785—2793 and 3164.

IN their investigations on the condensation of cinnamene (styrol) with methylbenzene derivatives (Ber. 1890, 23, 3269—3283; this Journal, 1891, 38 and 39) the authors briefly referred to the formation of viscous cinnamene compounds possessing the properties of mineral oil. In continuation of these researches they have attempted to ascertain in what relation these compounds stand to mineral oils. Owing to the fact that the viscosity of mineral oils increases as the quantity of solid paraffin diminishes, it is feasible to attribute the formation of viscous compounds to certain changes which paraffin has undergone after the formation of petroleum. The conversion of solid paraffin into liquid products has been investigated by a number of

authors, and although it is unnecessary for the purpose of the present paper to gain further insight into the nature of this dissociation, the authors contend it to be highly probable that the liquid hydrocarbons thus formed while acting mutually on one another may in course of time be resolved into viscous compounds resembling the products which are obtained by the condensation of cinnamene with methylbenzene derivatives.

The new compounds described by the authors were prepared by mixing 100 cc. of anhydrous allyl alcohol with 1,000 cc. of pseudocumene and treating the mixture gradually whilst cold with 100 cc. of concentrated sulphuric acid and 50 cc. of fuming sulphuric acid. Two layers of liquid were formed, the heavier of which contained sulphonic acids. The lighter portions were separated, washed with water and soda, and distilled in a current of steam. At 200°—220° a colourless viscid liquid came over, the residue forming a yellowish-brown resinous compound. The oil after fractionation boiled above 300° almost without decomposition. It had a viscosity of 775 at 15° (water being 1) compared with the figure 40 which was obtained in the same apparatus with a sample of best Russian lubricating oil. It had the composition $C_{21}H_{28}$. The resinous compound was found to be a polymeric of the original substance. The liquid obtained from xylene and allyl alcohol had the formula $C_{15}H_{24}$, and showed the lower viscosity number of 8.1. It will be seen that oxygen was not present in these compounds, and from this fact it was supposed that they had not been produced under the same conditions as the cinnamene derivatives, but that the condensation must have been accompanied by the elimination of water. The formation is illustrated by the authors in the following manner:—



The product obtained from pseudocumene and allyl alcohol is therefore dimethyldicumylmethane. The authors regard these compounds as the "viscosity carriers" of mineral oils; moreover they consider they have proved that the lubricating property depends on the number of methyl groups present in the compound, and that all high boiling fractions of petroleum are free from oxygen whilst the highly viscous oils contain less hydrogen than the oils of lower viscosity.

The authors explain on page 3164 of the *Berichte* that they omitted to refer to the researches of Baeyer (Ber. 6, 224), who obtained a viscous compound of high boiling point by the condensation of allyl alcohol and mesitylene with concentrated sulphuric acid, although no mention was made by him of the constitution or composition of the product.

—D. B.

PATENTS.

A New Product possessing the Same, or nearly the Same Properties as Spirits of Turpentine. T. Drake, Huddersfield. Eng. Pat. 16,916, October 23, 1890. *Ad.*

See under XIII., page 45.

Production from Mineral Oils of Sulphonic Acids and Sulphones, and the Manufacture of a New Product by treating Gelatinous Matters with Sulphonic Acid. A. M. Clark, London. From the "Gewerkschaft Messel," Grube Messel, Germany. Eng. Pat. 19,502, November 29, 1890. *6d.*

THE unsaturated hydrocarbons present in petroleum, mineral wax, or rosin oil are converted into a mixture of sulphonic acids and sulphones when treated with fuming

sulphuric acid at the ordinary temperature, or with acid containing 10 per cent. of the anhydride at 80° C. Petroleum of sp. gr. 0.860–0.890, when thus treated, yields a syrupy liquid containing these sulphonic acids. When this liquid is run into water the acids are partially precipitated, their complete precipitation being effected by the addition of common salt. The precipitate is redissolved in water, and reprecipitated by the addition of brine, this operation being repeated until all the sulphuric acid is removed. The sulphones can be separated from the sulphonic acids by converting the latter into their sodium salts and then extracting the former by means of ether or of naphtha. The sodium salts, when dissolved in water and decomposed with hydrochloric acid, yield the free sulphonic acids, to which the name of "*Tumenol-sulphonic acids*" is given. These bodies when moist form a syrupy paste having a spicy taste, and drying at 110° C. to a pulverisable residue. They dissolve readily in water, but are precipitated from solution by common salt, hydrochloric acid or sulphuric acid. The alkaline salts are soluble in water, while those of the alkaline earths and of the heavy metals (except antimony and mercury) are insoluble. The free acids are readily oxidised, and are specially characterised by their property of precipitating glue and gelatin from slightly acid solutions with the formation of an elastic caoutchouc-like precipitate which may be drawn into threads.—C. A. K.

IV.—COLOURING MATTERS AND DYES.

Addition of Hydrogen to Tricyclic Systems. E. Bamberger. Ber. 1891, 24, 2463–2469.

THE tricyclic compounds, anthracene and phenanthrene, take up 2 and 4 atoms of hydrogen respectively, but since there is no clue to the position of the added hydrogen atoms, the author has investigated the products of the reduction of the naphthoquinolines (compare following abstracts). The reduction is perfectly comparable with that of bicyclic acid compounds; it takes place in two stages, in each of which 4 atoms of hydrogen become added. The first group of 4 hydrogen atoms is taken up by the pyridine nucleus, and this reduction to tetrahydride is effected by means of tin and hydrochloric acid. In the second stage of reduction, which yields an octohydride, 4 hydrogen atoms are taken up by one or other of the two rings of the naphthalene nucleus; this is effected by means of sodium and amyl alcohol. The tetrahydronaphthoquinolines behave like bicyclic compounds, and, in fact, resemble alkylated naphthylamines in their properties. Similarly, the octohydrides behave as monocyclic or benzene derivatives. The second stage of the reduction may take place in either of the two rings which constitute the naphthalene nucleus, and the classes of octohydrides obtained, are distinguished as *aromatic* and *alicyclic* hydrides.—A. K. M.

Ethyl-α-Naphthylamine. E. Bamberger and C. Goldschmidt. Ber. 1891, 24, 2469–2472.

ETHYL-α-NAPHTHYLAMINE readily reacts with diazo-compounds, yielding azo-dyes, which on reduction yield ethyl-1:4-naphthylenediamine.

Phenylazo-ethyl-α-naphthylamine has been previously described by Eicker, whose results the authors confirm. *Sulphophenyl-azo-ethyl-α-naphthylamine* forms a dark carmoisine red crystalline powder of green metallic lustre; it dissolves in hot alcohol with a bluish, deep red colour, in concentrated sulphuric acid with a violet colour, and in alkalis with an orange-red colour. Its sodium salt, $C_{18}H_{16}N_3 \cdot SO_3Na$, separates as a deep red precipitate on the addition of salt to its aqueous solution.

Ethyl-1:4-naphthylenediamine hydrochloride—
 $C_{12}H_{14}N_2 \cdot 2HCl$

obtained by the reduction of the above dye with a solution of stannous chloride in hydrochloric acid, forms silvery needles which become greenish on exposure to the air, and which do not melt at 300°. It dissolves very readily in water, and sparingly in concentrated hydrochloric acid. The free base forms a colourless oil having an odour resembling that of crude α-naphthylamine. It is sparingly soluble in cold water, much more soluble in hot water, readily in the ordinary organic solvents, and when exposed to air and light it rapidly becomes dark in colour.

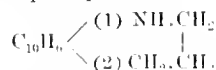
When it is treated with hydrochloric acid, hydrogen sulphide, and ferric chloride it gives a slight brown colouration and turbidity; with aniline, potassium dichromate, and glacial acetic acid it gives a brownish-red colour, which becomes deep Bordeaux red on boiling; and with potassium dichromate and meta-tolylenediamine a bluish-green colour which changes to red on boiling.

The *chlorimide* obtained by the action of bleaching powder on an acid solution of ethylnaphthylenediamine, gives a deep red colouration with an alcoholic solution of aniline and hydrochloric acid.—A. K. M.

Tetrahydro-α-naphthoquinoline. E. Bamberger and L. Stettenheimer. Ber. 1891, 24, 2472–2480. (See also this Journal, 1891, 999–1000.)

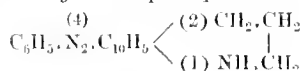
THE authors prepared α-naphthoquinoline by Skraup's method, which, however, they have modified in some respects. The product melts at 52° and boils at 223°, under a pressure of 47 mm., and at 338° under a pressure of 719 mm., and not at 251°, under 747 mm. pressure, as stated by Skraup. It crystallises from light petroleum in clear colourless thick monoclinic tables, and when quite pure has a very faint odour, unlike that of quinoline. When ferric chloride is added to its solution in fuming hydrochloric acid, a compound of naphthoquinoline hydrochloride with ferric chloride separates, which is very readily soluble in water, and which crystallises from alcohol in golden yellow silky needles.

Tetrahydro-α-naphthoquinoline—



is prepared by gradually adding a solution of α-naphthoquinoline (20 grs.) in hydrochloric acid to a boiling mixture of tin (80 grs.) and 38 per cent. hydrochloric acid (500 grs.) and heating until the metal is dissolved. The purified base crystallises in snow-white, lustrous scales, melting at 46.5°; it dissolves readily in the ordinary solvents, and its solutions exhibit an intense blue fluorescence, which is destroyed by the addition of a trace of an alkali or mineral acid. Oxidising agents produce an intense carmoisin colour when added to its acid solution, and when potassium dichromate has been employed and the solution allowed to stand a few minutes, the chromate of a new base separates, and when crystallised from boiling water, is obtained in the form of lustrous dark green needles resembling quinhydrone. *Tetrahydronaphthoquinoline hydrochloride*, $C_{10}H_{12}N \cdot HCl$, crystallises in thick vitreous prisms, melts at 260°–261°, dissolves sparingly in hydrochloric acid and not very readily in water. The *nitroso-derivative*, $C_{10}H_{12}N \cdot NO$, crystallises from light petroleum in flat, broad, lemon-yellow prisms, melting at 59.5°.

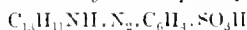
Phenylazotetrahydro-α-naphthoquinoline—



crystallises from dilute alcohol in groups of cherry-red needles, exhibiting a bronze lustre; it dissolves in concentrated sulphuric acid with a cornflower-blue colour, and in organic solvents with a deep orange-red colour. Its

sulphate ($C_{13}H_{11}NH.N_2.C_6H_5)_2.H_2SO_4$, crystallises in flat olive-green prisms, and gives violet-red solutions.

Sulphophenylazotetrahydro- α -naphthoquinoline—



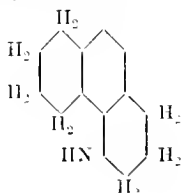
forms a dark violet-red crystalline powder, exhibiting a bronze lustre, and yielding red solutions; its sodium salt forms an orange-red crystalline precipitate.

Paramidotetrahydro- α -naphthoquinoline, $C_{13}H_9N_3$, obtained by the action of stannous chloride and hydrochloric acid on the sulphophenylazo derivative, is unstable, dissolves readily in alcohol and in ether, and the solution exhibits a green fluorescence. Its hydrochloride, $C_{13}H_{11}N_3.2HCl$, crystallises in white needles, which do not melt at 300°, and which dissolve readily in water, sparingly in absolute alcohol, and very sparingly in strong hydrochloric acid. Its slightly acid solution gives with bleaching powder a yellowish white chlorimide, readily soluble in alcohol and ether. With hydrogen sulphide, hydrochloric acid, and ferric chloride it gives a brownish-red colour; with alkaline α -naphthol and exposure of the product to the air, it gives a greenish-blue precipitate; with aniline, acetic acid, and potassium dichromate, a brownish-red colouration, which becomes deep bordeaux on boiling; with meta-tolylene-diamine, acetic acid, sodium acetate, and ferric chloride, a deep reddish-brown colouration.

When the hydrochloride is fused with aniline hydrochloride and some free aniline and amidoazobenzene, a deep violet-red melt is obtained, which dissolves in alcohol with a very intense reddish-violet fluorescence and a violet colour. The formation of such fluorescent dyes distinguishes the paraminines of naphthalene from those of the benzene series.—A. K. M.

"Aromatic" Octohydro- α -naphthoquinoline. E. Bamberger and L. Stettenheimer. Ber. 1891, 24, 2481—2495. (See preceding abstract.)

Ar.-octohydro- α -naphthoquinoline—

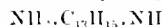


is obtained by the reduction of α -naphthoquinoline by means of sodium and amyl alcohol. It crystallises in thick plates, melts at 47—48°, boils at 216° under 37.5 mm. pressure, is somewhat volatile in steam, and has a characteristic sweet odour. Like the "aromatic" hydronaphthylamines, it reduces alcoholic silver nitrate solution; with ferric chloride in an acid solution it gives a carmoisin colouration on warming, which disappears on cooling; with potassium dichromate a similar reaction, but the colour soon appears also in the cold; with chromic acid it gives a deep violet-red colouration, which rapidly disappears. The hydrochloride, $C_{13}H_{17}N$, HCl crystallises in monoclinic plates; the hydrogen sulphate, $C_{13}H_{17}N.H_2SO_4$, in wavelite-like aggregations, is very readily soluble in water, softens at 183°, and melts at 187°; the picrate, $C_{13}H_{17}N.C_6H_3O(NO_2)_3$, melts at 155—156°; the platinochloride ($C_{13}H_{17}N)_2PtCl_6$ appears to exist in three different forms, which differ in colour and in the amount of water of crystallisation which they contain. The nitroso-derivative, $C_{13}H_{16}N.NO$, melts at 77.5°; the acetyl-derivative, $C_{13}H_{16}N.C_2H_3O$, forms colourless vitreous prisms, melting at 68—69°; the methyl-derivative, $C_{13}H_{16}N.CH_3$, crystallises in large thin nacreous plates, melting at 37—38°, and its hydriodide in long, silky needles, melting at 202°.

Ar.-octohydro- α -naphthoquinoline-azobenzene sulphonic acid, $C_{13}H_{16}N_2.C_6H_4.SO_3H$, forms slender violet-brown needles, sparingly soluble in water and alcohol and soluble in concentrated sulphuric acid to a deep violet solution. In an acid bath it dyes wool and silk a bright red.

When diazobenzene chloride reacts with octohydro- α -naphthoquinoline in the presence of an excess of sodium acetate, a reddish-yellow product separates, and when this is warmed with dilute sulphuric acid, phenylazo-octohydro-naphthoquinoline sulphate is obtained. It crystallises in magnificent cherry-red prisms with a bronze lustre, melts at 190.5°, and dissolves in concentrated sulphuric acid with an olive-green colour. The dye-base forms lustrous orange-red prisms, melting at 118.5°.

Ar.-octohydroparamido- α -naphthoquinoline—



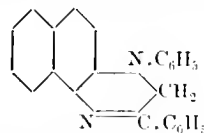
obtained by the reduction of the above octohydro- α -naphthoquinoline-azobenzene sulphonic acid by stannous chloride and hydrochloric acid, crystallises in groups of radiating flat white prisms, melting at 97°, and is not affected by light and air. Its hydrochloride crystallises in lustrous white needles, readily soluble in water, and its solution gives the following reactions:—With hydrochloric acid, hydrogen sulphide, and ferric chloride an intense and beautiful crimson (Thionine); with meta-tolylene-diamine hydrochloride, sodium acetate and ferric chloride, it gives the Tolylene-blue and Tolylene-red reactions; with a solution of α -naphthol in dilute potash, it shows the indophenol reaction with production of a beautiful greenish-blue dye; with aniline hydrochloride and potassium dichromate, it gives a dark-brown colouration which soon becomes reddish to greenish-brown; it does not give the indamine and saffranine reaction, and in this behaves like a poly-substituted paramidine; when the base is heated with amidoazobenzene, aniline hydrochloride and some free aniline, a reddish-violet melt is obtained, the alcoholic solution of which does not exhibit fluorescence, but appears violet by reflected light, and red by transmitted light.

A characteristic property of octohydro- α -naphthoquinoline is the readiness with which it parts with the added hydrogen atoms of the pyridine nucleus. This takes place when a solution of the base in dilute sulphuric acid is oxidised by means of potassium dichromate; the product is ditetrahydro- α -naphthoquinoline, $C_{26}H_{26}N_2$. It crystallises in white lustrous needles, melting at 282°, and from its reactions appears to be a tertiary base; it does not react with diazo-salts to form dyes.—A. K. M.

A New Class of Fluorescent Dyes of the Quinoxaline Series III. O. Fischer and M. Busch. Ber. 1891, 24, 2679—2683.

The authors have recently shown that the quinoxalines obtained from ketonic alcohols and mono-substituted α -diamines are converted by oxidising agents such as ferric chloride into Witt's phenazonium bases (this Journal, 1891, 998). Thus the triphenyletho- α - β -naphthazonium hydroxide, previously described, has also been obtained by Witt's method from benzil and phenyl-orthonaphthylenediamine.

Diphenyletho- α - β -hydronaphthoquinoxaline—



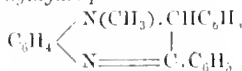
is obtained by the action of benzoyl carbinol on phenylortho-naphthylenediamine at 150°—160° in a closed tube. It is readily soluble in benzene, less so in ether and in glacial acetic acid, very sparingly in alcohol, and is almost insoluble in light petroleum. Its solutions exhibit an intense yellowish-green fluorescence. It crystallises in lustrous orange coloured needles, melting at 164°—165°. Its solution in concentrated sulphuric acid yields a precipitate of the base when water is added.

In the preparation of the above, a secondary product is also obtained and melts at 194°—196°. It forms magnificent dark red plates which are yellow in reflected light, and its solutions exhibit a purple-red fluorescence.

When the above quinoxaline is oxidised by means of ferric chloride, an azonium compound is produced which is

identical with diphenylethionaphthazonium hydroxide previously prepared from bromacetophenone and β -phenylethionaphthylenediamine (*loc. cit.*).

Methyltriphenylhydroquinoline—



is obtained when benzoin is heated with monomethylorthophenylenediamine for 5–6 hours at 160–170°, and crystallises in bright yellow needles melting at 133°. It is readily soluble in benzene and in ether, less so in alcohol and very sparingly in light petroleum; its solutions exhibit a greenish-yellow fluorescence. Its salts are partially decomposed by water. When the alcoholic solution of the base is heated with ferric chloride and hydrochloric acid, it yields an ammonium base, the ferric chloride double salt of which forms long bright yellow prisms.—A. K. M.

Synthesis of Indigo-disulphonic Acid (Indigo-Carmine).

B. Heymann. Ber. 1891, 24, 3066–3071.

A REPLY to Knietseh, who has offered a different explanation (this Journal, 1891, 916) of the reaction occurring in the synthetic formation of indigo-disulphonic acid from that given by the author (this Journal, 1891, 827), who discovered the method of synthesis.

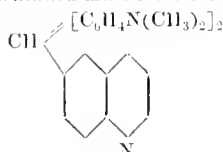
According to Knietseh, the synthesis of indigo-disulphonic acid from phenylglycine takes place in two stages, leuco-indigotin-disulphonic acid being produced in the first stage, and being oxidised (on diluting the acid solution) by atmospheric oxygen in the second. That atmospheric oxygen takes no part in the reaction, however, the author has now clearly proved, since he finds that, in an atmosphere of carbon dioxide, indigo-disulphonic acid is instantly produced on diluting with concentrated sulphuric acid, the yellow-coloured solution obtained by the action on phenylglycine of fuming sulphuric acid containing 80 per cent. of anhydride. The yellow solution contains the sulphonic acid of indoxyl sulphuric ester, which, as the author has already indicated (*loc. cit.*), is a sulphuric ester of a leuco-indigo compound. This compound, on diluting its solution, is oxidised by the sulphuric anhydride. Several instances of oxidation effected by sulphuric anhydride are cited in support of this view.—E. B.

Examination of the Colouring Matters of the Triphenylmethane Group. E. Noeltling, M. Polonowsky, and Skawinski. Ber. 1891, 24, 3126–3139.

ALREADY abstracted from Bull. Soc. Ind. Mulhouse, 1890, 98–100 (this Journal, 1891, 456–457). See also following abstract.

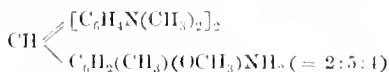
Dyestuff Derivatives of Triphenylmethane. E. Noeltling and C. Schwartz. Ber. 1891, 24, 3139–3143.

A GREEN dye is formed on oxidation of the quinoline derivative of tetramethyltriamidotriphenylmethane (prepared from tetramethyldiamidobenzhydrol and aniline) (this Journal, 1890, 53). It was assumed that in the latter compound the amido-groups all occupied the para position relatively to the methane-carbon atom, but this has been questioned by Nathansohn and Müller (this Journal, 1889, 978). The compound in question, has, however, been prepared by the present authors from tetramethyldiamidodiphenylmethane (4 parts) by heating with glycerin (3·8), sulphuric acid (6), and nitrobenzene (0·9), 10–12 hours at 110°–150°, as well as by quinylation of the tetramethyltriamidotriphenylmethane obtained by condensation of dimethylaniline and *p*-nitrobenzaldehyde and subsequent reduction. Its constitution must therefore be—



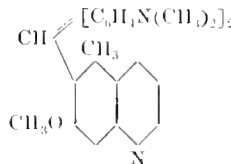
as previously stated (*loc. cit.*)

Tetramethyltriamidodiphenylmethoxytoluylmethane—



was prepared by heating for four hours on the water-bath a mixture of tetramethyldiamidobenzhydrol (10 parts), amido-cresol methyl ether (5·3), and concentrated hydrochloric acid (10·3), pouring the product into water, precipitating with ammonia, and crystallising from alcohol, colourless needles melting at 158°–159° being so obtained. On oxidation of this leuco-base a blue dye is produced; by heating it with acetic anhydride, previously to oxidising, a green dye is formed.

Tetramethyldiamidodiphenylmethoxytoluylmethane—



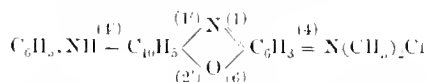
was prepared from the last-described compound by Skraup's reaction, picric acid being, however, used instead of nitrobenzene as giving a greater yield. The product was obtained from benzene-petroleum in colourless needles melting at 183°, which on oxidation with chloranil or lead dioxide yield a pure-green dye.

It thus appears that quinylation of a para-amido group in triamidotriphenylmethane destroys its influence on the colour of the dyestuff obtainable from the same. (See also this Journal, 1891, 827.)—E. B.

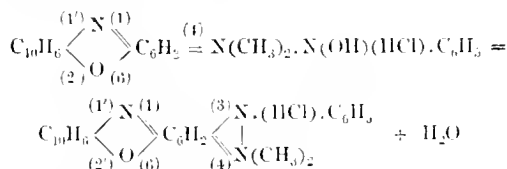
The Condensation of Meldola's Blue with Aromatic and Fatty Amines. C. C. Schlarb. Chem. Zeit. 1891, 15, 1281–1283, and 1317–1318.

THE dyes known as New-blue R, New-blue B, New-blue 2 B, New-blue GB, and New-blue G, representing the products of the interaction of nitrosodimethylaniline hydrochloride, and β -naphthol are not homogeneous compounds, but appear to consist of mixtures in varying proportions of dimethylphenylammonium- β -naphthoxazine chloride (Meldola's blue), the primary product of the reaction, and a dye having a more greenish shade ("cyanamine") which is produced by the condensation of the oxazine chloride with *p*-amido-dimethylaniline, a compound simultaneously formed in the reaction (compare Witt, this Journal, 1890, 933). The oxazine chloride reacts with equal molecules of primary and secondary amines of the aromatic and fatty series yielding greenish-blue dyes for which the author adopts Witt's name "cyanamines" (*loc. cit.*). They are only sparingly soluble in hot and cold water, an addition of mineral acid increasing their solubility in hot water, but are readily soluble in alcohol and organic solvents; they dissolve in mineral acids with a brown colour, are reprecipitated unaltered on diluting with water, and are scarcely attacked by hot concentrated sulphuric acid. On oxidation with potassium bichromate the colour is at first changed to violet, and finally completely destroyed; whilst on reduction leuco-compounds, unstable on exposure to the air, are produced. When the "cyanamines" are precipitated from their solutions by zinc chloride and common salt, they are obtained as tarry masses which dry to hard friable cakes, and on pulverising the latter a brownish-red powder of a feeble coppery lustre is formed; whilst they separate from alcohol in the form of small green needles with a considerable coppery lustre. Cotton mordanted with tannin or tartar emetic decolorises their solutions and assumes greenish-blue shades, which are fast towards light, but in some cases unstable in the presence of alkaline liquids. When the oxazine chloride (Meldola's blue) (5 grms.) is dissolved in 95 per cent. alcohol (250 cc.) in a narrow-necked flask, aniline (1·5 grms.) added, and the flask filled with alcohol and a cork inserted to exclude the air, after remaining for three days the colour is almost pure green, and on removing the cork and passing a current

of air through the liquid, it gradually changes its colour to greenish-blue. It appears therefore that the "cyanamine," which is already formed undergoes an alteration with the oxygen of the air; two atoms of hydrogen are doubtless thus eliminated as water, and its constitution might accordingly be expressed by the formula—



It is difficult, however, to account for the following facts by this formula according to which the formation of the "cyanamine" is independent of the group $=\text{N}(\text{CH}_3)_2\text{Cl}$, contained in the oxazine chloride:—The oxazine chloride is very stable, being only slowly converted into the base by cold aqueous alkalis, whereas the salts of the cyanamine are dissociated even on dilution with water. This remarkable alteration in basicity appears therefore to indicate that in the cyanamine reaction the amido-compound combines with the group $=\text{N}(\text{CH}_3)_2\text{Cl}$ of the oxazine chloride; it would also seem that when air is passed through the product (see above) an atom of oxygen also enters into combination and is then subsequently eliminated together with two atoms of hydrogen as water thus:—

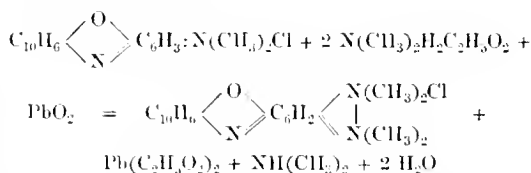


The cyanamines prepared from *m*- and *p*-phenylenediamine, *m*-toluylenediamine, and *p*-amido-dimethylaniline resemble closely the last described compound, but are more readily soluble in hot water, and the shades produced on cotton fibres mordanted with tannin are more stable towards alkaline liquids. To prepare them, New-blue R and the hydrochloride of the diamine (equal mols.) are dissolved in hot water and soda, slowly added to the solution at a temperature of 60° C. until no further precipitation occurs; the precipitate is well washed with acidified water, suspended in dilute hydrochloric acid, and brought into solution by leading a current of steam through, whence the "cyanamine" is reprecipitated from the filtrate by adding zinc chloride and common salt.

Ammonia, dimethylamine and diethylamine are almost without action on New-blue R in aqueous solution, and only indifferent results are obtained when alcohol is used as solvent; the following method yields, however, satisfactory results:—New-blue R is triturated with a solution of copper sulphate (1 part of the salt to 20 parts of the dye), mixed with five times its weight of fine sand, and introduced into a flask of such a capacity that it is three-quarters full; the flask is closed with a treble bored cork and inverted; two tubes, one of which admits air and the other ammonia or the vapour of the amine which is evolved from another flask containing concentrated solutions of ammonia or the diamine, pass almost to the bottom: whilst a third tube connected with an aspirator reaches only a little beyond the cork, and is loosely packed with glass-wool. A drying apparatus is placed between the two flasks. The flask containing the base is heated in such a manner that only a gentle stream of the gaseous compound is evolved, whilst a brisk current of air is aspirated through the liquid; the reaction is usually complete in 3–4 hours. The product is exposed to the air in a thin layer for 2–3 hours, extracted with boiling water, the solution filtered and the dye salted out; the yield of "cyanamine" is 60–90 per cent. of the New-blue R employed. The Ammonia cyanamine may also be prepared by mixing New-blue R (31·5 grms.) to a paste with an equal weight of water at 80° C. until about half the latter has evaporated, and then with 15 cc. of a solution of cupric ammonium sulphate, introducing the mixture into a vessel surrounded with a freezing mixture, and slowly running in (at –10° C.) 10 cc. of a solution of dimethylamine (4·5

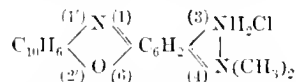
grms.). After about two hours the reaction is complete, and the dye is isolated as in the preceding method. The "ammonia cyanamine" is a somewhat strong base, the salts of which are stable in dilute solutions; the shades obtained with it are between blue and greenish-blue.

"Dimethylamine cyanamine" is also obtained in accordance with the equation—



When New-blue R (31 grms.) is mixed into a paste with an equal weight of water at 80° C., and then triturated with dimethylammonium acetate (21 grms.) and lead peroxide (25·9 grms.) at a temperature of 15°–40° for 2–4 hours, the yield is at most 80 per cent. of the New-blue R employed. This dye is the most valuable and beautiful of all the cyanamines; in the pure state it forms bright green needles, and is readily soluble in cold water; alkalis only slowly convert it into the free basis; it dyes cotton mordanted with tannin or tatar-emetic very beautiful fast greenish-blue shades; "diethyl cyanamine" closely resembles the dimethyl-derivative.

It is probable that in the formation of all the "cyanamines" a similar intermediate hydroxy-derivative to that given under "aniline cyanamine" (see above) is produced. "Ammonia cyanamine" is the simplest representative of this series of dyes, the others being substitution derivatives of it; its constitution, according to the author, is—



The value of the cyanamines as dyes will be seen by the following table, which shows their behaviour when boiled with soap and 10 per cent. soda solution respectively:—

Cyanamine of	Soap Solution.	Soda Solution.
Aniline	Brownish-red	Grey.
<i>o</i> -Toluidine	"	"
<i>p</i> -Toluidine	"	"
<i>m</i> -Phenylenediamine	Unaltered	Greenish-grey.
<i>p</i> -Phenylenediamine	"	"
<i>m</i> -Toluylenediamine	"	"
<i>p</i> -Amidodimethylaniline	"	"
α -Naphthylamine	"	"
β -Naphthylamine	"	"
Ethylaniline	"	Somewhat more stable.
Ammonia	"	Greenish-grey.
Dimethylamine	"	Unaltered or somewhat green and the colour fainter.
Diethylamine	"	"

A. R. L.

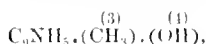
Applications of some New Dyes. H. von Perger. Mittheil. Tech. Gewerbe-Museums, 1891, 202–253.

See under VI., page 30.

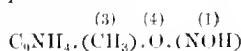
Studies on Derivatives of the Toluquinolines and of Metacryloquinoline. E. Noetting and E. Trautmann. Bull. Soc. Ind. Mulhouse, 1891, 285—324.

The two methylquinolines ($\text{CH}_3=1$ and 3) are prepared from *o*- and *p*-toluidine by Skraup's method, the yield being equal to that of the toluidine employed; whilst dimethylquinoline ($\text{CH}_3:\text{CH}_3=1:3$) is prepared from acetyl-*m*-xylydine ($\text{CH}_3:\text{CH}_3:\text{NH}_2=1:3:4$) by the same method; the reaction proceeds much less violently than when the free xylydine is employed. When quinoline is dissolved in sulphuric acid (10 parts) and to the cool solution nitric acid (1 mol.) mixed with sulphuric acid is added, afterwards sufficient of 20—25 per cent. fuming sulphuric acid to remove the water present, kept for some days in the cold, and finally heated on the water-bath, 4-nitroquinoline is formed (compare Koenigs, Ber. 12, 113; Claus and Kramer, Ber. 18, 1243).

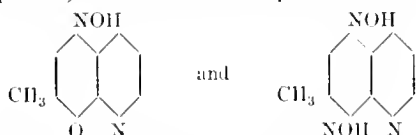
4-Nitro-3-methylquinoline is obtained by treating 3-methylquinoline dissolved in sulphuric acid (5 parts) with the calculated quantity of nitric acid of sp. gr. 1.39, mixed with three times its weight of sulphuric acid at 100°; the quantity of sulphuric acid used and the temperature at which the reaction takes place appear, however, to have no influence on the nature of the product. It crystallises from alcohol in small bright yellow needles and melts at 116°—117°; the *methiodide* melts at 189—190°; the corresponding *amido-derivative* melts at 145°, and gives an *acetyl-compound* melting at 160°; the *hydroxy-derivative*—



obtained from the amido-compound by the diazo-reaction sublimes in colourless needles and melts at 230°; is insoluble in cold water and not volatile with steam. On treating 3-methylquinoline with 25 per cent. fuming sulphuric acid at 90° a sulphonic acid is produced which yields the last-mentioned hydroxy-derivative on fusion with potash. *Methylquinolinequinone oxime*—



prepared by dissolving 4-hydroxy-3-methylquinoline in concentrated hydrochloric acid (2.5—3.5 mols.), cooling to 0°, adding sodium nitrate (1 mol.) and precipitating with sodium acetate, separates from alcohol in yellowish luminae decomposing without melting above 200°; it dyes cotton mordanted with iron a beautiful bright fast green. The latter property appears to be in opposition to Kostanecki's observation (this Journal, 1889, 698), namely, that only *o*-quinone-oximes colour mordanted fibres. Attention is drawn to the fact, however, that quinoline is a weak chromogen, and it has already been mentioned (this Journal, 1891, 356) that 1-hydroxyquinoline colours mordanted fibres; this may also be said of the higher homologues of the latter (see below), whilst it is not the case with those hydroxyquinolines, containing the hydroxyl-group in any other position, even carbostyryl belonging to the latter class. The quinone-oxime-derivatives of quinoline colour mordanted fibres when they are derivatives of an *o*-quinone, but not when they are derivatives of a *p*-quinone, unless a chromophoric group occupies simultaneously the position 1 (peri-position); thus of the two compounds—



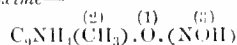
the second only possesses tinctorial properties.

1-Nitro-3-methyl-4-hydroxyquinoline, obtained by oxidising the corresponding quinone oxime with potassium ferriyanide, forms salts with acids and bases, but is not a dye.

1-Hydroxy-2-methylquinoline, prepared from amidocresol ($\text{NH}_2:\text{OH}:\text{CH}_3=1:2:3$), crystallises from dilute alcohol in long colourless needles, melts at 72°—74°, is volatile with

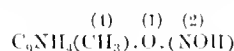
steam, and gives a green colour with ferric chloride; it dyes mordanted cotton, and when heated with copper oxide in the Bunsen flame imparts a colour to the latter resembling that produced by the halogens, a property which 1-hydroxyquinoline and its other methyl-derivatives also possess.

The *quinone-oxime*—

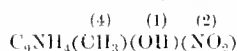


formed by treating the last described hydroxy-derivative dissolved in acetic acid with sodium nitrite (1 mol.), is not a dye, but 1-hydroxy-2-methyl-4-nitroquinoline obtained by oxidising it with potassium ferriyanide colours cotton mordanted with alumina, yellow, or with iron, brown.

1-Hydroxy-4-methylquinoline, obtained from amido-cresol ($\text{NH}_2:\text{OH}:\text{CH}_3=1:2:5$) crystallises from dilute alcohol in colourless needles, melts at 122°—124°, and dyes yellow with alumina mordants; the *quinone-oxime*—



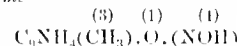
dyes green with iron mordant, and yields a *nitro-compound*—



melting at 205—206°, which dyes yellow with alumina and brown with iron mordants.

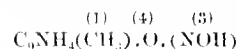
4-Nitro-3-methylquinoline, melting at 116—117° (see above) represents the chief portion of the product from nitrotoluidine ($\text{CH}_3:\text{NH}_2:\text{NO}_2=1:4:6$.)

1-Nitro-3-methylquinoline, prepared from nitro toluidine ($\text{CH}_3:\text{NH}_2:\text{NO}_2=1:4:5$.) yields on reduction with sulphuretted hydrogen in ammoniacal alcoholic solution, the corresponding *amido-derivative*, which melts at 62°—64°, yields an *acetyl-derivative* melting at 91°—92°, and the corresponding hydroxy-derivative by the diazo-reaction. The *quinone-oxime*—

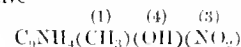


which colours mordanted fibres is obtained from the last-mentioned amido-derivative. 1-Amido-4-chloro-3-methylquinoline is formed, together with the non-chlorinated base (see above), when the nitro-methylquinoline is reduced with tin and hydrochloric acid; it crystallises from alcohol in pale yellow needles, melts at 129°—130°, and yields an *acetyl-derivative* melting at 136°—137°.

4-Nitro-1-methylquinoline, obtained by nitrating 1-methylquinoline with a mixture of nitric and sulphuric acid, or from nitro toluidine ($\text{CH}_3:\text{NH}_2:\text{NO}_2=1:3:5$) by Skraup's method, forms transparent yellow needles, melts at 93°, and gives a purple liquid rapidly becoming red on heating with alcoholic potash; the *amido-derivative* crystallising from dilute alcohol in long yellowish needles, and melting at 143°, is furnished on reduction with iron and acetic acid; the latter gives Skraup and Fischer's methylphenanthroline melting at 95°—96° when treated by Skraup's method; it also yields an *acetyl derivative* melting at 187°, and the corresponding hydroxymethylquinoline melting at 262°—263° by the diazo reaction. The *quinone-oxime*—



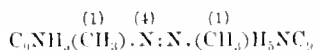
produced by treating the hydroxy-derivative dissolved in glacial acetic acid with sodium nitrite (1 mol.) decomposes above 200° without melting, gives insoluble lakes with the heavy metals, and colours fibres, mordanted with iron, green; the nitro-derivative—



formed by oxidising the quinone-oxime with potassium ferriyanide melts at 181°—182°, and does not colour mordanted fibres.

When 4-nitro-1-methylquinoline (12 grms.) is dissolved in a mixture of concentrated hydrochloric acid (40 cc.) and water (100 cc.) iron filings (10 grms.) being then added in small portions at a time, a red substance separates, which is

purified by repeated recrystallisation from hydrochloric acid, and is finally treated with ammonia and crystallised from glacial acetic acid, from which it separates in orange needles melting at 260°; this is found to be the *azomethylquinoline*—



the corresponding azoxy-derivative is obtained on adding ammonia to the united hydrochloric acid mother-liquors from the azo-compound, and extracting the precipitated compound with boiling alcohol, but it is best obtained by dissolving the nitromethylquinoline in a mixture of water (100 cc.) and concentrated hydrochloric acid (40 cc.) and slowly adding iron filings (6 grms.) with agitation; the pure substance melts at 201°, and gives the hydroxy-azo-derivative on heating at 110°–115° with concentrated sulphuric acid (10 parts).

1-Nitro-1 : 3-dimethylquinoline is obtained by dissolving 1 : 3-dimethylquinoline in concentrated sulphuric acid (200 grms.), adding a mixture of nitric acid of sp. gr. 1.39 (23 cc.) and concentrated sulphuric acid (50 cc.) and finally heating on the water-bath, or by treating nitroxyline $[(\text{CH}_3)_2\text{NH}_2 \cdot \text{NO}]_2 = 1 : 3 : 4 : 6$ according to Skraup's method; it crystallises from alcohol in long yellowish needles and melts at 107°–108°. The *amido-derivative* produced on reducing the preceding either with iron and acetic acid or with tin and hydrochloric acid, melts at 91°, and gives an *acetyl-compound* melting at 201°.

1-Hydroxy-1 : 3-dimethylquinoline is obtained from the amido-derivative by the diazo-reaction; it crystallises from chloroform in white tablets, sublimes in small needles without decomposition, and melts at 197°–198°.—A. R. L.

Metaxylenesulphonic Acids (II). G. T. Moody. Proc. Chem. Soc. 1891–1892, 189–190.

In a previous communication (Proc. 1888, 77), the author has described the preparation of 1 : 2 : 3-metaxylenesulphonic acid, and has called attention to the fact that only the 1 : 3 : 4-acid is formed on direct sulphonation of the pure hydrocarbon. Attempts to prepare the symmetrical 1 : 3 : 5-sulphonic acid have not yet met with success, the sulphonation of 1 : 3 : 4-acetmetaxylid failing to give the required substitution.

Acetmetaxylid (1 : 3 : 4) is readily sulphonated when heated for some time at 140° with $\frac{1}{2}$ times its weight of 20 per cent. anhydrosulphuric acid, and on boiling the solution after the addition of water, metaxylidine sulphonic acid $[\text{CH}_3 : \text{CH}_3 : \text{NH}_2 : \text{SO}_3\text{H} = 1 : 3 : 4 : 6]$ is obtained. It crystallises from water, in which it is only very sparingly soluble, in well-formed, slender needles, insoluble in alcohol and other common solvents; it does not change at 290°, and when heated to a higher temperature decomposes without having previously melted. The sodium salt, $\text{C}_6\text{H}_3\text{Me}_2\text{NH}_2\text{SO}_3\text{Na} \cdot \text{H}_2\text{O}$, is exceedingly soluble in water and crystallises in flat plates.

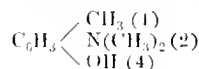
When the diazo-product is boiled with bromhydric acid, the corresponding bromoxyline sulphonic acid $[\text{CH}_3 : \text{CH}_3 : \text{Br} : \text{SO}_3\text{H} = 1 : 3 : 4 : 6]$ is formed. It crystallises in long, slender needles, and does not melt at 270°, but at a considerably higher temperature melts with decomposition. The sodium salt agrees with the description given by Weinberg (Ber. 11, 1062), who obtained it on bromination of a dilute aqueous solution of barium 1 : 3 : 4-metaxylenesulphonate; but the sulphochloride obtained by the author, which crystallises in splendid, oblique prisms, melts at 2° higher (62–63°), whilst the sulphonamide melts at 5° lower (189°) than found by Weinberg. The melting point of the sulphonamide agrees with that given by Sartig (Annalen, 230, 335), who prepared it by sulphonating metaxylidine, and subsequently replacing amidogen by bromine. It thus appears that both xylidine and acetxylid give the same acid on sulphonation, and that the displacement of hydrogen in the amido-group by acetyl does not lead to any change in the position taken up by the sulphonic group.

PATENTS.

Improvements in the Manufacture of Di-alkyl-meta-amido-cresols. H. H. Lake, London. From "A. Leonhardt and Co.," Muhlheim, Germany. Eng. Pat. 20,252, December 11, 1890. 6d.

DIMETHYL- and diethyl-meta-amido-cresols can be produced by diazotising the corresponding meta-amido-dialkyl-orthotoluidines and then decomposing the diazo-compounds with water, or by sulphonating the dialkyl-orthotoluidines and fusing the resulting sulphonic acids with alkalis at a high temperature. The meta-amido-dialkyl-orthotoluidines can be obtained by nitrating the dialkyl-orthotoluidines in sulphuric acid solution and then reducing the mono-nitro-compound thus formed. Details for the preparation of dimethyl-meta-amido-cresol from meta-amido-dimethyl-orthotoluidine and of the di-ethyl compound from di-ethyl-orthotoluidine are given in the specification. The former distils without decomposition and can be crystallised from a mixture of benzene and petroleum spirit; it melts at 76°, and dissolves readily both in caustic alkalis and in mineral acids. The latter is a thick oil boiling at 264°–267° C. Both products are of value in the colour industry in cases where the di-alkyl-meta-amidophenols are of less or no value, as, for instance, in the production of the blue basic dyestuffs obtained with the nitroso-derivatives of the aromatic amines (Eng. Pat. 13,565 of 1890; this Journal, 1890, 760).

The formula of the dimethyl compound is probably—



—C. A. K.

Improvements in the Manufacture of Indigo-carmin from Phenyl-glyceoll and its Salts or Ethers. B. Wilcox, London. From the "Farbenfabriken vormals F. Bayer & Co.," Elberfeld, Germany. Eng. Pat. 20,563, December 17, 1890. 6d.

By treating phenyl-glyceoll, its salts or ethers with fuming sulphuric acid at a low temperature, pouring into concentrated sulphuric acid, and subsequently diluting the solution with concentrated sulphuric acid, the phenyl-glyceoll is easily converted into indigo-carmin. The process is in fact an application of that described in Eng. Pat. 12,715 of 1890 (this Journal, 1891, 759). One kilo. of phenyl-glyceoll is mixed with 20 kilos. of dry pure sand and added to 20 kilos. of sulphuric acid containing 80 per cent. of anhydride, the temperature not being allowed to rise above 30° C. The yellow liquid thus obtained is mixed with sufficient sulphuric acid of 60° B. to convert all the sulphuric anhydride in excess into sulphuric acid. This produces a liquid of an intense blue colour, which is poured on to ice and the indigo-carmin formed salted out. The excess of anhydride can also be removed by passing moist air through the melt, but the conversion is slower than by the method above described.—T. A. L.

Improvements in Triphenylmethane Colouring Matters. S. Pitt, Sutton. From L. Cassella and Co., Frankfurt-on-the-Maine, Germany. Eng. Pat. 857, January 16, 1891. 6d.

VIOLET and blue colouring matters which are sulphonated derivatives of secondary and tertiary rosanilines are obtained by oxidising certain derivatives of diamidodiphenylmethane in presence of an aromatic amine, such as dimethylaniline or diphenylamine, in an aqueous or alcoholic solution. The following example illustrates the formation of a violet dyestuff:—Di-ethylidibenzyl-diamido-diphenylmethane disulphonic acid is prepared by heating 58 kilos. of ethyl benzyl aniline sulphonic acid with a concentrated aqueous solution of 3 kilos. of formic aldehyde on the water-bath for 12–24 hours. The solution is made alkaline with caustic soda and the sodium salt of the acid precipitated by salt. 60 kilos. of this acid are then dissolved in 1,000

litres of water and heated for 25 hours to 30—40° C. with 12 kilos. of dimethylaniline and 20 kilos. of potassium bichromate. After filtration, the disulphonate of the diethyl-dimethyl-dibenzyl-triamidotriphenylearbinol is salted out from the violet solution. The formation of this body may also be performed in one operation by mixing the solutions of ethyl-benzylaniline sulphonic acid (3 mols.), formic aldehyde (1 mol.), with the oxidising agent and heating for some time.—T. A. L.

Improvements in the Production of a Blue-Green and a Red-Violet Colouring Matter from Alizarin Blue. O. Imray, London. From the "Farbwerke vormals Meister, Lucius und Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 1354, January 24, 1891. 6d.

By acting with nitrosulphuric acid (containing sulphuric anhydride) on Alizarin blue a Nitro-alizarin blue can be obtained which on reduction yields an Amido-alizarin blue, both of which substances are very strong colouring matters. One kilo. of finely-powdered Alizarin blue is added, at 6° C., to 1.5 kilos. of nitric acid of 47° B. and 4.5 kilos. of sulphuric acid containing 20 per cent. of sulphuric anhydride, and the whole slowly heated to 20° C. When a sample, precipitated by water, washed and redissolved in sulphuric acid, does not show the characteristic spectrum of Alizarin blue, the melt is poured into a dilute soda solution, cooled with ice, and the sodium salt which separates is decomposed with an acid. The Nitro-alizarin blue forms a greenish-blue powder which crystallises from naphtha in fine scales. It may be used for dyeing and printing by itself or together with bisulphite. The conversion into the amido compound is performed as follows:—One kilo. of Nitro-alizarin blue is suspended in 50 litres of water containing 2.5 kilos. of a 35 per cent. caustic soda solution and 8 kilos. of glucose, and the whole heated to 70°—80° C. until a sample, decomposed by an acid, filtered and washed, dissolves in ammonia with a pure blue colour. The whole solution is then acidulated, and the amido compound formed filtered off and washed. In place of the glucose other alkaline reducing agents may be employed. The Amido-alizarin blue is a reddish-violet colouring matter twice as strong as Alizarin blue. It can be used for dyeing and printing similarly to the nitro compound.—T. A. L.

Improvements in the Manufacture of Colouring Matters. O. Imray, London. From the "Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 1737, January 30, 1891. 6d.

A RED colouring matter which dyes wool and cotton is obtained by reacting with the intermediate product, formed by combining one molecule of diazotised benzidine with one molecule of β -naphthol disulphonic acid G (Eng. Pat. 2213 of 1886; this Journal, 1891, 133), on the methyl, ethyl, and phenyl ethers of salicylic acid, or on *o*- and *m*-cresol carboxylic acid. These colouring matters may afterwards be converted into their methyl or ethyl derivatives, giving somewhat similar shades. The alkylated dyestuffs, however, resist the action of alkalis, and may thus be dyed from an alkaline or soap bath.—T. A. L.

The Manufacture of New Dyestuffs derived from Anthracene and Anthraquinone. B. Wilcox, London. From the "Farbenfabriken vormals Fr. Bayer & Co.," Elberfeld, Germany. Eng. Pat. 1883, February 2, 1891. 6d.

THE first part of this patent is an extension of Eng. Pat. 18,729 of 1890 (this Journal, 1891, 917), and describes the application of the process to dichloro- or dibromo-anthracene in place of the anthraquinone there employed. The specification then describes the sulphonation of "Alizarin-eyanine G" obtained according to Eng. Pat. 17,712 of 1890 (this Journal, 1891, 917). Another claim refers to the sulphonation of colouring matters obtained according to Eng. Pat. 12,715 of 1890 (this Journal, 1891, 759).

—T. A. L.

A New or Improved Material for Use in the Production of Colouring Matters. I. Levinstein, Manchester. Eng. Pat. 2682, February 14, 1891. 6d.

ACCORDING to this invention a new naphthylamine disulphonic acid is obtained in the following manner:—100 lb. of sodium α -naphthalene sulphonate are quickly stirred into 300 lb. of concentrated sulphuric acid previously heated to 150° C., and the mixture is kept at this temperature for 2—4 hours, forming a naphthalene disulphonic acid. After cooling to 10°—15° C., 45 lb. of nitric acid of 40° B. are run in, the temperature being kept below 40° C. The whole is then poured into 700 lb. of brine, when the new nitro-naphthalene disulphonic acid separates out. After washing with brine and pressing, the acid is dissolved in 400 lb. of water and reduced by boiling with 50 lb. of iron borings. When the reduction is complete, the mixture is made alkaline with soda, filtered, concentrated, and allowed to crystallise. The sodium salt of the new naphthylamine disulphonic acid thus obtained is filtered off, pressed, and dried. The same naphthalene disulphonic acid as above described is said to be obtained by stirring 60 lb. of naphthalene into 240 lb. of cold concentrated sulphuric acid and agitating the mixture until a sample dissolves in cold water. The whole is then heated with the addition of anhydrous sodium sulphate to 150—160° C. for 2—4 hours, or as long as may be necessary. The subsequent treatment is the same as above.—T. A. L.

Improvements in the Manufacture and Production of Colouring Matters. C. Dreyfus, Manchester. Eng. Pat. 17,635, October 15, 1891. 4d.

A PROCESS for preparing lakes from basic coal-tar dyes by precipitating the latter in presence of a neutral resin soap by means of a soluble metallic salt or of a salt of an alkaline earth. The lakes are soluble in benzene, "solvent naphtha," alcohol, ether, carbon bisulphide, chloroform, oleic and stearic acids, linseed oil, turpentine, &c., but are insoluble in petroleum and glycerol. They can be used for printing inks, paints, and also as paper-staining colours. (See also Eng. Pat. 2878 of 1886; this Journal, 1887, 138.)

—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Papyrus. Papier Zeitung, 1891, 16, 2528.

See under XIX., page 55.

Note on the Scouring of Wool of different Growths. J. J. Armandon. Monit. Scient. 1891, 1256—1263.

THIS paper contains a long list showing the percentages of suint, water, and scoured wool (dried at 100°) in 40 kinds of wool. All these wools are now on exhibition at the "Musée Méreologique" at Turin. The method of analysis employed is as follows:—500 grms. of wool are taken and treated with water rendered slightly alkaline. To 10 litres of water 200 to 250 grms. of soda crystals are added, and for each 100 grms. of wool 2 litres of water, containing about 50 grms. of soda crystals, are used. The wool is allowed to soak for three hours, agitating from time to time, at a temperature of from 60°—70°. It is then taken out and washed with water until the wash-water is clear. The wool is then pressed and dried upon a stretched linen cloth exposed to a current of air. After 20 days' exposure to the air and sun it is weighed and the drying is then continued until the weight remains constant. The loss of weight gives the suint plus the water lost by drying in air. A small portion of the wool is then dried at 100°, and the loss of weight noted.—H. S. P.

PATENT.

Production from Mineral Oils of Sulphonic Acids and Sulphones, and the Manufacture of a New Product by Treating Gelatinous Matter with Sulphonic Acid. A. M. Clark, London. From the "Gewerkschaft Messel," Grube Messel, Germany. Eng. Pat. 19,502, November 29, 1890, 6d.

See under III., page 22.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

The Determination of Indigotin in Indigo. F. Ulzer. Mittheil. Techn. Gewerbe-Museums, 1891, 178—184.

See under XXIII., page 63.

Grape-Seed Oil and its Technical Application. F. M. Horn. Mittheil. Techn. Gewerbe-Museums, 1891, 185—187.

See under XII., page 41.

Use of Sodium Tungstate as a Fixing Agent for Mordants. G. Ulrich. Mittheil. Techn. Gewerbe-Museums, 1891, 187—195.

THE employment of a 15 per cent. solution of sodium tungstate is recommended for fixing chromium, aluminium, tin, iron, nickel, cobalt, and similar mordants on yarns or fabrics composed of cotton, wool, or silk, or of mixtures of two different fibres. The material to be mordanted is impregnated with a solution of chromium acetate, basic aluminium sulphate, &c., and passed (in the case of cotton fabrics, preferably after drying) through the sodium tungstate bath, which is heated to 30°—40°. The mordants, which are fixed in the form of tungstates, give on dyeing shades which in point of brilliancy and fastness compare well with those obtained on the free metallic oxides. The cotton in a mixed fabric should be prepared with oleum before weaving, to ensure a regular deposition of the mordant on the fabric. This application of sodium tungstate has been patented in Germany (Ger. Pat. 58,171 of 1890).—E. B.

Experiments in Mordanting Wool with Iron. G. Ulrich. Mittheil. Techn. Gewerbe-Museums, 1891, 195—196.

Wool mordanted with cream of tartar (1 mol. per mol. of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) and ferrous sulphate dyes a dull grey-black with logwood. An addition of copper sulphate to the mordanting bath effects a marked improvement in the shade of black produced. The best results are obtained with 10 per cent. (of the weight of the wool) of ferrous sulphate, 8.15 of cream of tartar, and 3.6 of copper sulphate.

Also with the ferric mordant copper sulphate is found to be a useful addition. A rich black is obtained on dyeing with logwood wool which has been mordanted with iron alum (12 per cent.), cream of tartar (6 mols. per mol. of iron alum), and copper sulphate (4 mols.).

The logwood blacks dyed on the mixed copper-iron mordant are faster to light than those obtained on the iron mordant alone.—E. B.

Application of Alizarin Lakes for Colouring Candles, &c. G. Ulrich. Mittheil. Techn. Gewerbe-Museums, 1891, 198—202.

See under XII., page 44.

Applications of some New Dyes. H. von Perger. Mittheil. Techn. Gewerbe-Museums, 1891, 202—253.

Fast Green, blue shade (alkaline salt of sulphonated benzyltri- or benzyltetra-alkylated pararosaniline), is sold both as powder and paste, the latter a 10 per cent. solution in acetic acid. It dyes wool and silk a dark blue-green from an acid bath, the shades being fuller and faster than those yielded by Acid green. Concentrated sulphuric acid dissolves the dye with a golden-brown colour.

Acridine Orange (Eng. Pat. 8243 of 1890; this Journal, 1891, 537), is dyed or printed on cotton with tannic acid as mordant.

Pyronine (Eng. Pat. 13,217 of 1889; this Journal, 1890, 931) dyes silk, wool, or tannin-mordanted cotton a pink resembling Rhodamine.

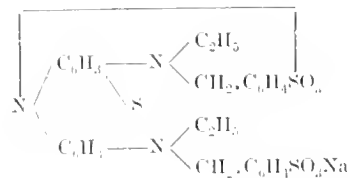
Toluylene Blue, (Eng. Pat. 2499 of 1890; this Journal, 1891, 132) a basic induline-dye prepared by the action of *p*-phenylenediamine on the induline-base of the formula $\text{C}_{30}\text{H}_{27}\text{N}_3$, gives on cotton mordanted with tannic acid dark shades of blue resembling indigo; alum and chromium acetate are added to the dye-bath, and the dyed cotton is passed through a boiling solution of potassium bichromate to darken the shade. The blue may also be dyed on unmordanted cotton from a bath containing acetic acid and sodium acetate. It is also suitable for wool and silk. It dissolves in concentrated sulphuric acid with a blue colour; alkalis precipitate the colour base; potassium bichromate gives a blue-black precipitate.

Rosinduline 2 B is the sodium salt of a rosindulone sulphonic acid (this Journal, 1890, 601); it dyes wool bluish-red from an acid bath; in applying it copper dye-vessels must be avoided. The dye is tolerably fast to light, but not so to soap. Of similar composition to this dye is *Rosinduline 2 G*, which is applied in a similar way, yielding scarlet shades. This dye exhibits on silk an orange-red fluorescence. Its fastness to light is inferior to that of the 2 B quality.

1-Naphthyl Blue, anilido-isonaphthylrosinduline, is obtained, together with phenylrosinduline by the action of phenylazo- α -naphthylamine on aniline. Silk which has been dyed with it shows a red fluorescence. It is faster to light than the indulines in ordinary use. Its blue-green solution in concentrated sulphuric acid turns successively blue and blue-purple on dilution with water.

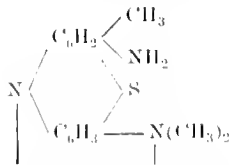
Azine Green (Eng. Pat. 3098 of 1890; this Journal, 1891, 132) is dyed on cotton by means of tannic acid, and is very fast towards dilute solutions of alkalis, acids, and bleaching powder.

Thiocarmine R is produced by the oxidation of a mixture of ethylsulphobenzyl-*p*-phenylenediaminethiosulphonic and ethylbenzylanilinesulphonic acids, and has the formula—



It is sold in the form of paste, which is employed for dyeing wool with the addition to the dye-bath of sodium sulphate and sulphuric acid. The blue shades produced are not fast to light. Concentrated sulphuric acid dissolves the dye with a green colour; acidulated stannous chloride decolourises it.

Toluidine Blue is the sulphate of trimethylthionine—



It is applied in the same way as Methylene blue, which it resembles.

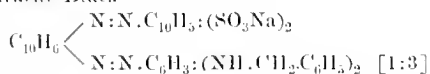
Methylene Green extra, the mononitro derivative of Methylene blue, is prepared from the latter substance by dissolving it in concentrated sulphuric acid, cooling to 0°, and adding the calculated quantity of sodium nitrite. It is faster to bleaching powder solution than Methylene blue, and also even faster to light than that dye. It colours concentrated sulphuric acid blue-green; alkalis yield a purple precipitate; acidulated stannous chloride decolourises it, the colour being restored by hydrogen dioxide.

Methylene Grey is a mixture of several dyes.

Nitrazine Yellow is manufactured by heating nitroxylylhydrazinesulphonic acid with dihydroxytartaric acid. It dyes silk and wool a more greenish shade of yellow than Tartrazin S, and on wool is faster to milling than the latter. It may be distinguished from the latter dye by the greater solubility of its barium compound, Nitrazine yellow not being precipitated by the addition of barium chloride to its hot aqueous solution.

Azo-green, prepared by diazotising *m*-amidotetramethyldiamidotriphenylcarbinol and combining the resultant compound with salicylic acid (Eng. Pat. 3398 of 1890; this Journal, 1891, 249), comes into commerce in the form of a paste, which dissolves in water with a green colour and in concentrated sulphuric acid with a brown. It may be fixed on cotton by means of tannic acid, and on wool on the chrome mordant. It is also recommended for calico-printing in conjunction with chromium acetate as a mordanting salt. Its fastness to light and soaping or milling is, however, scarcely satisfactory.

Anthracite Black—



is obtained from a naphthylaminedisulphonic acid by diazotisation and combination with naphthylamine and combination of the diazo derivative of the resultant compound with dibazyl-*m*-phenylenediamine (Eng. Pat. 4825 of 1889; this Journal, 1890, 172). It dyes wool directly with 4 per cent. of dyestuff a blue-black, which is fast to light but only moderately so to milling.

Chromotropes of the shade-marks 2 R, 2 B, 6 R, 8 B, and 10 B, are azo-dyes, which have the property, when dyed in the customary manner on wool (yielding shades ranging from scarlet to violet-red) of being transformed by the action of a boiling solution of potassium bichromate into blue-black, black, or green-black colours, whose fastness to light and milling is very considerable.—E. B.

The Dyeing of Black Hosiery. E. Frey. *Färber-Zeitung*, 1891, 53—54.

COTTON stockings and knitted goods are now generally dyed black with aniline, and the author describes the process as applied to stockings. The goods are first boiled for one hour with from 3 to 5 per cent. of their weight of soda in water, and then rinsed and soaked for half an hour in water at 40° C. containing from 5 to 10 per cent. of their weight of acetic acid. The goods are taken out of this bath, drained, and dried in a room maintained at 40° to 50° R. (50°—60° C.), when they are ready for dyeing. Two solutions are used for the dyeing process. The first is made by mixing 15 kilos. each of aniline salt, aniline oil of 4, and hydrochloric acid of 18 B. When cold, this mixture is added

to 50 litres of water containing 15 kilos. of sodium chloride. The second solution is made by dissolving 5 kilos. of copper sulphate, 100 grms. of sodium bichromate, and 500 grms. of concentrated sulphuric acid in sufficient water to bring the density to 4° B. A wooden trough is filled with the first solution diluted with water to a density of 8° B., and one litre of the second or copper solution is added and well mixed. The dry stockings are then immersed and well stirred about in the bath for half an hour, when they are taken out and drained, first on a rack and finally in a centrifugal machine. Each stocking is then drawn over a leg-shaped board, on which it is carefully smoothed out, and is placed in the oxidation chamber, where it is exposed to moist air at 45° R. (56° C.) for two hours. The stockings, now of a dark green colour, are taken off the boards and worked for a quarter of an hour at 30° R. (37° C.) in a solution of 3 per cent. of potassium bichromate, which fully develops the black colour. The goods are then rinsed and well washed in a washing-machine charged with 10 per cent. of oleme soap, 2 per cent. of soda, and 2 per cent. of ammonia, and after 40 minutes' treatment at 40° R. (50° C.) they are rinsed in water and dried.—G. H. B.

Aluminium Sulphate. *Papier-Zeitung*, 1891, 16, 2326—2328.

See under XIX., pages 52—55.

Applications of New Insoluble Azo Colouring Matters for Cotton Dyeing. A. Kertész. *Chem. Zeit.* 1891, 15, 701—702.

BEFORE the discovery of primuline the results obtained were more or less unsatisfactory, as no method of this kind existed for rendering dyes on cotton fast. Primuline contains a free amido-group which, if diazotised on the fibres, produces perfectly insoluble and fast dyes. L. Cassella and Co. are known to have prepared certain colouring matters, by treating benzidine and its analogous compounds with γ -amidonaphtholsulphonic acid, and it is interesting to note that the azo derivatives of this acid contain a free amido-group; it may, therefore, be expected that these will show the same property as primuline. This is actually the case, as Baeyer has proved, and the following colouring matters can be diazotised on the fibres: Diamine black RO, Diamine black BO, Diamine blue-black E, which, if developed with different substances, give indigo blue, dark blue, or blackish shades respectively, and Diamine brown V.

To these must be added Cotton-brown A and Cotton-brown N, which were known for some time previously.

The process of diazotising is an expeditious one, e.g., cotton treated with Diamine black and passed through the acid nitrite bath, at once changed to a light blue. In many instances it is advisable to wash the material after the diazotising process. Then follows the development by means of amido- or oxy-compounds. Experiments show that the best developers are β -naphthol for dark blue shades; naphthylamine ether for indigo blue; phenylenediamine or resorcinol for black; and Chrysoidine AG for brown. The developing baths are prepared in the following way:—

(1.) *β -Naphthol.*—1,450 grms. of β -naphthol and 1,200 grms. of caustic soda (40°) are dissolved in hot water and diluted to 20 litres. One-tenth litre of this solution is required for every kilo. of cotton, and at the beginning 2 litres have to be added for every 100 litres of water.

(2.) *Naphthylamine ether.*—The paste has to be dissolved in boiling water. Fifty grms. of paste are required for every kilo. of cotton, and at the beginning 1 kilo. of paste must be added for every 100 litres of water.

3. *Phenylenediamine.*—1,080 grms. of phenylenediamine are dissolved in 20 litres of hot water, the same quantities being used as of the β -naphthol solution.

(4.) *Resorcinol.*—1,100 grms. of resorcinol and 2,400 grms. of caustic soda (40°) must be dissolved and diluted to 20 litres, the same proportions being employed as for the β -naphthol solution.

(5.) *Chrysoidine AG*.—Four grms. of Chrysoidine AG (dissolved in hot water) are required for every kilo. of cotton; and at the beginning 10 grms. for every 100 litres of water. To keep the bath neutral, chalk is added at the rate of 5 grms. for every kilo. of cotton.

The diazotised materials are passed through the cold developing liquids for about 10 or 15 minutes, and then washed with water, or with water and soap. (Compare this Journal, 1891, 762—763.)—H. S.

Method for the Valuation of Extracts of Logwood.
v. Cochenhausen. Monit. Scient. 1891, 5, 943—948.

Up to the present, according to the author, there has existed no analytical method for the determination of colouring matters in extracts. If the oxidation of hæmatoxylin does not stop at hæmatein there is no reason why [extract of logwood should not contain all the possible oxidation products. Very little is known as to the functions of hæmatoxylin, hæmatein, and their further oxidation products in dyeing, and it is with the object of elucidating these points that the author has made the following experiments. (Compare this Journal, 1889, 612—618.)

Pure hæmatoxylin and hæmatein were employed in solutions of 0.5 per cent., except when otherwise stated. The percentages of dye and mordant refer to pounds of fibre dyed. The wool employed was mordanted (1) with 4 per cent. of commercial chromium fluoride and 4 per cent. of tartar; (2) with 1 per cent. of potassium dichromate and 0.33 per cent. of sulphuric acid; (3) with 1 per cent. of potassium dichromate and 2 per cent. of tartar; (4) with 6 per cent. of alum and 4 per cent. of tartar. The cotton was mordanted as usual with iron, strong and weak, with alumina, strong and weak, and with a mixture of iron and alumina. Some of the pieces were mordanted with 3 per cent. of tannin and a solution of aluminium acetate at 5° B. The dyeing operation lasted for one hour.

The results of dyeing wool and cotton mordanted as above in hæmatoxylin solution were the same; in both cases the samples mordanted with chromates were immediately dyed blue, while those mordanted with chromium oxide and alumina were not dyed at all during the first 20 minutes, and at the end of the hour only a much feeble shade than that obtained with the chromic acid mordants. When these experiments are conducted in vessels which yield alkali to boiling water, or with water which contains chalk or dissolved air, the shades obtained are totally different.

With hæmatein all samples, whether mordanted with chromium oxide or chromic acid, give the same colours.

The dyeing by hæmatoxylin of chromic acid mordanted fabrics is, then, due to the oxidation of the hæmatoxylin to

hæmatein by the chromic acid. The iron mordanted cotton dyed the same in both baths, apparently because of the oxidising action of ferric oxide on hæmatoxylin.

Inasmuch as hæmatein is capable of further oxidation to substances which have little tinctorial value, it might be expected that the more chromic acid is put into a fabric the less dyed it will be by hæmatein. Experiments showed that this is actually the case; when 6 per cent. of potassium dichromate and 2 per cent. of sulphuric acid were used, hæmatoxylin (5 per cent. solution) produced no colour in the fabric. Further experiments showed that this oxidation rapidly deteriorates an alkaline bath of hæmatoxylin, the hæmatein at first formed soon becoming further oxidised.

Dyers prefer decoctions to extracts of logwood; this is probably because the former, especially when made from fermented wood, contain more hæmatein and less foreign substances: for when wool is mordanted with potassium dichromate and acid, even if tartar be not present—and owing to its high price it is frequently omitted—some of the chromic acid gets reduced either by organic matter in the water or by the wool itself. When hæmatein is present it immediately forms a lake with the chromium oxide, while the remaining chromic acid is oxidising hæmatoxylin. When, however, only hæmatoxylin is present it has to be oxidised by the chromic acid, the chromium oxide meantime dulling the shade by combining with the foreign matters.

The author dismisses the methods of Houzeau (Dingl. Polyt. J. 190, 242) and Schreiner (this Journal, 1890, 976) for the valuation of logwood extract as being inexact, and adopts a comparative method in which a series of samples, mordanted according to a fixed prescription, are dyed with the extract to be valued and compared with the same series dyed with standard solutions of hæmatoxylin and hæmatein, arranged in diminishing arithmetical progression, viz.:—

0.5 per cent., 0.45 per cent., 0.4 per cent., 0.35 per cent., 0.3 per cent., 0.25 per cent. (*sic*), 0.2 per cent., 0.15 per cent., 0.1 per cent., 0.05 per cent.

The series of shades are obtained with the following wools:—(1), mordanted with 4 per cent. of chromium fluoride and 4 per cent. of tartar, and dyed in hæmatein; (2), mordanted with 1 per cent. potassium dichromate and 2 per cent. of tartar, and dyed with hæmatoxylin; (3), mordanted with 6 per cent. alum and 4 per cent. tartar, and dyed with hæmatein.

As hæmatoxylin gives a feeble tint to chromium oxide mordanted wool, 0.05 per cent. of hæmatein is allowed for this shade on such wool, while 0.025 per cent. is allowed for alum-mordanted wool.

The following table gives some of the author's results; the numbers in brackets indicate the hæmatein which would have been present in the original extract if that fixed by the wool be supposed to have been so present:—

	Source.	Price per 100 Kilos.	Hæmatein.	Hæmatoxylin.	Price per 100 Kilos. of Colouring Matter.
			Per Cent.	Per Cent.	
1. Logwood extract, NyD. solid.....	America	Sch. 96	— (2.5)	90	240
2. Sanford extract, solid	America	?	Trace (3.75)	35.6	?
3. Dubose extract No. 1, solid.....	France	105	Trace (3.75)	35.0	300
4. Dubose extract No. 2, solid.....	France	97	Trace (3.75)	32.5	299
5. Powder of hæmatein.....	Germany	150	7.5 (10)	40.5	316
6. I. Liquid logwood extract, 30	Germany	68	Trace (2.5)	16.3	417
7. I. Extract for printing	Germany	68	Trace (2.5)	8.8	773

Similarity of procedure is of course necessary for obtaining good results.

In the manufacture of logwood extracts no attempt should be made to convert hæmatoxylin into hæmatein by oxidising agents, such as chlorine; this should be left to the dyer, who can easily bring it about by addition of ammonia and exposure to air. The addition of calcium acetate is to be recommended.—A. G. B.

Report on a Prize Competition for a Practical Method of Preventing the Formation of Oxycellulose in Printing Discharges on Indigo Blue by Means of Chromic Acid.
A. Scheurer. Bull. Soc. Ind. Mulhouse, 1891, 484—486.

The method proposed was to soak the fabric, dyed with indigo, in a solution of sodium silicate of 2° to 4° B. before printing on the discharge. The author tested the method by making comparative trials, and the prepared samples

were printed with the ordinary discharge of alkaline chromate thickened with starch or gum. They were then placed for one minute at 50° C. in a bath composed of 160 grms. of sulphuric acid, 50 grms. of oxalic acid, and 790 grms. of water. After rinsing the samples were then boiled for 30 minutes with 10 grms. of sodium carbonate dissolved in a litre of water. The samples were then tested for strength in a "dynamometer," when it was found that the samples submitted to the sodium silicate treatment were not sensibly stronger than the others. By using a stronger solution of sodium silicate a somewhat more favourable result was obtained, but the discharge was then imperfect, and in fact the alkaline substance seemed to act no better than a thickener of the same viscosity in preventing the tendering action of the acid bath.—G. H. B.

On the Weakening of the Tissue in the Printing of White Discharges on Vat Indigo Blue. A. Scheurer. Bull. Soc. Ind. Mulhouse, 1891, 487—495.

THE first part of this research aims at fixing the limits of the variations to be introduced in the experiments on the various substances which are described in the second part. The method pursued is to print a discharge in a narrow stripe across a strip of cotton sheet 4 cm. broad and dyed with vat indigo blue. The strip is then placed in an acid bath to effect the discharge and washed; it is finally steeped in an alkaline bath to bring out the maximum weakening or tendering, which is measured by the breaking strain exerted in a "dynamometer." Briefly expressed, the author finds that an alkaline bath containing 10 grms. of sodium carbonate in a litre of water has no sensible effect on the tissue during 30 minutes at a boiling temperature, and that variations due to imperfections inherent in the tissue range up to 10 per cent., which is therefore taken as the unavoidable error of experiment. The full period of 30 minutes boiling in the alkaline bath was found to be required to develop the maximum weakening due to the action of the acid bath. It was immaterial to the result whether the strip was tested in the "dynamometer" in a wet or dry condition. Even considerable alteration of the strength of the acid bath did not affect the results beyond 10 per cent., but the effect was sensibly increased when the temperature of the bath exceeded 60° C. The substances whose powers of hindering the weakening of the tissue were to be tested, were added in quantities of 200 grms. each to 1 litre of the acid bath composed of 160 parts of sulphuric acid, 50 of oxalic acid, and 590 parts of water, and the operation of souring and washing of the printed strips were now conducted under the conditions determined by the preliminary experiments. Water, sugar, glucose, formic acid, tartaric acid, acetone, alcohol, and glycerin were experimented with, but the results obtained with the two last only were of interest. Alcohol had been for some years used in this way by Brandt, whilst glycerin was employed by H. Koechlin. The author finds that the protective action of glycerin is proportional to the quantity employed. Of the inorganic substances tried, sodium bisulphite, tin-salt, and arsenious acid stopped the development of the discharge, the sulphates of copper and cobalt increased the weakening effect, and the only favourable results were obtained with manganese chloride and tartar emetic.—G. H. B.

Means of Preventing the Formation of Oxycellulose in the Printing of Discharges on Indigo Blue. Brandt. Bull. Soc. Ind. Mulhouse, 1891, 496—497.

IN order to print a white discharge on cotton tissues dyed with indigo blue, the design is printed with an alkaline chromate solution thickened with gum, and the action of the oxidising substance is developed by a passage through an acid bath containing sulphuric and oxalic acids. But this acid bath is very detrimental to the cotton tissue, as the chromic acid set free gives rise to the formation of oxycellulose, the weakness or tenderness of which is still further increased by the subsequent washing in alkaline or soap solutions. The presence of oxycellulose may be shown by the method proposed by Witz, which consists in dyeing the

tissue with Methylene blue, which does not affect the unaltered cellulose, but dyes those portions converted into oxycellulose to a depth proportional to the degree of conversion. In order to impede the formation of oxycellulose in this kind of printing the author has for four years added 10 per cent. of alcohol to the acid bath with fairly satisfactory results. The weakening was very sensibly decreased, whilst a full discharge was obtained, and the Methylene blue test showed that the conversion of the fibre into oxycellulose was very small. Any kind of debaturated alcohol may be used, as the impurities do not interfere with the results. The author has used glycerin in a similar way with favourable results, but not so good as with alcohol.—G. H. B.

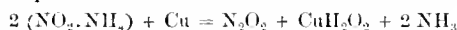
On a Special Process for Preparing "Sulphoricinate." A. Scheurer-Kestner. Bull. Soc. Ind. Mulhouse, 1891, 499—502.

THIS communication begins with the publication of a paper sealed and deposited on 31st July 1889 and opened on 29th April 1891, which states that De Milly was the first who succeeded in effecting saponification industrially by steam, and the author has extended this method to the preparation of Turkey-red oil.

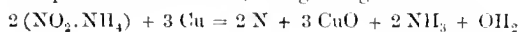
In an additional note the author now gives the results of his examination of the oil, and he finds that the fatty acid obtained in this way is not the normal ricinoleic acid, but an acid of a lower saturation equivalent and giving a more violet shade of red in the alizarin dyeing process. This acid gives a milky solution with ammonia, whilst normal ricinoleic acid gives a clear solution when neutralised with ammonia. Its molecular weight is 480, that of the normal acid being 298. In preparing Turkey-red oil by means of sulphuric acid, there results a mixture of sulphonated and non-sulphonated acids of normal constitution as well as polymerised, the effect of sulphonation tending to produce yellow shades, whilst the polymerisation is favourable to blue shades of alizarin. When a polymerised acid is saponified with soda below 80° C. it remains unaltered and the original acid is reproduced on acidification, but if the saponification be accompanied by prolonged boiling or conducted under pressure at a temperature above 100° C. the normal acid is formed.—G. H. B.

Properties of Cuprammonium. Prud'homme. Bull. Soc. Ind. Mulhouse, 1891, 510—512.

THE author traces an analogy between the action on cellulose of cuprammonium and hydrogen peroxide. In both cases oxycellulose is formed. Cuprammonium appears to have a stronger oxidising power than hydrogen peroxide on indigo blue, which it decolourises quickly. Mercerised cotton is also strongly attacked by it. The blue solution formed by dissolving copper in ammonia in presence of air becomes decolourised when left in contact with excess of copper in a bottle which is quite filled and stoppered, and the copper salt is reduced to the cuprous state. Ammonium nitrite treated with copper in the cold evolves nitric oxide according to the equation—



but in presence of ammonia, nitrogen is given off—



—G. H. B.

Note on a New Chromium Mordant. A. Scheurer. Bull. Soc. Ind. Mulhouse, 1891, 522—524.

THIS mordant is obtained by reducing potassium bichromate with sulphurous acid, and differs from potassium chrome alum by containing less potassium sulphate, and by having a green instead of a violet colour. It is prepared by adding 57 grms. of sulphurous acid to 88 grms. bichromate dissolved in 855 grms. of water. After printing the mordant may be fixed by exposure to ammonia gas. The substance remaining on the fibre is not chromic oxide but a basic

sulphate, which gives a different shade on dyeing. This mordant gives with nitroalizarin a yellowish-rose of great freshness. The same dye gives with a pure chromic oxide mordant a more violet and less brilliant shade.—G. H. B.

PATENT.

Improvements in or relating to Laundry Blue. J. Knowles, Bolton. Eng. Pat. 13,429, August 8, 1891. 6d.

See under XI11., page 45.

VII.—ACIDS, ALKALIS, AND SALTS.

Aluminium Sulphate. Papier-Zeitung, 1891, 16, 2326—2328.

See under XIX., pages 52—55.

Reduction of Oxygen Compounds by Magnesium. C. Winkler. Ber. 1891, 24, 1966—1984.

See under X., pages 39—40.

The Fusing Point and Crystalline Form of Aluminium Chloride. K. Seubert and W. Pollard. Ber. 1891, 24, 2575—2577.

ALUMINIUM chloride was prepared by heating the approximately pure metal in a stream of dry hydrochloric acid gas and its melting point taken by heating it in a capillary tube in a paraffin bath. The substance boiled up and sublimed at 175°—179° C. and the sublimate fused at 194° C. It crystallised in hexagonal tables about 1 cm. in diameter and 1 mm. thick.—B. B.

The Chlorine Industry. Laboratory Investigations.

A. Reychler. Monit. Scient. 1891, 1249—1256.

I. Regeneration of Manganese Dioxide.—In the Dunlop process for recovering manganese dioxide as carried out at the works of Messrs. Tennant at Glasgow, the operation of calcining the manganese carbonate is effected by circulating the material in small waggons through a special furnace, where it is gradually raised from a low temperature to a higher one (300°—400° C.), the operation lasting about 36 hours. The author finds that this time may be considerably shortened by simply heating the carbonate briskly upon an iron plate, taking care not to let the temperature rise to that of incipient redness. In this way he obtains in less than one hour a black pulverulent product containing 60 to 75 per cent. of available peroxide of manganese, which would be very suitable for industrial use if it did not also still contain too much carbonic acid. This product can be made richer in peroxide by moistening it with water to which nitric acid has been added equal to one-third or one-fourth of the remaining manganous oxide. The substance is then dried, and afterwards calcined for a couple of hours at 125°—260° C., when nitrous vapours equivalent to 9—10 per cent. of the nitric acid added are given off, and a product free from carbonic acid (but retaining sometimes a trace of nitric acid) is recovered, which contains from 91.5 to 93.5 per cent. of manganese dioxide. This treatment resembles the Kuhlmann process, but differs from it in only converting into nitrate the manganous oxide left after the first calcination, instead of converting the whole of the manganese into nitrate. If this modification of the Kuhlmann process had originally been worked conjointly with the Dunlop process, it is probable enough that it might have become an industrial process. The development of the chlorine industry, however, is now following another course.

II. The Weldon Process with Magnesia (modified).—

This process may be considered in two phases:—1st. The manganite of magnesia ($MnMgO_3$) is agitated with concentrated hydrochloric acid, giving a solution of manganous chloride and magnesium chloride, and liberating chlorine equal to about one-fourth of the chlorine in the acid used. 2nd. The solution of the chlorides is evaporated and the residue calcined in a reverberatory furnace with two compartments, similar to a salt-cake furnace. In the "pan" the material continues to lose water, but yields also hydrochloric acid and chlorine, and in the "furnace" it yields chiefly chlorine and becomes oxidised by the air, re-forming the manganite. The calcination must be conducted with the greatest care, on account of the easy fusibility of the mixed chlorides. The chlorine obtained is very much diluted and difficult to use.

(a.) *The Fusibility of the Chlorides* may be overcome by adding to them a certain amount of magnesium sulphate.

If equivalent quantities of magnesium chloride, manganous chloride, and magnesium sulphate, are melted together in their water of crystallisation and the mixture heated in a sand-bath, a solid residue, apparently dry, but still retaining, however, a certain quantity of water, is obtained. This residue may be calcined quickly at a red heat without fusing, and leaves a black mass which is tolerably consistent, very porous, and only retains a trace of chlorine. The sulphate of magnesium can be extracted from this mass by washing with water, and a black manganite remains which is easily attacked by acids and which contains about 47 per cent. of manganese dioxide. The formula $Mn_2Mg_3O_8$ corresponds to 47.67 per cent. of dioxide. This compound may be looked upon as a mixture of two oxides of the magnetic type in which magnesia replaces a part of the manganese $MnMg_2O_4 + Mn_2MgO_4$. The product of the calcination has the formula—



Such a mixture ought, in fact, to disengage chlorine from hydrochloric acid equal to one-fourth the chlorine contained in the acid used. The quantity of magnesium sulphate may be increased or diminished without affecting the composition of the manganite to any great extent. Other mixtures have been tried but none was so satisfactory as the Weldon mud mixed with magnesium sulphate.

(b.) *The Hydrochloric Acid and Chlorine liberated on Calcination.*—The author heated the dried residue of manganese and magnesium chlorides mixed with magnesium sulphate in a porcelain tube at a dull red heat and in a current of air. The temperature and the humidity of the air have an influence upon the nature of the gases evolved. The evolved gases were analysed by absorbing them in an alkaline arsenious acid solution of known strength; in one portion of the solution the unoxidised arsenious acid was determined and in another portion the amount of hydrochloric acid produced was estimated. The following are some of the results obtained: 1. Equivalent quantities of the three substances were used. The total weight of the dried residue was 13 grms. The air passed through the tube during calcination was saturated with moisture. 25.75 per cent. of the chlorine was liberated. 2. Twice the above amount of magnesium sulphate was used. The humidity of the air used was that of the atmosphere at the time of the experiment. 10.15 per cent. of the chlorine was evolved as HCl during the desiccation of the material, 67.65 per cent. as HCl during the calcination, and 22.2 per cent. as free chlorine. 3. The air before coming in contact with the substance was passed through a drying apparatus and then over a layer of fragments of sandstone heated to redness. Under these conditions 50 per cent. of the chlorine was evolved in the free state. According to Lunge, Weldon obtained a similar result.

The utilisation of this diluted chlorine is a difficult problem to solve. Weldon could scarcely make any use of it except for making chlorates or a solution of chloride of lime.

(c.) *Action of Hydrochloric Acid upon the Product of Calcination.*—When the residue, $Mn_2Mg_3O_8 + MgSO_4$, is treated with water or with hydrochloric acid, it becomes

heated and forms nodules of which the interior parts are withdrawn from the action of the acid. In practice, it would therefore be necessary to begin by grinding the calcined residue with a moderate amount of water, to let it settle, and then use the mud for making chlorine. In his laboratory experiments the author extracted the magnesium sulphate with water and used the insoluble residue for generating chlorine. It yielded chlorine equal to the theoretical amount, according to the equation—



A quarter of the chlorine of the acid is evolved as free chlorine. Weldon's manganite, to which he gave the formula, MnMgO_3 , also yields one-fourth of the chlorine in the hydrochloric acid used to dissolve it, a fact, however, which is not in accordance with that formula.

One of the difficulties, therefore, of the Weldon magnesia process, the fusibility of the mixed chlorides, has been overcome. The other drawbacks of the process, cost of evaporation and difficulty of utilising the dilute chlorine, still exist.

III. DE WILDE AND REYCHLER'S PROCESS.

(a.) *With Sulphate and Chloride of Magnesium.*—When a current of hydrochloric acid gas is passed over a calcined mixture of the sulphate and oxide of magnesium contained in a porcelain tube heated to a temperature rather lower than that of incipient redness, the greater part of the acid is absorbed and a certain amount of water is formed. If the product thus obtained be now heated to dull redness in a current of air, it evolves chlorine mixed with a certain amount of aqueous vapour and hydrochloric acid, and the original substance is regenerated ready to be again acted on with hydrochloric acid gas. The discovery of this fact is due to Prof. De Wilde. The author has investigated the reactions quantitatively in his laboratory. He finds that after the mixture of sulphate and oxide has ceased to absorb hydrochloric acid gas, it contains Cl—18·18 per cent., SO_4 —51·90 per cent., Mg—23·72 per cent., from which the following composition may be deduced:—

	Per Cent.
MgCl_2	24·33
MgSO_4	64·94
Mg(OH)_2	10·02
MgO	0·71

or—

	Per Cent.
MgCl(OH)	28·43
Mg_2OCl_2	2·40
MgCl_2	6·23
MgSO_4	64·94

The chlorination is therefore incomplete and is accompanied by an hydratine. The latter fact was also been noted by Mond and Eschellmann.

The reoxidation of the product requires an incipient red heat, or even a dull red heat. The air was dried before passing it over the substance, and was also heated to the temperature of the experiment by passing it first over a layer of heated fragments of sandstone. Allowing 1 litre of air to pass in 15 minutes, the gases evolved contained—

At the end of 20 minutes, 14·5 vols. per cent. of Cl and 38·5 vols. per cent. of HCl .

At the end of 56 minutes, 16·3 vols. per cent. of Cl and 40·44 vols. per cent. of HCl .

At the end of 92 minutes, 12·1 vols. per cent. of Cl and 0 vols. per cent. of HCl .

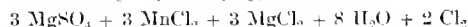
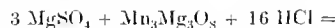
On continuing the experiment, 8, 6·5, 10·5, 10, and 9 vols. of chlorine per cent. were evolved according to the degree of heat employed. Even at a bright red heat the chlorine evolved only amounted to 12 to 13 vols. per cent. The drawbacks to the process are that the chlorine evolved is not concentrated, and that at the beginning of oxidation it is mixed with a large quantity of hydrochloric acid.

(b.) *With Magnesium Chloride, Manganous Chloride, and Magnesium Sulphate.*—Recognising the advantages of de Wilde's method, the author conceived the idea of applying the principle to other active substances, especially to the manganite of magnesium, and in this way as it were elaborating a *dry Weldon process*. The calcined mass employed was that having as already shown the composition $3 \text{MgSO}_4 + \text{Mn}_3\text{Mg}_3\text{O}_8$. This substance was treated in a porcelain tube with gaseous hydrochloric acid made from ammonium chloride and sulphuric acid, and raised to the temperature of the experiment by passing over heated fragments of sandstone. The reaction goes on best at a temperature below incipient redness, about 400° — 450° . At 300° very little chlorine is evolved, whilst at dull redness a considerable quantity of oxygen is evolved. In an experiment lasting five hours, during which the chlorine and hydrochloric acid which had been evolved during each hour were estimated at the end of each hour, the following results were obtained:—

	46·0	51·8	48·4	46·2	24·4	Mean
Vols. per cent. of chlorine.	46·0	51·8	48·4	46·2	24·4	43·4
Vols. per cent. of acid.....	33·3	35·2	51·6	51·4	75·6	49·4

In the tests made at the end of the first hour air was still present, whilst at the end of the second hour the gases evolved contained oxygen. Another experiment, lasting six hours, gave a mean result of 50·2 vols. per cent. of chlorine and 47·7 vols. per cent. of hydrochloric acid.

The chlorinated material obtained is still somewhat dark coloured, but shows numerous white particles. When powdered it has a light grey colour. It was found to contain from 31 to 36·5 per cent. of chlorine. It is probable that the manganese is converted into manganous chloride, and the magnesium chiefly into oxychloride slightly hydrated. The hydrochloric acid utilised may be calculated from the formula—



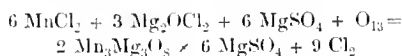
One volume of chlorine evolved corresponds to 8 vols. of HCl used. In the first experiment, therefore, the volume of acid utilised was $43·4 \times 8 = 347·2$. The total volume employed was $347·2 + 49·4 = 396·6$, which shows a utilisation of 87 to 88 per cent. of the acid employed. The percentage of acid utilised in the second experiment was 89 to 90 per cent. Making allowance for the fact that the magnesia is only about one-half chlorinated and forms oxychloride instead of chloride, one volume of chlorine evolved is equivalent to 6·5 volumes of acid, which gives therefore a utilisation of the hydrochloric for these two experiments, equal to 85 per cent. and 87 per cent. respectively.

Action of Air upon the Chlorinated Mixture.—On passing a current of dry air at constant speed over the chlorinated mixture heated to incipient redness (525°) the evolved gases contain from 16 to 20 volumes per cent. of chlorine. At a dull red heat or at a bright red, the percentage of chlorine may even rise to 25 per cent. Using 85 grms. of the substance, and a current of air passing at the rate of 1 litre in 8 to 10 minutes, from 5 to 6 hours suffice to expel about two-thirds of the chlorine present. Towards the end the evolved gases become weaker and contain from 12 to 14 vols. per cent. of chlorine.

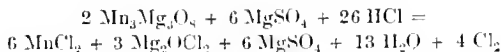
Treatment by a Mixture of Air and Gaseous Hydrochloric Acid.—The author has made numerous experiments to investigate this modification. As a general result, he finds that the concentration of the chlorine evolved is not much less than that obtained by the treatment of the chlorinated substance with air alone. But, on the other hand, there is not so great an economy of the hydrochloric acid by the mixed treatment, as it is far from reaching the utilisation of from 80 to 90 per cent. found by the alternating treatment (in an example cited the utilisation of the hydrochloric acid by the mixed air and acid treatment amounted to 50 per cent.).

The reactions that take place in the mixed air and acid process may be expressed by the two following equations:—

I.



II.



For descriptions of De Wilde and Reyche's process see also this Journal, 1890, 510 and 1128.—H. S. P.

The Action of Sulphurous Acid on Flowers of Sulphur.
A. Colefax. Proc. Chem. Soc. 1891—1892, 180.

DEBUS's statement that sulphurous acid has practically no action on sulphur is not confirmed. Sulphurous acid acts on flowers of sulphur at the ordinary temperature of the air, and produces thiosulphuric acid and a polythionic acid, probably trithionic acid. No pentathionic acid was found. According to Flückiger (Jahresbericht, 1863, 149), sulphurous acid gave, by its action on flowers of sulphur, thiosulphuric acid. The presence of a polythionic acid is proved by a comparison of the iodine titrations and the acidity titrations before and after the addition of iodine requisite for the iodine titration. It is thus shown that there is present a considerable quantity of an acid having no iodine titration, and which is not merely oxidised sulphurous acid. (Qualitative tests point to the presence of thiosulphuric acid, or trithionic acid, or a mixture of the two. Not even in the dark is sulphurous acid without action on sulphur. A higher temperature (say 80°—90° C.) favours the action of sulphurous acid on sulphur; water has no action on flowers of sulphur, either at ordinary temperatures or at this higher temperature.

PATENTS.

Improvements in the Manufacture of Barium Chloride and Strontium Chloride. M. N. D'Andria, Manchester. Eng. Pat. 1168, January 22, 1891. 4d.

The sulphides of barium or strontium, obtained by the reduction of the corresponding sulphates, are treated with a neutral solution of iron protochloride (a by-product from galvanising); the solution of alkaline earthy chlorides is filtered "from the remaining sulphide of iron formed" and is evaporated to crystallisation. In an alternate way of working the iron protochloride is furnished along with the sulphate and coal, and the chlorides dissolved out at once from the reduced mass.—H. A.

Process for Bleaching and Purifying Aluminium Sulphate.
O. Imray, London. From "La Société Anonyme des Anciennes Salines Domaniales de l'Est," Paris, France. Eng. Pat. 1261, January 23, 1891. 4d.

A product free from iron can be obtained by the addition of a sulphite, bisulphite, or hyposulphite (preferably of soda), or barium dioxide and dilute acid, or oxygenated water, to a slightly acid and nearly boiling solution of aluminium sulphate.—H. A.

Improvements in Apparatus for Concentrating Acids. W. C. Herrens, Hanau, Germany. Eng. Pat. 2499, February 11, 1891. 4d.

The platinum apparatus hitherto in use for concentrating sulphuric acid labours under the disadvantage of being attacked by concentrated acids. A coating of gold renders the vessel more durable, but up to the present no really satisfactory coating has been applied, and it has also been found impractical to repair such coated apparatus. The

invention consists in the production of such coating by heating the sheet platinum to a temperature higher than the melting point of gold, and then pouring the molten gold over it, in any convenient form of mould; the double sheet is then rolled out to any desired thickness. Vessels made from these double-sheets also serve as substitutes for gold pans.—H. A.

Improvements in the Manufacture of Caustic Alkali, Carbonates of the Alkaline Metals and Muric Acid, and of Bricks, Cakes, or Blocks for use therein, and Apparatus therefor. H. H. Lake, London. From The Kayser Patent Company, Jersey, U.S.A. Eng. Pat. 10,202, June 16, 1891. 1s. 1d.

The improvements refer to the decomposition of a mixture of clay and salt, for the production of the above enumerated substances. A tough mixture of clay (containing a proportion of 1½ lb. of silica to 1 lb. of alumina, to render the mass as refractory as possible) and of dense salt is moulded into cakes of cylindrical shape, provided with a central channel. The cakes are dried and hardened by gradual heating to 220°—250° F. in a special furnace, through which a current of hot air is passed. A contrivance is described for charging the furnaces, and keeping the cakes from breaking or pulverising, so as to maintain free access of the gases to all parts of the charge. There are four furnaces or converters, cylindrical on top and sufficiently conical on the bottom to allow the whole finished charge to roll out. Cooled generator-gas, or water-gas, or natural gas is forced in the top part of any of the converters, the inlet being above the charge and in tangential direction to the periphery of the converter, whereby a thorough and uniform heating of the charge is said to take place. The gases sink down and can be led by means of a vertical shaft from the bottom of a converter to the gas inlet of the next converter, or, by means of a downward extension of the shaft, to an underground passage, to be further treated for the recovery of hydrochloric acid. All connexions are provided with dampers. Air, steam, and gas are introduced together into any of the converters. A ring made of fire-bricks and provided with radial openings separates the gas passage on the bottom and its outlet from the interior of the converter. Below this ring is the discharge opening which is closed by means of a plate provided with tapholes and with a central opening.

In working the process the supply of gas, air, and steam, are so regulated as to obtain an oxidising flame. The charge is finished in about four days, and the operation is so conducted that the united gas mixture raises first the contents of a particular converter to white heat, the products of combustion, containing hydrochloric acid, being drawn off through the underground passage; with an increase of temperature some of the salt fuses and has to be drawn off through the tapholes on the bottom. Meanwhile the next converter has been heated independently, and when sufficiently hot to prevent the choking up of the passages with sublimed salt, the combustion gases from the first converter are admitted along with generator gas, and the escaping hydrochloric acid is again conducted into the underground passage. While this is proceeded with, the third and fourth converters are also heated independently, the former having been recently charged and the latter just finishing off.

The drawn charge consists of an acid, "sodium-silico-aluminate," which may be converted into the soluble basic salt by fusing with alkali (soda-ash); if the product so obtained contain only 40—42 per cent. soda, the action on the lining of the furnace will not be so destructive. The basic salt is next broken up and "leached systematically until the lye shows about one degree B." (1.5° Tw.). "The insoluble remainder is hydrous sodium-silico-aluminate with from 17—20 per cent. of sodium oxide." This is ground up, suspended in water, and boiled with milk of lime. The clear alkaline solution of 4°—5° B. (6°—7.5° Tw.) is utilised for leaching a fresh quantity of the basic salt. The residue of "hydrous calcium silico-aluminate" is washed in a filter-press, and produces on exposure to the air calcium carbonate, silica, and alumina,

a mixture which is "an entirely new article and capable of many practical applications" and "is furthermore distinguished by containing a very large quantity of chemically bound water when air dried (say 30 per cent.)."

An alternate way of working consists in omitting the leaching operation, and treating the basic salt direct with milk of lime or carbonic acid, for the production of caustic soda or sodium carbonate.

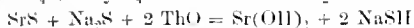
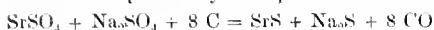
In a third alternate method the acid salt need not be converted into basic salt, but its mixture with calcium oxide or calcium carbonate is heated to a high temperature whereby sodium aluminate and insoluble "calcium-silico-aluminate" are obtained. The solution of the former may be decomposed with carbonic acid for the production of sodium carbonate, or treated with milk of lime for the preparation of caustic alkali, the secondary reaction being the precipitation of pure alumina (as much as 16—18 per cent.) in the first place, and of insoluble calcium aluminate in the second instance. The residual calcium-silico-aluminate may be calcined and utilised as a hydraulic lime.

The combustion gases passing from the converters to the underground flues contain hydrochloric acid and some volatilised salt. The gases are exhausted by means of a fan, and passed through a tower filled with coke for separating the salt, and from thence into condensers for the recovery of hydrochloric acid.

Fifteen claims are made and three sheets of drawings accompany the specification.—H. A.

A Process for the Production of Caustic Alkali, Carbonate of Alkaline Metals, and Useful Bye-Products. F. Eichstädt, Göteborg, Sweden. Eng. Pat. 15,136, September 7, 1891. 6.

"THE invention for the production of caustic alkali depends upon the interchange effected between sulphates of the alkalis and hydrates of the alkaline earths, barium and strontium, to form hydrates of the alkalis, and sulphates of the alkaline earths." Strontium hydrate is preferably employed for this purpose. "The strontium hydrate is preferably produced by the novel reaction produced by the sulphides of strontium and sodium in solution in water." (Compare C. F. Claus, Eng. Pat. 1096 of 1883; this Journal, 1883, 476), for which purpose the inventor proposes to roast equivalent quantities of strontium sulphate and sodium sulphate with a quarter of the weight of the mixture of coal and dissolving the melted mass in boiling water. The reactions can be expressed by the equations—



The strontium hydrate crystallises out on cooling, and may be purified by recrystallising; the mother-liquor from the strontium hydrate crystals, consisting chiefly of sodium sulphhydrate, may be utilised in various ways. Thus addition of sulphuric acid produces sodium sulphate, with evolution of sulphuretted hydrogen, which may be treated for the production of free sulphur or sulphuric acid. Or treatment with an insufficient quantity of sulphurous acid produces a certain amount of hyposulphite in the solution and a subsequent addition of sulphuric acid causes formation of sodium sulphate and of precipitated sulphur, but no evolution of sulphuretted hydrogen. Or the hydrosulphide of sodium may be oxidised atmospheric air, to produce hyposulphite, which is then treated with sulphuric acid.

The caustic soda solution, resulting from the treatment of the redissolved strontium hydrate with sodium sulphate, may be carbonated for the production of alkaline carbonate.

—H. A.

Improvements relating to Carbonic Acid Baths and Tablets for use therein. E. Sandow, Hamburg, Germany. Eng. Pat. 16,422, September 28, 1891. 4d.

THE bath consists of a solution of sodium bicarbonate, from which it is proposed to liberate carbonic acid, not with hydrochloric acid as heretofore, but with sodium bisulphate, cast in tablets of suitable shape, which can be

moved about in the bath. The gas may thus be generated near any part of the body. A "steel bath" may be produced by dissolving a melted mixture of sodium bisulphate and ferrous sulphate.—H. A.

Improvements in the Manufacture of Alumina. W. P. Thompson, Liverpool. From J. A. Bradburn and J. D. Pennock, Syracuse, U.S.A. Eng. Pat. 17,933, October 20, 1891. 4d.

THE object of this invention is the manufacture of alumina from bauxite, preferably from that variety of the mineral which contains the iron in the ferric state and is contaminated with but little or no organic matter. The difficulties connected with "the art of obtaining alumina from ferrous bauxite" are overcome by mixing the ground mineral with a solution of bleaching powder and passing carbonic acid through the mass; the chlorine thus liberated oxidises the iron and organic matter. The bauxite is then digested with a caustic soda solution containing, say, 150 grms. of Na₂O per litre, which extracts the bulk of the alumina. The solution is filtered off. Should the residue contain a paying quantity of alumina, it is heated with $1\frac{1}{2}$ to 1 $\frac{1}{4}$ parts of sodium carbonate, and the resulting mass lixiviated with the sodium aluminate solution previously obtained. The resulting tank-liquor has a turbid appearance, which is due to iron in suspension; it may be clarified by the addition of milk of lime, the gelatinous precipitate of hydrated alumina thus produced carrying down the iron with it.

The filtered and heated liquor is now precipitated with sodium bicarbonate, and after washing the alumina "with a reasonable amount of water," it is heated with a solution of ammonium chloride, which converts the soda into common salt. This is easily washed out, and the pure alumina is then filtered, dried, and calcined.—H. A.

An Improved Process for Manufacturing Nitrate of Ammonia or Chloride of Ammonia, simultaneously obtaining either Precipitated Phosphate of Lime or an Enriched Phosphate of Lime. L. Brummer, Wetzlar, Germany, and A. Zanner, Laeken, Belgium. Eng. Pat. 18,324, October 24, 1891. 4d.

THE poorer varieties of phosphates may be enriched by treating the phosphatic rock with a sufficient quantity of nitric acid to dissolve the impurities alone, which consist chiefly of calcium carbonate. A bi-calcium phosphate is obtained by increasing the quantity of nitric acid used, in order to dissolve the phosphate as well, and precipitating it with ammonia, gas-liquor, or milk of lime. The resulting solution contains in either case calcium nitrate, and in the latter case ammonium nitrate as well. Three alternate methods are given for converting this calcium nitrate into ammonium nitrate, viz.:—(1) Treatment with ammonium carbonate, or carbonic acid in a solution of ammonia, the by-product being calcium carbonate. (2) Treatment with ammonium sulphate, with simultaneous formation of calcium sulphate. (3) Small quantities of calcium nitrate may be precipitated with phosphoric acid, in presence of ammonia.

Instead of the nitric acid, hydrochloric acid may be employed for the production of ammonium chloride; or a mixture of nitric acid and sulphuric acid may be used with advantage.—H. A.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Manufacture of Glass Pipes of Large Diameter. L. Appert. Bull. Soc. d'Encouragement l'Industrie Nationale, 1891, 6, 114—121.

GLASS tubes of large size are costly when produced by the ordinary method of blowing, owing to the fact that none but the very best workmen can produce them. The ordinary method of coating only admits of the production of short tubes of considerable thickness. In this memoir improved machinery for casting or moulding such tubes is figured and described. The molten glass in the required state of fluidity is run into a strong iron mould, which is then closed, and the workman regulates the rapidity of passage of the spindle or core according to the dimensions of the tube. The mould is then opened and the tube taken out for annealing. With tubes of 100 mm. diameter, 15 can be made in an hour. Two metres is a usual length, which would give 30 metres an hour, but that 20 per cent. must be deducted for failures, giving an effective output of 24 metres an hour, or about 500 metres per diem.

Four men and a boy are employed in the work. The power (steam or compressed air) required for driving the cone or spindle is very slight. The facility of working is greater with the larger size of tubes.

The method of connecting the tubes depends on the use to which they are put, metallic joints being used for tubes designed for the passage of water at high pressure.—V. C.

A Method of Hardening Plaster Casts. M. Denstedt, Ber. 1891, 24, 2557—2558.

See under IX., next column.

PATENTS.

Improvements in Forming Under-cut Projections and Recesses in Tiles and other Articles of Pottery, and in Apparatus therefor. H. L. Doulton and S. H. Leech, Lambeth. Eng. Pat. 943, January 19, 1891. 8d.

IN this process under-cut projections or recesses are formed by pressing against the clay pieces or perforated sheets of india-rubber or other elastic material, one face of which is held, whilst the face next the clay spreads out laterally by the pressure. On one or more of the faces of the mould are fixed projections of india-rubber, furnished with projections if it is desired to make under-cut holes, or with holes if it is desired to make under-cut projections. When pressure is applied, the india-rubber spreads laterally on its face next the clay, whilst the surface in contact with the mould remains fixed. When the pressure is relieved the india-rubber resumes its former shape, which facilitates delivery.—V. C.

Improvements in Baking Ceramic Pastes and Pottery. C. G. Losada, Seville, Spain. Eng. Pat. 14,381, August 25, 1891. 11d.

THE invention consists in an improved continuous oven for baking ware, and in special interior fittings for the same. The advantages are as follows: The goods are only introduced into the oven when the latter is in proper condition for melting the glaze. Economy of fuel is said to be effected. Saggers and stilts are not required owing to the arrangement of trays of refractory material moveable on rollers. The process is capable of being regulated accurately, as the chambers are open at the ends and the progress of the operations can be watched.—V. C.

Improvements in the Liquid Material or "Slip" used in the Manufacture of Porcelain, Stoneware, and the like. E. Edwards, London. From K. Goetz, Karlsbad, Germany. Eng. Pat. 18,189, October 22, 1891. 4d.

THE process consists in preparing the liquid or "slip" by mixing the material used with an aqueous solution of carbonate of soda, bicarbonate of soda, calcined soda or soda ash, instead of mixing the material with water. One of concentrated solution to 1,500 of the material is sufficient. The following advantages are claimed over "slip" made by the ordinary process, viz., that the fluid pours better, articles being made in one mould which formerly required two or three. Articles can be made in moulds which ordinarily have to be turned or shaped separately. Increased rapidity of production. The articles are of more uniform quality and stronger. The mould can be used more frequently without drying. The shrinkage is considerably reduced, the temperature required is lower, and the grinding operations take less time. A further point connected with the same invention is the mixing of a small quantity of einnabar with the materials of the "slip" to prevent the swellings and the grey colour sometimes produced upon porcelain, especially at the edges, during burning.—V. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

A Method of Hardening Plaster Casts. M. Pennstedt. Ber. 1891, 24, 2557—2558.

THE method consists in immersing the plaster cast to be hardened in a solution of silicic acid so that it becomes saturated, and afterwards permitting it to dry so that the silica passes into the insoluble state and remains diffused throughout the mass. The article under treatment is then transferred to a saturated solution of barium hydrate kept at a temperature of 60°—70° C. for a short time, then removed and dried in a moderately warm place. Casts may also be hardened by the admixture with the plaster before casting of metallic hydrates (e.g. those of aluminium and zinc) and subsequent treatment with silicic acid, with which they unite to form silicates.

Coloured casts may be produced by treating the articles to be coloured with a weak solution of some suitable sulphate, such as sulphate of copper, before immersion in the hot solution of barium hydrate.—B. B.

PATENTS.

Improvements in and Apparatus for the Manufacture of Cement. W. R. Taylor, Rochester. Eng. Pat. 1115, January 21, 1891. 8d.

THE first improvement claimed by the patentee consists in mixing the raw materials (e.g. clay and chalk) for making cement by blowing them together, either powdered or suspended in water or some liquid hydrocarbon by means of a jet of air, steam, or other fluid. The materials thus prepared may be moulded into perforated bricks and burnt in a revolving kiln such as is described in Eng. Pat. 5719 of 1890 (this Journal, 1891, 466). The flue of the kiln is water-jacketed, the water thus heated being used for mixing with the raw materials or for boiler purposes. Another improvement consists in exposing the raw material in the form of bricks to the flue gases by means of a travelling band or other form of conveyor. A claim is made for drawing off carbon dioxide from the kiln flue and utilising it in the ordinary way. The waste heat of the kilns may also be utilised by introducing water pipes or coils at the top of the kiln or the flue in such a manner as not to impair the draught, the water being used in the same way as that circulating through the annular space between the flue proper and its outer covering.—B. B.

Improvements in the Manufacture of Artificial Roman Cement. C. von Forell, Brunswick, Germany. Eng. Pat. 1750, January 30, 1891. 4d.

THE patentee states that seeing that nearly all Roman cements contain more or less uncombined lime owing to the comparatively low temperature at which they are burnt, such cements may be mixed with raw materials rich in alumina, such as silicate of alumina, in such proportion that the ratio of the lime to the hydraulic factors is about 1.7 : 1. The aluminous material must be finely powdered. It is said that a material is thus obtained of much higher quality than ordinary Roman cement.—B. B.

X.—METALLURGY.

Reduction of Oxygen Compounds by Magnesium. C. Winkler. Ber. 1891, 24, 1966—1984.

THE results of Brauner's recent determinations and the author's present results have led to the relinquishment by the author of the view entertained by him as to the relegation of lanthanum to the 4th periodic group. His experiments on the behaviour of oxygen compounds when mixed with magnesium and heated in an atmosphere of hydrogen, have now been extended to the metals of the 1st, 2nd, and 3rd periodic groups.

The members of the 1st group do not yield hydrides under the conditions of the author's experiments, because the heat developed is sufficient to decompose any such compounds; the hydrides Na_2H_2 , K_2H_2 , for example, decompose at a moderately high temperature. However, under experiment, lithium and sodium hydroxides or carbonates underwent reduction with dangerous violence, and potassium and rubidium compounds developed great heat whilst with cesium hydroxide the action was so violent that ignition of the hydrogen ensued, and a sintered mass of cesium and magnesium oxides was obtained.

In Group II. the oxides of zinc, cadmium, and mercury, on account of the violence of their reduction, were not further considered, but the alkaline earthy oxides proved of great interest; as a rule, when the mixture of any of these oxides with the proper proportion of magnesium was heated in a current of hydrogen, at first an expansion took place, but as the heat was continued and increased, absorption of the gas ensued at a rate varying with the oxide under investigation. In some cases the continuance of high temperatures for some hours necessitated the employment of iron tubes for the experiments in this group. The products were always allowed to cool in an atmosphere of hydrogen, and were analysed as soon as possible after preparation.

Beryllium.—When a mixture of 25 parts by weight (1 mol.) of beryllium oxide and 24 parts by weight (1 atom) of magnesium powder was treated in the manner described, at a red heat, hydrogen absorption commenced but slowly, and progressed tardily but continuously, reaching a maximum in half an hour, then falling slowly from 10 to 4 bubbles a minute, at which it remained at the termination of the experiment at the end of four hours. The light brownish-grey product had not sintered. In contact with the air it emitted an unpleasant odour, and evolved hydrogen very sparingly with cold water, more decidedly with boiling water, but violently with dilute hydrochloric acid, in which case a considerable quantity of unattached beryllium oxide remained undissolved. The product could be heated in a porcelain crucible to incipient redness without alteration, but at higher temperatures it glowed and emitted a hydrogen flame; this flame, as well as the formation of water, were especially pronounced when the heating took place in a current of oxygen. The following was the composition of this product:—

BeH	BeO	MgO	Mg	Total.
3.33	45.10	45.05	6.24	100.00

showing that 14.96 of the beryllium employed had undergone conversion into hydride.

Magnesium.—A mixture of magnesium oxide and magnesium powder in similar proportions and under similar treatment behaved very much in the same way as the beryllium mixture. The product was almost white, had not sintered, and had the composition—

MgH	MgO	Mg	Total.
3.51	82.06	14.40	100.00

showing that only 6.42 per cent. of the original magnesium oxide had been reduced. It had an unpleasant odour, and even with cold water evolved hydrogen slowly with effervescence. Heated in the air, it first emitted a hydrogen flame, then glowed with dazzling brightness, and finally exhibited the luminous flame of burning magnesium. In oxygen, the hydrogen flame and the formation of water were better seen.

Calcium.—The behaviour of the mixture of calcium oxide and magnesium under the conditions of these experiments was not so sluggish as in the preceding cases; the absorption commenced tardily, but reached the rate of 120 bubbles a minute in half an hour, and was practically complete at the end of four hours. The slightly sintered, light grey product had the composition—

CaH	CaO	MgO	Mg	Total.
33.14	28.31	37.66	0.89	100.00

Hence 61.52 per cent. of the original calcium oxide had become converted into hydride. On exposure to the air it swelled up and fell to powder, and hydrogen was evolved from it most vigorously, either by the action of water or dilute hydrochloric acid. Heated in air it burnt faintly, and became surrounded with slightly luminous flame, whilst in oxygen it inflamed with slight explosion and burnt with great brilliancy, the hydrogen flame being distinct, and the formation of water abundant.

Strontium.—Strontium oxide was prepared from the pure carbonate, mixed with the suitable proportion of magnesium powder, and heated in hydrogen, when, after the preliminary expansion, absorption set in rapidly at an incipient red heat, but soon commenced to fall off, and terminated altogether within two hours. The slightly sintered, greyish-brown product was composed of—

SrH	SrO	MgO	Mg	Total.
66.23	4.17	28.93	0.77	100.00

indicating a conversion of 94.91 per cent. of the original strontium employed into hydride. It was very readily oxidised; in the air it at once turned grey, became hot, swelled up, and, with the evolution of hydrogen, formed strontium hydroxide. With water, it gave off hydrogen with effervescence. Heated in air or oxygen, it inflamed in the latter case with a slight report, showing a hydrogen flame at first, and then burning quietly itself. Impure strontium oxide, containing carbonate, was not only more troublesome to deal with, but also gave a less satisfactory result.

Barium.—With this metal also, some difficulty was experienced in getting a pure oxide and ultimately baryta of the following composition:—

BaO	Ba(HO) ₂	BaCO ₃	Al ₂ O ₃	SiO ₂	Total.
71.26	18.13	7.34	1.87	1.10	100.00

was employed, and in the experiments the precaution of heating up in a moderately rapid current of hydrogen, had to be taken to obviate disaster from the realisation of the reaction $\text{Ba(HO)}_2 + \text{Mg} = \text{BaO} + \text{MgO} + \text{H}_2$. This danger over, the end of the tube was closed, and at a red heat absorption set in with vigour and was complete in two hours. The product had the following composition:—

BaH	BaO	MgO	Al ₂ O ₃	SiO ₂	O (excess)	Total.
70.33	4.27	29.99	1.63	0.97	1.73	99.95 (100 in the paper.)

and resembled the strontium compound in character and reactions, the latter being somewhat more energetic in this case.

The author alludes to the probable existence of these particular hydrides in the glowing atmospheres of the sun and certain fixed stars.

Group III.—In this group neither boric anhydride nor alumina were reduced by this method of treatment. With yttrium oxide, however, absorption was moderate but distinct; it soon diminished, and stopped in an hour. The light brownish-grey product evolved hydrogen very slightly with boiling water, not at all with cold water, violently with hydrochloric acid, and when heated in air or oxygen burnt, giving a small flame feebly luminous in the latter case. It had the composition:—

Y ₂ H ₃	Y ₂ O ₃	MgO	Mg	Total.
12.88	72.56	10.15	4.41	100.00

Pointing to the conversion of 18.44 per cent. of the yttrium employed into hydride, this conversion is not as complete as in the case of lanthanum, but nevertheless shows that the latter is not the only member of periodic Group III. capable, when in the nascent state, of combination with hydrogen.—D. A. L.

On the Colloidal Sulphides of Gold. E. A. Schneider. Ber. 1891, 24, 2241—2247.

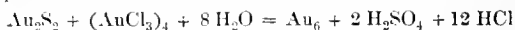
This is a paper on the preparation and properties of the colloidal sulphides of gold with reference to the occurrence of gold in nature.

The formation of "colloid solutions" by washing precipitates which previously had been treated with another compound in quantity insufficient to effect complete solution has already been observed. Wright (J. Chem. Soc. 1883, 43, 163), has stated that freshly precipitated sulphide of iron passes over into the colloid state when treated with potassium cyanide solution, so that a portion of it passes into solution. On washing the residual sulphide of iron with water, a portion of it passes through the filter and forms a colloid solution.

The present author has confirmed that experimentally. Indeed some years before Wright's observation the author had remarked that on digesting ferric hydrate with aluminium chloride solution, the former passes into solution, and if an excess of ferric hydrate be employed and the

washing continued till all salts are removed, a colloid solution is formed which is very similar in properties to the ordinary colloid ferric hydrate solution.

Gold chloride solution was incompletely precipitated with sulphuretted hydrogen, and the resulting liquid placed upon a dialyser; after the course of some hours the gold chloride solution had diffused through, while on the dialyser, however, instead of the expected auro-aure-sulphide, finely divided gold was found. Without doubt, the gold chloride had acted upon the auro-aure-sulphide according to the following equation:—



In point of fact, a mixture of colloid auro-aure-sulphide with gold chloride does give rise to a separation of metallic gold.

The following results were arrived at:—

1. That the separation of gold in nature is due to the action of sulphuretted hydrogen on solution of gold chloride; since the pyrites, which always accompanies gold, owes its origin to the action of sulphuretted hydrogen solution on ferric oxide compounds, at temperatures below 100°.

2. That the separation of gold is possible at a very slight depth, and where the temperature does not exceed 100°, since it is shown in the above paper that gold chloride separates gold from auro-aure sulphide (Au_2S_3) at temperatures much below 100°.

3. That the formation of pyrites has taken place nearer the surface than the separation of the gold; or that in any case the formation of pyrites and separation of gold were not simultaneous. For the mineral acids formed during the separation of gold by the action of gold chloride on auro-aure sulphide would require for their neutralisation a considerable thickness of rock.—H. K. T.

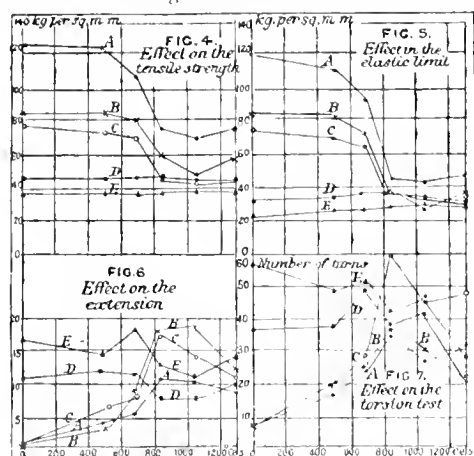
The Influence of Heat upon the Properties of Iron and Steel Wire. M. Rudeloff. Mitt. König. Tech. Versuchs. 1891, 109—140.

The material used for the purposes of the investigation was in the form of wire. Five samples were examined, three being wire ropes and two being telegraph wires. They had a tensile strength of 126.3, 84.7, 76.7, 45.1, and 36.3 kilos. per sq. mm. respectively (1 kilo. per sq. mm. = 1425.45 lb. per sq. in.), and were distinguished by the letters A, B, C, D, E. In order to ascertain what influence (if any) exposure to an elevated temperature in a lead bath had upon their chemical composition, analyses were made of three of the samples (A, B, and E) before and after they had been submitted to this treatment, with the following results:—

Heated to	Com-bined Carbon.	Silicon.	Man-ganese.	Sul-phur.	Phos-phorus.	Copper.
..	0.46	0.15	0.89	0.01	0.028	0.08
A. { 450°—560°C.	0.47	0.13	0.92	0.01	0.029	0.06
{ 780°—880°C.	0.32	0.17	0.96	0.03	0.021	0.05
..	0.15	0.04	1.10	0.03	0.093	0.04
B. { 450°—560°C.	0.17	0.03	1.09	0.03	0.095	0.04
{ 780°—880°C.	0.05	0.10	0.95	0.03	0.101	0.05
..	0.02	0.07	0.27	0.05	0.041	0.041
E. { 450°—560°C.	0.02	0.07	0.28	0.07	0.039	0.01
{ 780°—880°C.	Trace	0.08	0.28	0.07	0.041	0.02

Preliminary experiments were conducted to determine the best method of heating the test-pieces and the time during which it was necessary to subject them to the temperature of the lead bath. It was found that although the rapidity with which the full alteration in properties was produced, varied, yet a period of five minutes generally sufficed; this time was therefore taken for the rest of the experiments.

The result of these experiments is most compactly shown in the following tables of curves:—



INFLUENCE OF HEAT UPON THE PROPERTIES OF IRON AND STEEL.

The temperatures must be taken as approximate only.

Certain other experiments were carried out, both to confirm the results quoted above, and to determine the electrical and magnetic relations of the test specimens before and after heating; the conclusions arrived at are recorded below:—

(1.) The samples examined suffered no appreciable change by heating in a lead bath to 475° C. An alteration was first perceptible when the temperature reached 889° C., and was then confined to the diminution of the percentage of combined carbon. No lead was absorbed from the bath in any case.

(2.) The length of time during which the samples were exposed to a high temperature had an influence upon their tensile strength and extension, which varied with the character of the sample. The effect was the more marked the higher the tensile strength, but in all cases was complete in five minutes; in the case of sample A (crucible cast steel), although the chief change was effected in five minutes, yet a further alteration was perceptible in a second like period.

(3.) The tensile strength decreased as the temperature to which the test-pieces were subjected was increased, the conditions of time and method of cooling being the same. The effect of the heating was first perceptible at about 500° C., and in general was lower the higher the original tensile strength of the material. The change induced by heating was complete when the temperature reached 1,000° C. The extension and the number of turns in the torsion test increased with the increase of the temperature used, contrary to what was observed with the tensile strength. Exposure to a temperature somewhat under 500° C. merely caused an increase in the extensibility and homogeneity of the sample, wherefore it should be expected that in these respects galvanised wire should be superior to the uncovered material. The influence of an elevated temperature upon the extensibility of the wire was complete at about 900° C. It was found that of samples which suffered the same diminution of tensile strength by heating, the increase in ductility and extensibility was not necessarily similarly related when the origin and nature of the samples differed.

(4.) Exposure of the test specimens to a temperature of 800°—1,200° C. had but little influence upon their electrical conductivity: such influence as could be perceived appeared to be due rather to an alteration in the chemical composition of the samples than in their mechanical properties.

(5.) The temperature coefficient of the electrical conductivity and the magnetic moment of the samples decreased as the original tensile strength of the material increased. After heating, the temperature coefficient showed an increase which was greater the higher the tensile strength of the original material. (Compare Le Chatelier's

researches, this Journal, 1891, 373). The magnetic moment was but slightly affected by heating, the tendency being for it to increase. (Compare "Effects of Abnormally Low Temperatures on Structural Iron." This Journal, 1891, 1008.)—B. B.

Tempered Copper. B. Kirsch. Mittheil. Techn. Gewerbe-Museums, 1891, 261—267.

So-called tempered copper has been put upon the market by the Eureka Tempered Copper Company, samples of which were examined at the Versuchsanstalt für Bau- und Maschinen material with the following results:—

1. CHEMICAL COMPOSITION.

	Ordinary Copper.	Tempered Copper.
	Per Cent.	Per Cent.
Silver.....	0.025	0.025
Copper.....	99.930	99.981
Tin .....	.. ..	.. ..
Zinc .....	.. ..	.. ..
Iron	0.082	0.088
Aluminium .....	.. ..	.. ..
Arsenic	0.016	0.012
Phosphorus.....	0.017	0.018
Total	100.101	100.154

As will be seen from the foregoing analyses, the difference of tempered copper from copper of ordinary commercial quality, as far as its composition is concerned, is but slight.

II. MECHANICAL PROPERTIES.

The coppers of which the analyses are given above were mechanically tested, with the following results:—

	Strength in Kilos. per Sq. Mm.	Elastic Limit in Kilos. per Sq. Mm.	Extension per Cent.	Contraction in Area per Cent.
Tension, tempered	18.14	8.05	18.0	26.7
Tension, tempered	19.58	7.67	22.5	36.6
Tension, untempered....	16.30	7.13	21.0	36.6
Tension, untempered ...	17.17	7.08	22.5	35.7
Compression, tempered .	39.38	10.42	28.0	..
Compression, tempered .	37.20	9.93	26.8	..
Compression, untempered	33.12	9.62	27.4	..
Compression, untempered	36.21	11.20	27.6	..

* 1 kilo. per sq. mm. = 1425.45 lb. per sq. in.

The tests and analyses quoted above were carried out in America and are quoted for the sake of comparison with those performed at the Versuchsanstalt, which are as follows:—

(a.) **Modulus of Elasticity.**—The modulus of elasticity determined on a specimen tested in tension, was 10,050 kilos. per sq. mm. The modulus determined by compression test was 2,930 kilos. per sq. mm., with a load of 2.5 kilos. per sq. mm., and 1,020 kilos. per sq. mm., with a load of 7.2 kilos. per sq. mm.

(b.) *Tensile Strength.*

Test Pieces used.	Kilos.* per Sq. mm.
Sheet, 0·11 mm. in thickness	50·2
" 0·13 " "	67·9
" 0·55 " "	56·8
" 0·64 " "	53·4
" 1·19 " "	52·3
Wire, 0·59 mm. in diameter	31·8
" 0·80 " "	72·0
" 1·65 " "	52·0
" 2·60 " "	50·0
" 4·26 " "	47·6
Rod, 87 mm. in diameter.....	19·0

The last named specimen had an elastic limit of 8·1 kilos. per sq. mm. A compression test was made in which deformation began when the load had reached 8·1 kilos. per sq. mm. The load could be increased to 219 kilos. per sq. mm. without producing cracks, although the test piece, which was originally 30 mm. in height, had been shortened to 7·8 mm.

(c.) *Ductility.*—The extension given by the sheet varied between 0·2—2·0 per cent., while that of the wire was 0·1—0·2 per cent., and that of the rod 13·1 per cent., while the contraction of area at the point of fracture of the latter was 33 per cent. From these tests, as well as by winding tests with the wire, it appears that the material possesses great ductility.

The foregoing series of tests shows that tempered copper possesses properties that distinguish it from the ordinary material, its strength in pieces of small section being noticeably high, although that of larger test pieces is by no means remarkable, as it shows the tensile strength of only 19 kilos. per sq. mm., while ordinary commercial copper gives 20—25 kilos. per sq. mm. Castings made of it are of good quality, and its electrical conductivity is high.

—B. B.

"*Argentine.*" A. Harpf. *Papier-Zeitung*, 1891, **16**, 2584—2585, 2612—2614, and 2640—2642.

See under XIX., pages 55—56.

PATENTS.

Improvements in Apparatus for Concentrating Acids. W. C. Herrens, Hanau, Germany. Eng. Pat. 2499, February 11, 1891. 4d.

See under VII., page 36.

Improvements in the Manufacture or Purification of Steel or Homogeneous Metal. J. H. Darby, Brymbo. Eng. Pat. 2673, February 13, 1891. 6d.

THE author has previously described a method for the recarbonisation of iron or steel (Eng. Pats. 418 of 1888, 20,586 of 1889, 4030 of 1890; this *Journal*, 1890, 1134; and 1891, 469) by the direct introduction of carbon (see also Eng. Pat. 6303 of 1891, below). The present patent is a modification for the purpose of obtaining steel as free as possible from sulphur, phosphorus, arsenic, and manganese. The material used is basic pig iron low in silicon and sulphur, and containing phosphorus and manganese. In carrying out the process the basic pig iron is first converted into soft steel in a basic-lined hearth or converter. Its average composition when tapped would be: sulphur, 0·02 to 0·04 per cent.; phosphorus, 0·03 to 0·05 per cent.;

silicon, nil; manganese, 0·15 to 0·25 per cent.; carbon, 0·07 to 0·12 per cent. This product is next charged with carbon, by the methods described in the above patents, up to 1 to 1·5 per cent., and is transferred to a second basic-lined open-hearth furnace. 10 to 20 per cent. of grey hematite pig is added, and when the charge is thoroughly melted, it is worked in the usual way with limestone, lime and iron ore additions, if necessary. The charge is then tapped and recarbonised to any required extent. A separate furnace should be used for the second operation, since if a furnace is used which has been employed for phosphoric heats, it will take several charges to wash out the phosphorus contained in the basic lining and adhering slag. It is found that in the second melting and working the charge works freely, and does not froth, as is usually the case with hematite pig iron.—H. K. T.

Improvements in the Manufacture of Steel. J. H. Darby, Brymbo. Eng. Pat. 6303, April 13, 1891. 4d.

IN the methods patented by the author for the direct addition of carbon (Eng. Pats. 418 of 1888, 20,586 of 1889, and 4030 of 1890; this *Journal*, 1890, 1134; and 1891, 469), considerable difficulty is experienced in bringing the carbon into contact with the metal without great loss through combustion. In the present patent the ground carbon is mixed with the pulverised silicon, aluminium, nickel manganese, or other alloy of iron which has always to be used, and the two are added together through the chute or other apparatus employed for the regular addition of the carbon. (See also Eng. Pat. 2673 of 1891, above.)

—H. K. T.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

"*Argentine.*" A. Harpf. *Papier-Zeitung*, 1891, **16**, 2584—2585, 2612—2614 and 2640—2642.

See under XIX. pages 55—56.

The Electrolysis of the Metallic Sulphocyanides. L. K. Frankel. *J. Franklin Inst.* 1891, **13**, 144—150.

The Electrolysis of Metallic Phosphates in Acid Solution. E. F. Smith. *J. Franklin Inst.* 1891, **13**, 206—209. (See also this *Journal* 1890, 898—899.)

Electrolytic Separations. E. F. Smith and F. Muhr. *Ber.* 1891, **24**, 2175—2181; and *Amer. Chem. J.* 1891, **13**, 417—422.

See under XXIII., pages 60—61.

PATENTS.

A Method of Renewing and a Preparation for Firing Filaments in Incandescent Lamps. J. Möhrle, Munich, Germany. Eng. Pat. 16,613, October 18, 1890. 8d.

THE lamp is either divided longitudinally into two parts, or more usually pierced by an elongated opening with the help of a blowpipe. Through this opening the old filament is removed, the platinum wires cleaned, and a cement applied to their ends composed of pure carbon mixed to a paste with the solution of a salt of some metal that can be fused only at a high temperature, such as a saturated acid solution of platinum or copper. The ends of the filament are applied

to the cement-coated ends of the platins, and the joints hardened and rendered conductive by an electric current passed into each joint by one platinum wire, and led away by a copper wire temporarily introduced through the slit and pressed against the joint.—E. T.

Improvements in or Relating to Electric Accumulators. P. Lauber, Basle, Switzerland. Eng. Pat. 17,631, November 3, 1890. 8d.

THE inventor's battery, called an "Elektrothek," is to enable "any proportion of volts to ampères" to be obtained. A large number of lead plates are separated from one another by insulating frames so that a series of water-tight cells is formed, the whole resembling a filter-press open at the top, except that there is no liquid connection from cell to cell. In charging, a current is passed in at one end plate, through the whole series, and out at the other end one, each plate becoming positive on one face and negative on the other. The active material is retained in depressions or cavities in the faces of the plates. The number of plates depends on the voltage required, and their area on the rate of discharge.—E. T.

Improved Means and Apparatus for Separating Alkaline and Earthy Metals and other Products from the Salts of such Metals, or from other Substances containing them. G. J. Atkins and E. Applegarth, London. Eng. Pat. 20,768, December 19, 1890. 8d.

TAKING sodium chloride as an example, it is stated that oxygen and chlorine are liberated at the anode, that sodium hydrate is produced and dissolved in the liquid at the cathode, and that if the latter be of mercury, an amalgam of sodium and hydrogen will be produced. This amalgam, however, when concentrated, causes a very high back E. M. F., and therefore increases the cost of the process. To diminish this the inventors cause fresh mercury to be continually exposed as cathode, either by allowing fresh mercury continually to stream over the surface of the latter, or by causing the cathode, in the shape of an endless band, to be in continual motion, and to be constantly picking up fresh mercury and getting rid of the old.—E. T.

Improvements in or Appertaining to Mercurial Air Pumps. W. P. Thompson, Liverpool. From A. Raps, Berlin, Germany. Eng. Pat. 2969, February 18, 1891. 8d.

See under XXIII., page 60.

Improvements in Secondary Batteries. P. Goward, London. Eng. Pat. 7949, May 8, 1891. 8d.

THE positive electrode is a tube of lead enclosing a round perforated porous pot. A large number of Λ - or Ω -shaped incisions are made in rows round the lead tube so as to leave metallic tongues of these shapes. The space between the lead tube and the porous pot is packed with peroxide of lead, or with the finely-divided metal produced by pouring melted lead into cold water. When the packing has reached the first row of incisions the tongues of these are turned inwards, more layers of packing are added in the same way and bound in place by the metallic tongues till the whole space is full. The negative electrode is of zinc and rests in a tray of mercury. All parts are perforated to allow free circulation of the electrolyte, and bound together by bolts of suitable insulating material.—E. T.

Improvements in Electric Primary Batteries. T. J. D. Rawlins, Lymington, and A. Walker, Bristol. Eng. Pat. 9683, June 8, 1891. 6d.

THE electrodes are made in the form of vertical discs mounted on a spindle and are kept revolving. The lower parts only are immersed, and by the frequent exposure to the air, are prevented from polarising.—E. T.

Improvements in Galvanic Batteries. A. de Meritens, Paris, France. Eng. Pat. 10,977, June 27, 1891. By Internat. Convention November 28, 1890. 8d.

THE negative electrode is composed of a sheet of aluminium soldered or riveted to a sheet of lead. The positive metal is zinc and the electrolyte a mixture of two parts of sulphuric acid and one of nitric acid diluted with water. By local action between the aluminium and lead, the latter becomes coated with its sub-oxide. By the action of the cell this is reduced to metallic lead, only to be formed again by the local action. The cell gives a very constant current, and can easily give 25 ampères per square decimetre. Instead of aluminium, "plates of platinum or other metal unattackable by or possessing greater power of resistance to the action of the acids," may be employed. (See also Eng. Pat. 15,575 of 1891, below.)

Improvements in Means to be Employed in the Electrical Deposition of Copper and the Obtaining of Products from the Operation. T. Parker, Wolverhampton. Eng. Pat. 12,898, July 29, 1891. 8d.

IN the commercial deposit of copper, the solutions contain as impurities arsenic, iron, tin, bismuth, and antimony, and these are deposited with the copper if present in too large quantities, or if the voltage at the terminals of the bath should rise too high. To prevent this the electrolyte is passed through a series of baths, one of which has electrodes of only one-third to one-fourth the area of those in the other baths, so that the voltage at its terminals is raised. The foreign metals are here deposited readily, and the solution thus kept in normal condition for the other baths.

The deposit removed from the vessels consists chiefly of copper sulphide, silver, gold, and bismuth. It is roasted and then treated successively with dilute sulphuric acid to remove the copper, hot concentrated sulphuric acid to remove the silver, and potassium cyanide to remove the gold. The separate solutions thus obtained are electrolysed for the recovery of the metals they contain.—E. T.

Improvements in Methods of and Apparatus for giving Increased Life and Efficiency to Arc Light Carbons. N. M. Garland, New York, U.S.A. Eng. Pat. 14,379, August 25, 1891. 8d.

A hood or sleeve made of metal at its upper part and of refractory porcelain or such material at its lower part, is fitted over each carbon, so that only the pointed parts of the hot ends are free. Many devices are described for maintaining the position of these sleeves. Their object is to hinder the combustion of the carbons, and to lessen the resistance of the lamps by leading the current as directly as possible to the points of the carbons. There are 37 claims.—E. T.

Improvements in Galvanic Batteries. A. de Meritens, Paris. Eng. Pat. 15,575, September 14, 1891. 8d.

THIS patent (as in Eng. Pat. 10,977 of 1890, abstracted above) relates to methods of eliminating polarisation by constructing the negative electrode of two metals of different potentials in the liquid. Platinised lead is more especially referred to, the platinum coating only extending over parts of the lead. The lead is the negative electrode to the zinc, and is prevented from polarising (as in the above-mentioned patent) by the local action which takes place between it

and the more negative metal platinum. Various designs for electrodes and complete batteries are described in the specification.—E. T.

An Improved Galvanic Battery. C. U. Fisher, London. From R. H. Thompson, New York, U.S.A. Eng. Pat. 15,597, September 15, 1891. 6d.

The point of the invention is the construction of negative electrodes of carbonised fibrous material such as rattan. The material is used in the form of rods or in a spiral, but the inventor prefers the former. When rods are employed the ends are placed in a groove in a carbon plate, which forms the top of the cell, by a cement composed of powdered coke, lamp-black, and asphaltum, the whole being then carbonised together. The fibrous carbon is said to be mechanically preserved from polarisation by its corrugated surface and porous nature, and the whole cell to be better in this respect than a Leclanché cell.—E. T.

Improvements in the Method of Making the Plates or Elements of a Secondary or Storage Battery. S. C. C. Currie, Philadelphia, U.S.A. Eng. Pat. 15,621, September 15, 1891. 8d.

The inventor preferably employs as electrodes rods or wires of lead enclosed in a porous or fibrous covering, such as braided asbestos. These are rapidly formed by being made anodes in a solution of lime chloride, the lead chloride thus produced being held in place by the covering. The lead chloride can then be reduced to spongy lead by making the plates cathodes in the tanks and passing current for a sufficient time.—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Artificial Mineral Lubricating Oils—the Condensation Products of Alkyl Alcohol with Methylated Benzenes. G. Kraemer and A. Spilker. Ber. 1891, 24, 2785—2793 and 3164.

See under III., page 22.

On a Special Process for Preparing "Sulphorivinate." A. Scheurer-Kestner. Bull. Soc. Ind. Mulhouse, 1891, 499—502.

See under VI., page 33.

Grape-Seed Oil and its Technical Application. F. M. Horn. Mittheil. Techn. Gewerbe-Museums, 1891, 185—187.

The oil obtained from dried grape-seeds by extraction with a mixture of ether and alcohol has been examined by the author, with the following results:—

Specific gravity at 15°	0.9561
Fatty acid content (Hehner's number).....	92.13
Acid number.....	16.2
Saponification equivalent.....	178.4
Volatile fatty acids (per cent.)	0.46
Iodine number.....	94.05
Glycerin content (per cent.)	8.87
Acid number of fatty acids	187.4
Iodine number of fatty acids	98.05
Acid number of acetylated fatty acids	137.1
Saponification equivalent of acetylated fatty acids ..	281.6
Acetyl number	114.5

The oil dissolves at a temperature of 70° in an equal volume of acetic acid of sp. gr. 1.0562, the solution on cooling becoming turbid at 66.5°. It is only partially soluble in alcohol, but dissolves readily in ether. It gives the claudin reaction. Its close resemblance, chemically and physically, to castor oil, suggested its possible utilisation for the manufacture of Turkey-red oil. A small quantity of that product was, therefore, prepared by the action of concentrated sulphuric acid (1 part) on the oil (4 parts), and subsequent washing and neutralisation with ammonia (2 per cent.), a sample of castor oil being simultaneously treated in the same manner. The two preparations were then tested with regard to their comparative values for Turkey-red dyeing, and the resultant shades found alike in all respects.

Grape seeds may be obtained in considerable quantity in the wine-manufacturing districts on the Continent, and since they contain up to 20 per cent. of oil, the extraction of the same should prove highly remunerative.—E. B.

Application of Alizarin-lakes for Colouring Candles, &c. G. Ulrich. Mittheil. Techn. Gewerbe-Museums, 1891, 198—202.

In the course of a research on the constitution of the Alizarin-red lake, it was discovered that the Alizarin colour-lake prepared by dyeing aluminium oleate of the composition $\text{Al}_2\text{O}(\text{OH})_2(\text{C}_{18}\text{H}_{33}\text{O}_2)_2$ (obtained by double decomposition between potassium oleate and aluminium sulphate), is soluble in beeswax, paraffin, and ceresin, and is, consequently, well-adapted for colouring candles, &c.

As aluminium oleate does not melt at the temperature of boiling water and, therefore, does not dye well with alizarin, &c. it is better, before dyeing, to render it fusible in hot water by melting it with an equal weight of wax. The dyeing is accomplished by suspending in hot water the mass so obtained, and adding alizarin, &c. until it is sufficiently dyed, the bath being then allowed to cool and the solidified cake removed, washed with water, and dried. Colour-lakes were prepared in this way from Alizarin, Alizarin-orange, Alizarin-green, and Alizarin-yellow. The dark-coloured mass obtained by dyeing in this manner with alizarin, when diluted with from 30 to 120 times its weight of wax, gives dark to medium shades of red; with still further dilution, pinks. The presence of the alumina lakes does not interfere with the combustibility of the candles, &c., provided the amount present does not exceed 12.5 per cent.

Aluminium ricinolate is unsuitable for the manufacture of lakes for the above-mentioned purpose, as it separates on cooling from its solution in wax.—E. B.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

"Argentine." A. Harpf. Papier-Zeitung, 1891, 16, 2584—2585, 2612—2614 and 2640—2642.

See under XIX., pages 55—56.

The Sizing of Paper. J. Wunder. Chem. Zeit. 1891, 15, 702—703.

See under XIX., page 52.

PATENTS.

Improvements in the Production of "White Lead" or Basic Carbonate of Lead and Apparatus therefor. R. W. E. MacIvor and Watson Smith, London. Eng. Pat. 16,093, October 10, 1890. 8d.

In this process finely-powdered litharge is added to a solution of ammonium acetate while the latter is being circulated by means of a pump through a "digestor" and a "heater." By this means, it is claimed, the litharge is rapidly dissolved by the ammonium acetate, with production of tribasic acetate of lead, $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2 \text{PbO}$, and free ammonia. The temperature to which the solution is raised depends upon the strength of the ammonium acetate solution employed, the temperature ranging between 60° and 100°C . As soon as solution is effected the liquor is filter-pressed, the red lead and other coloured impurities from the litharge being left behind in the press while the clear solution of tribasic acetate of lead passes through a cooling system (when, if the solution be strong enough, partial crystallisation will take place) to the carbonator, where it is suitably treated with carbonic acid, for the conversion of the tribasic acetate of lead into a basic carbonate of lead. The basicity of the product is ensured by the presence of the free ammonia, which acts as a carrier of carbonic acid, the free ammonia becoming first converted by the carbonic acid into ammonium carbonate, which reacts with the tribasic acetate of lead to form basic carbonate of lead and ammonium acetate for use over again. To prevent over carbonation the carbonation is stopped while the liquid is still faintly alkaline. In this way, a white lead of great purity and basicity is obtained (see below).—O. II.

A New Product possessing the same, or nearly the same Properties as Spirits of Turpentine. T. Drake, Huddersfield. Eng. Pat. 16,916, October 23, 1890. 4d.

PETROLEUM spirit, shale naphtha or similar hydrocarbons are treated in a suitable vessel with a current of air preferably dried by passing over lime, whereby a product is said to be obtained having practically the same properties as spirits of turpentine extracted from pine-wood, and which may be used for similar purposes. Or, 40 per cent. of the said spirit is distilled off, thus increasing its specific gravity, and then treating the residue with chlorine gas until its specific gravity is brought up to 0.900 to 1.050. The acid formed in the treatment is removed by first blowing air through the chlorinated liquid and then washing it with sodium carbonate or with any suitable alkali or alkaline earth which is afterwards separated from the liquid "by any well known chemical process or processes."

—C. A. K.

Improvements in Copying Inks, Copying Books, and Appliances. H. Beales, Bristol. Eng. Pat. 17,373, October 30, 1890. 4d.

THE ink, which is said to copy effectively without water, brush, or press, is prepared with softened water, logwood, sulphate of iron, nut-galls, gum arabic, glycerin, cloves, and vegetable black. The inventor states that copies of letters and other documents written with this ink may be taken on ordinary press-copy tissue paper, by merely laying the hand on the tissue paper superposed on the writing, and drawing the hand over the same. The invention also relates to a specially prepared pad for steadying letters when laid for copying, consisting of a sheet of india-rubber stretched on cardboard.—E. G. C.

Improvements in the Manufacture of Basic Carbonate of Lead or White Lead. Watson Smith and W. Elmore, London. Eng. Pat. 19,323, November 27, 1890. 6d.

WHEN crude or impure litharge is used for the production of white lead as described in Eng. Pats. 10,426 of 1888, 6815 of 1889, and 16,093 of 1890 (this Journal, 1889, 552; 1890, 630; and above) the solution of tribasic acetate of lead

frequently contains copper and traces of iron, &c., which by repeated use of the ammonium acetate for dissolving fresh quantities of litharge gradually accumulate, and even if the precaution as described in the above patents be adopted of not quite fully carbonating, yet the last portions of the white lead precipitated are likely to be coloured brownish or yellowish. To avoid this discolouration, the carbonation is carried out (according to the amount of impurities present and as determined by previous laboratory experiment), so long as possible without precipitating the impurities along with the white lead. After removal of the highly-basic and pure basic carbonate of lead, the solution is carbonated as usual for the production of an inferior quality of white lead. By adopting these precautions, litharge containing considerable quantities of copper, rendering the litharge otherwise worthless for the purpose, can be used for the production of a white and highly basic white lead, the copper being retained in solution by the ammonia till near the completion of the carbonation.—O. II.

Production from Mineral Oils of Sulphonic Acids and Sulphones, and the Manufacture of a New Product by Treating Gelatinous Matters with Sulphonic Acid. A. M. Clark, London. From the "Gewerkshaft Messel" Grube Messel, Germany. Eng. Pat. 19,502, November 29, 1890. 6d.

See under III., page 22.

Improvements in the Manufacture of Basic Carbonate of Lead or White Lead. Watson Smith and W. Elmore, London. Eng. Pat. 19,784, December 4, 1890. 6d.

THE improvements relate to the purification of the ammonium acetate solution used for dissolving litharge in the production of basic carbonate of lead, when by repeated use for dissolving cupreous litharge it contains considerable quantities of copper. For this purpose carbonic acid is passed into the solution after the removal of the white lead fractions, as stated above in Eng. Pat. 19,323 of 1890, until all the remaining lead, or all but traces, is precipitated, when the solution is made slightly acid with acetic acid, and treated with finely-divided zinc or lead; or an electric current is passed through the solution either when acid or when slightly alkaline, electrodes of carbon or other suitable material being employed.—O. II.

Improvements relating to the Manufacture of Carbonate of Lead or White Lead, and to Apparatus therefor. W. Astrop, London, and F. H. Parker, Gravesend. Eng. Pat. 684, January 13, 1891. 6d.

THE "required quantity" of an alkaline carbonate is melted in a pot, and molten lead added to it and mixed; the pot is then removed from the fire and the mass poured out on the floor. It is then allowed to cool and sprinkled occasionally for about 48 hours with water, during which time it absorbs carbonic acid gas from the atmosphere. The product is thrown into a tank, washed, and the white lead filtered off, the alkali being recovered from the liquors by means of evaporation. The white lead formed is friable, and does not require grinding, and the patentees claim that their process is not injurious to health. There are five claims.

—F. H. L.

Improvements in or relating to Laundry Blue. J. Knowles Bolton. Eng. Pat. 13,429, August 8, 1891. 6d.

THE blue is pressed into moulds of such a form that the blocks possess corrugations or ribs on the surface, so as to expose a larger surface to the action of the water during use in washing, by which artifice it becomes possible to compress them more strongly than usual and lessen the tendency to "speaking."—F. H. L.

An Improved Anti-Fouling Composition for Ships' Bottoms.

A. McCowatt, Belfast. Eng. Pat. 14,160, August 21, 1891. 4d.

THE ingredients and approximate proportions used are the following:—(solids) oxide of zinc, 56; oxide of iron, 2·75; acetate of copper, 3·2; arsenic acid, 15·5; sulphur, 16·15; sulphate of manganese, 5·3; and camphor, 2; (liquids) boiled linseed oil, 16·4; coal-tar naphtha, 12·5; shale spirit, 14·2; turpentine, 23; colophony, 12·1; gum, 10·5; gutta-percha (crude), 9·1; and tallow, 2·2.—E. G. C.

Improvements in the Manufacture of White Lead. J. C.

Fell, London. From C. A. Stevens, New York, U.S.A. Eng. Pat. 16,098, September 22, 1891. 6d.

IN the manufacture of white lead, electricity has already been employed (J. K. Kessler, U.S. Pat. 292,119 of 1884, and T. D. Bottome, U.S. Pat. 414,935 of 1889), metallic lead having been "decomposed in an alkaline electrolyte into an oxygen-bearing salt of the metal, after which an attempt is made to convert the said salt into hydrated lead carbonate by the introduction of carbon dioxide into the electrolyte." A leading feature of this invention "consists in making the oxygen-bearing salts of lead insoluble in an acid electrolyte after their formation under the influence of an electrical current, by rendering the electrolyte neutral or nearly so, in which condition practically all of the hydroxide of lead present will be converted into hydrated lead carbonate upon the introduction of carbon dioxide." The following is a *précis* of the steps in the process of manufacture:—"The electrical decomposition of metallic lead in an acid electrolyte into an oxygen bearing salt of the metal, the neutralisation of the electrolyte after it has become charged with the oxygen-bearing salts of lead, and the conversion of the said oxygen-bearing salts into hydrated lead carbonate, and the precipitation thereof by the introduction of carbon dioxide either free or combined with the electrolyte."—E. G. C.

Improvements in the Manufacture and Production of Colouring Matters. C. Dreyfus, Manchester. Eng. Pat. 17,635, October 15, 1891. 4d.

See under IV., page 29.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

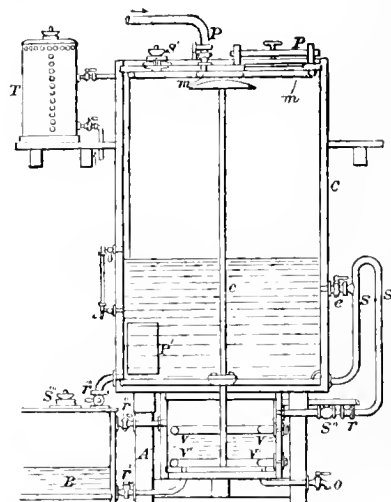
Manufacture of Tanning Liquors and Extracts. F. Jean. Monit. Scient. 1891, 5, 913—918.

THE high prices following the war of 1870 allowed foreign leather to obtain a firm footing in the French market, and ever since the native tanner has been endeavouring to overtake his competitors. To this end hemlock, chestnut, quebracho, mimosa, and spurge-laurel (*Daphne Laureola*), or extracts thereof, have been largely substituted for the more expensive oak bark. Unfortunately the fawn colour of oak-tannage is regarded by the purchaser as a criterion of the quality of the leather, and it is only by careful mixture of the above substitutes with oak bark that the inferior colouration which they impart to the leather can be sufficiently avoided. According to the author, the English and American tanners can tan leather in six or even three months, which by the French oak tannage in pits requires one and two years for production, because, not having to pay so much attention to the colour of their goods, they can employ a greater diversity of tanning materials and stronger extracts.

There is no doubt that although for some years past mixed tannages of chestnut, quebracho, mimosa, divi-divi,

and myrabolams with oak have been successfully employed, yet the French tanners have a deep-rooted dislike for the use of extracts. This is probably due to the fact that, notwithstanding the care with which such extracts may be made, the tanner finds it unsafe to use a tannage of whose origin, applicability to his special purpose, and accompanying colouring and other extractive matters he is necessarily ignorant.

But the utility, as a means of shortening the tanning process, of being able to add to the tannage, at a given moment, a liquor far richer in tannin than such as can be obtained in cold leaches, is now generally acknowledged. It is with the view of enabling tanners to make their own extracts of the required strength that the author has designed the apparatus here described. The fault of most extraction processes is that they are conducted under conditions favourable for the solution of much colouring and resinous matters and of substances resulting from the decomposition of the wood by action of too high a temperature and of air.



AUTOMATIC EXTRACTOR.

The automatic extractor consists of a wooden digester C.C. of about 5 cubic metres (176·6 cub. ft.) capacity, with a chamber A underneath it and communicating with it by means of the tube c, which descends to within 3 cms. (1·2 in.) of the bottom of A, and has a mushroom sprinkler h fixed on to the top end. The copper is connected with a vat B of about 3 cubic metres (106 cub. ft.) capacity, and with another vessel T. The siphon S allows of the drawing off of the liquid in the copper into the chamber A. The doors P and P' are hermetically sealed, and are opened only when fresh tan is to be inserted or spent tan removed. The tube m m, pierced with holes, distributes water from the pipe p.

1,000 kilos. (1 ton) of tan are introduced through the door P, which is then screwed down; water is allowed to flow in through m m until the tan has absorbed as much as it will and the water stands at the level of the top of the siphon S. The valve S' allows of the escape of air during the influx of water. After one or two hours' maceration the cocks r, r' and c are opened; the siphon fills itself, and all liquid above the level of e siphons into A—say about 250 litres (55 gallons)—the air in A being forced into B and through the valve S''. The cock r'' is now closed, and a current of steam passed through the coil v v fixed in A at two-thirds of its height. This vaporises some of the liquor in A, and causes sufficient pressure to force the liquid up the tube c (the valve s closing the siphon) back into the copper. When it has all passed over, the vapour in A follows, it escapes through S', and relieves the pressure; the valve s opens, and the liquid is once more siphoned over. This alternate action goes on automatically, the

volume of the water evaporated being made good by addition of low pressure steam from the vessel T, fed from a generator, or by water through the sprinkler pipe *m m*. When the density of a sample drawn from *o* no longer increases, extraction is complete, and the whole of the liquid contents of the copper are drawn off into the vat B.

The water retained in the tan will amount to two-thirds of the total added, and therefore two-thirds of the tannin dissolved will remain in the copper after it has been thoroughly drained into B. To displace this the cock *r* is closed and *r'''* opened; a slow stream of water is then allowed to flow through the sprinkler *m m* until two-thirds of the quantity originally used have passed. This will, of course, give a weaker liquor, which can either be mixed with the first quantity or used on a fresh quantity of tan in order to obtain a doubly strong liquor; to do this, the spent tan is raked out through P', fresh tan substituted for it through P, and the cock *r* opened. This allows some of the liquor in B to flow into A; here it is heated by the lower steam coil *v' v'*, and forced by the pressure of its vapour back into the copper; thus the intermittent extraction begins again and continues as before.

Figures are given in the original to show what sort of extracts may be expected from such an apparatus. One which would not occupy more than 2 sq. metres (21.5 sq. ft.) would easily yield, in 10 hours, 12,000 litres (2,640 gallons) of strong liquor.

The author recommends the use of oxalic acid for the removal of lime salts from hard water which is to be used for making tanning extracts, a slight acidity being favourable to the subsequent extraction. He also suggests the addition of hydrofluoric acid in small quantity to extracts in order to make them antiseptic and discourage the growth of harmful mycelium. The amount necessary is so small as to be in no way harmful to the skins while tanning.

The concentration of extracts until they solidify is best done by steam heat under diminished pressure.

The economical decolourisation of tanning extracts is a problem yet to be solved. Gondolo's method reduces the colour to a honey-yellow, and is often employed. It consists in neutralising the extract, adding blood, and raising the temperature, whereby a coagulum containing tannin albuminate and colouring matter is thrown down. Other methods are here mentioned. They are similar to those employed for decolourising other liquids, and are all objectionable as removing some of the tannin.

The analysis of a tanning extract should include:—(1) density; (2) substances insoluble in cold water, which should not exceed 2 per cent., except in quebracho extract, which may have 3—4 per cent.; (3) acidity, organic and mineral; (4) contents of tannin and gallic acid; (5) substances extracted by hide; (6) extractive matters; (7) substances possibly added to increase the density. To form some opinion of the extent to which the extract will colour the leather, some of it, diluted to $\frac{1}{2}$ B., may be macerated for 12 hours with pieces of unhaird skin plumped in water. After another maceration for 18 hours in a fresh portion of extract, the samples are exposed to the air and compared with standard samples prepared from known extracts. Bands of mordanted calico might be used for ascertaining the nature of the astringent matters in the extract, as suggested by Villon (compare this Journal, 1890, 820, 1157; 1891, 803 and 863).

The paper concludes with some remarks as to the position of tanning as a French industry.—A. G. B.

Chestnut Wood Tannin. H. Trimble. Jour. Franklin Inst. 1891, 132, 303—307.

Castanea vesca (Linn.) is a large tree of rapid growth, found in many parts of the United States. An extract of its wood and bark has been used in the United States and in France for many years, being especially useful in tanning, where it corrects the reddish colour of hemlock (see preceding abstract), and in dyeing, where it gives a dead black with iron salts. Extract of chestnut oak (*Quercus Prinus*, Linn.), is by no means the same, though doubtless often mixed with that of *Castanea vesca*.

The following analysis is of chips of the wood, free from bark, collected from a large tree about 40 years old, cut in August:—

	Per Cent.
Crystalline wax, melting at 50° C. soluble in hot 95 percent. and in absolute alcohol	1.03
Gallic acid.....	0.05
Resin.....	0.28
Tannin, extracted by absolute alcohol.....	3.42
Mucilage.....	1.15
Dextrin.....	1.89
Sugar.....	0.96
Tannin extracted by water	1.92
Pectin and albuminoids	1.46
Extractive, dissolved by dilute acid.....	2.95
Ash.....	7.08
Moisture.....	7.05
Cellulose and lignin	70.76
	<hr/> 100.00

The gallic acid may have been formed during the drying of the chips; determinations of tannin in a separate portion of the wood by gelatin and alum, and by permanganate and hide powder gave, respectively, 7.86 and 7.85 per cent.

For the identification of the tannin 2½ kilos. of the finely-powdered wood were extracted with commercial ether (about 74 parts of ether, 26 parts of alcohol, and a little water) by percolation. The residue from the ethereal extract was dissolved in water, filtered, and precipitated in three portions by "lead oxy-acetate"; the precipitates were decomposed by hydrogen sulphide, and the solutions, having been freed from excess of that reagent, were shaken with ether. Gallic acid was thus extracted from each. The tannin from the middle fraction was precipitated by addition of common salt to the aqueous solution; it was washed with a saturated solution of salt and dried over sulphuric acid *in vacuo*, then dissolved in a mixture of ether and alcohol, rapidly filtered and evaporated. To completely purify it the whole process was repeated.

The following reactions of this tannin are identical with those of gallotannic acid; but as they differ somewhat from those already published, they are reproduced here:—

Ferrous salts.....	No change.
{ Ferric chloride	Blue-black precipitate.
{ Ammonia added.....	Purple precipitate.
{ Tartar emetic.....	Slight clouding.
{ Ammonium chloride added ..	Pale precipitate.
{ Copper sulphate	No precipitate.
{ Ammonia added.....	Light-brown precipitate.
Bromine water	No precipitate.
Lime water	White precipitate, turning light blue.
Ammonium molybdate	Yellow colour.
Sodium sulphide	No change.
Concentrated sulphuric acid ..	Light yellow.
Sulphuric acid (1 : 9)	No deposit.
Lead nitrate.....	White precipitate.
Cobalt acetate	Flesh-coloured precipitate.
Manganese acetate.....	White precipitate.
Uranium acetate.....	Crimson colour, turning dark red.
Ammonium picrate	No precipitate.
Potassium bichromate	Brown precipitate.
Ferric acetate.....	Blue-black colour and precipitate.
Alkaloids	White precipitate.
Gelatin	White precipitate.
Lead acetate.....	Light precipitate.

The ultimate analysis of the tannin also agrees with that of gallotannic acid; so the author concludes that chestnut-wood tannin is gallotannic acid.—A. G. B.

The Application of the Alpha-Sulphonic Acid of Naphthalene to the Bating and Puring of Hides and Skins.
P. S. Burns and C. S. Hull. *Technology Quarterly*, 1891, 4, 191—193.

AFTER the unhairing of skins and hides by liming it is necessary to subject them to some process for the removal of the lime which has been absorbed by the hide fibre in order to avoid the formation of tannate of lime when the hide or skin is immersed in the tan pit, and the consequent discolouration, slow tannage, and brittle leather. This is the object of the bating and puring processes, which have heretofore consisted in immersing the hide in an animal or vegetable putrescent or fermenting solution, the substances employed being hen, pigeon, or dog dung, sugar, glucose, and bran. Such bates are accompanied by and dependent upon the action of bacteria, which by the dissolution of the gelatin of the hide bring about its depletion, and allow of the removal of the lime by subsequent mechanical means.

The authors' experiments show that the removal of the lime is assisted by the carbonic and phosphoric acids, and their ammonium salts, and the formic, acetic, propionic, lactic, butyric, and similar acids contained in the putrescent solutions. The loss of gelatin from the hide in the bate was found by experiment to amount to a minimum of from two to three per cent. of the weight of the dry hide; this loss would be nearly doubled in the tanned leather owing to the fact that leather may be considered to contain half its dry weight of tannic acid.

The removal of the lime by some acid with which it will form a soluble salt is the obvious method for avoiding this unfavourable action of putrescent bate; but all mineral acids and most organic acids which form soluble lime salts cause the hide to swell up and assume a transparent and gelatinous appearance, rendering it useless for making most kinds of leather.

In α -naphthalene sulphonic acid an agent was found which removes the lime without mechanical aid, and leaves the hide soft and white without any loss of gelatin; it is, moreover, an excellent antiseptic, effectually preventing the action of bacteria. This sulphonic acid is sold for tanners' use under the name "Acridene Antiseptic Bating and Puring Acid."

Two lots of 150 individually marked calf-skins, alike in condition and character and each lot weighing 880 lb. in the hair, were limed and unhaired in the usual way; one lot was then bated in hen-dung drench, and the other in 3 per cent. solution of the α -naphthalene sulphonic acid. The lots were then mixed and tanned in the same vats, and afterwards sorted into the original lots. The skins bated with hen dung made 255 lb. of dry leather, weighing 395 lb. when stuffed; those bated with the sulphonic acid made 266½ lb. of dry leather, weighing 413 lb. when stuffed. The stuffing was the same in each case, so that the difference in the bate caused a gain of 4.55 per cent. in the finished weight of the leather. "It was also noticed

that the hen-dung skins were very apparently lighter in the flanks and shoulders than those bated with the sulphonic acid." The safety with which this bate may be placed in the hands of workmen, and the abolition of stench, are further recommendations for its use.—A. G. B.

PATENT.

Improved Artificial Leather. J. Sadler, Mistley. Eng. Pat. 1634, January 29, 1891. 4d.

LEATHER waste from carriers and glove makers is shredded into small pieces and mixed in a tank with Portland cement, lime, glue, and paste in the following proportions:—Leather waste, 14 lb.; cement, 1 lb.; glue, ½ lb.; lime, 2 oz.; paste (sufficient to make the composition workable) made with wheat flour.

This composition is placed in trays to obtain the necessary quantities for the size and thickness of sheet required; it is then turned into linen sheets and compressed between steel plates by hydraulic pressure amounting to 2 tons and upwards per square inch. The leather boards thus made are dried either by exposure to air or in an artificially heated room.

It is claimed that such leather substitute is superior to any as yet invented, and can be advantageously used for inner soles and heels.—A. G. B.

XVI.—SUGAR, STARCH, GUM, Etc.

Researches on the Gums of the Arabin Group. Part II. Geddie Acid, Geddia Gums, the Dextro-rotatory Varieties. C. O'Sullivan. *J. Chem. Soc. (Trans.)* 1891, 59, 1029—1075.

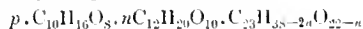
THE geddia gums consist of the calcium salts and small quantities of the magnesium and potassium salts of geddie acid, together with more or less albuminoid. Of the samples described, one contained but little nitrogenous matter, and the other two considerable quantities. Gum B. was diastatic, but did not invert cane sugar. The gums all dissolve easily in water, forming a yellowish or reddish syrup, which is neutral and dextro-rotatory.

The ash is separated by dialysing the acidified solution.

To obtain the pure gum acids, alcohol is added to the dialysed solution until a precipitate is produced; this is allowed to deposit and the clear supernatant liquid decanted. The addition of more alcohol produces a further precipitate, which is allowed to deposit, and so on until alcohol no longer produces a precipitate in the clear supernatant solution. By this method of fractional precipitation the whole of the albuminoid is obtained in the first precipitate; the other precipitates consist of a mixture of gum acids. The gum acids are separated from one another by repeating this fractional precipitation. The test of their purity is that a fraction on solution in water and fractional precipitation yields fractions possessing the identical optical activities and neutralising the same amounts of base. In this way the gum acids shown in the following table were obtained from two of the samples of geddia gum examined.

	Name.	Formula.	$[\alpha]_D$	Per Cent. of BaO in Barium Salt
Geddia gum I.	Tetr-arabinan-tri-galaetan-geddie acid	$4C_{10}H_{16}O_8, 3C_{12}H_{20}O_{10}, C_{23}H_{34}O_{19}$	+ 59	5.59
	Tri-arabinan-tri-galaetan-geddie acid	$3C_{10}H_{16}O_8, 3C_{12}H_{20}O_{10}, C_{21}H_{32}O_{17}$	+ 49	6.05
	Di-arabinan-tri-galaetan-geddie acid	$2C_{10}H_{16}O_8, 3C_{12}H_{20}O_{10}, C_{23}H_{34}O_{19}$	+ 43	6.75
	Mon-arabinan-tri-galaetan-geddie acid	$C_{10}H_{16}O_8, 3C_{12}H_{20}O_{10}, C_{23}H_{34}O_{19}$	+ 37	7.65
Geddia gum II.	Non-arabinan-tetra-galaetan-geddie acid	$9C_{10}H_{16}O_8, 4C_{12}H_{20}O_{10}, C_{22}H_{30}O_{15}$	+ 110	3.43
	Hept-arabinan-tetra-galaetan-geddie acid	$7C_{10}H_{16}O_8, 4C_{12}H_{20}O_{10}, C_{23}H_{34}O_{18}$	+ 100	3.53
	Pent-arabinan-tetra-galaetan-geddie acid	$5C_{10}H_{16}O_8, 4C_{12}H_{20}O_{10}, C_{23}H_{34}O_{18}$	+ 90	4.55
	Tri-arabinan-tetra-galaetan-geddie acid	$3C_{10}H_{16}O_8, 4C_{12}H_{20}O_{10}, C_{23}H_{34}O_{18}$	+ 80	5.40

The composition of any one of these gum acids may be represented by the general formula—

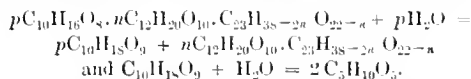


The gum acids which were soluble in the strongest alcohol were the most optically active and neutralised the least amount of base.

When an aqueous solution of any one of these gum acids containing 2 per cent. H_2SO_4 is heated at 80° – 100° for 10–30 minutes, the gum acid is hydrolysed to arabinon and a gum acid of lower molecular weight; the greater portion of the arabinon is at the same time hydrolysed to arabinose.

Under the above conditions the whole of the arabinan group is separated from the remainder of the molecule of the gum acid, and is hydrated to arabinon and arabinose, but by carefully restraining the reaction it is possible to obtain gum acids still containing a portion of the arabinan group.

The general reaction may be expressed as follows—

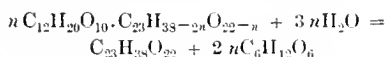


The gum acid may be easily separated from the sugar by precipitating the gum by alcohol, the alcoholic solution contains the sugar and sulphuric acid, the latter is easily removed by baryta and the neutralised filtered solution after concentration deposits crystals of arabinose.

On referring to the list of gum acids contained in the two samples of gum, it will be evident, that if any one of these from the same sample be hydrolysed according to the general reaction, the same gum acid will be obtained; but that the acids from different samples will be different. The following table shows the relationships of these gum acids with one another, and with that obtained from gum arabic under like conditions:—

Obtained by the Action of Sulphuric Acid on the Gum Acids contained in	Name.	Formula.	$[\alpha]_D$	Per Cent. BaO in Barium Salt.
Gedda gum III.	Penta-galactan-geddic acid	$5C_{12}H_{20}O_{10} \cdot C_{23}H_{38}O_{17}$	+ 30	6.51
Gedda gum II.	Tetra-galactan-geddic acid	$4C_{12}H_{20}O_{10} \cdot C_{23}H_{38}O_{15}$	+ 22	7.49
Gum arabic	Tetra-galactan-arabic acid	$4C_{12}H_{20}O_{10} \cdot C_{23}H_{38}O_{15}$ .....	..	7.49
Gedda gum I. ..	Tri-galactan-geddic acid	$3C_{12}H_{20}O_{10} \cdot C_{23}H_{38}O_{13}$	+ 20	8.81

These gum acids closely resemble the natural gum acids. They are, however, less soluble in weak alcohol, but their most marked difference from the natural gums is their behaviour when their aqueous solution containing 2 per cent. H_2SO_4 is heated. They offer great resistance to the hydrolytic action of sulphuric acid, but they are hydrolysed slowly, the final stage being represented by the general equation—



The slowness of this reaction as compared with the rapidity of the first may perhaps be partly explained by the fact that in the latter both the gum residue and the sugar residue are hydrated; whilst in the former, it is only the sugar residue that is hydrated.

The sugar produced in the last reaction is all galactose; the gum acid, $C_{23}H_{38}O_{22}$, is difficult to prepare in quantities sufficient to accurately determine its properties.

It is easy to stop this reaction at any stage and obtain gum acids still containing the galactan residue. One of these, $C_{23}H_{38}O_{22} \cdot C_6H_{10}O_5$, has been carefully examined and appears to be identical with an acid obtained under like conditions from gum arabic, except that whereas the acid from gedda gum is strongly dextro-rotatory, that from gum arabic is inactive.

These gum acids are very soluble in alcohol of all strengths except the very strongest, and are dialysable.

—A. L. S.

l-Sorbitol. E. Fischer and R. Stahel. Ber. 1891, 24, 2141.

THE syrupy hexahydric alcohol, obtained in the reduction of *l*-gulose, when purified by means of its benzal derivative and dissolved in 7 parts of warm 90 per cent. alcohol, is, in course of eight days, deposited in warty tufts of small needles, retaining much water. These crystals, after drying for three days over sulphuric acid in vacuo melt at 75° , have the composition $C_6H_{14}O_6 \cdot \frac{1}{2}H_2O$, and in fact resemble ordinary sorbitol in all but its optical properties. The latter in saturated borax solutions containing 8.69 per cent. of sorbitol and having a sp. gr. 1.043, is slightly dextro-rotatory, turning the plane at 20° in a 20 cm. tube, 0.25° , the specific rotation being $[\alpha]_{20} = +1.4$, whereas the

substance under investigation is levo-rotatory to the same degree, and is therefore undoubtedly, as already suggested, *l*-sorbitol the optical isomeride of ordinary sorbitol.—D. A. L.

Chemical Composition of Vegetable Cell Membranes.

E. Schulze. Ber. 1891, 24, 2277–2287.

IN this communication the author not only introduces new researches, but also summarises previous work (see this Journal, 1890, 878, 956, 1143, and 1151). Firstly, as regards those carbohydrates which are readily extracted from vegetable cell membranes by hot dilute mineral acids; four of this kind, yielding on hydrolysis galactose, mannose, pentagucose, and arabinose respectively have been discovered in the cell walls of numerous plant seeds, for example in the seeds of:—yellow lupin (*Lupinus luteus*), soja bean (*Soja hispida*), coffee bean (*Coffea arabica*), pea (*Pisum sativum*), bean (*Faba vulgaris*), cocconut (*Cocos nucifera*), palm nut (*Elais guineensis*), *Phania dactylifera*, *Tropaeolum majus*, *Paonia officinalis*, *Impatiens balsamina* and in the seedlings of red clover (*Trifolium pratense*) and vetch (*Medicago sativa*) the first of these carbohydrates is found, whilst the second is present in a great number of seeds, but the third and fourth do not appear to be so widely or profusely distributed. These particular portions of the cell walls, which are so readily attacked by dilute acids, on hydrolysis yield, almost without exception, a mixture of glucoses.

Turning now to the portions of the cell membranes less readily attacked by dilute mineral acids, the so-called celluloses, four new ones, one from white deal (*Picea excelsa*), one from rye straw (*Secale cereale*), one from red clover (*Trifolium pratense*) and one from sesame (*Sesamum indicum*) seed cake have been investigated. The wood cellulose was prepared by the sulphite method, and before use was extracted by boiling for some hours with 4 per cent. hydrochloric acid. To prepare the others the finely rubbed material was exhausted with ether, then with very dilute sodium hydroxide, then boiled four or five hours with 4 or 5 per cent. hydrochloric acid, then treated with F. Schulze's reagent (cold dilute nitric acid and potassium chlorate), being finally washed with warm dilute ammonia, water, alcohol, and ether. All four yield dextrose on hydrolysis with strong sulphuric acid by Flechsig's method, and the author has already shown that celluloses derived

from lupin grain, pea seeds, lupin pods, wheat bran, coconut cake, and coffee beans also yield dextrose under similar treatment, while Flechsig has proved the same to be true of cotton cellulose, making in all 11 celluloses from which grape sugar has been obtained.

The next point investigated was the kind of sugar, if any, which was associated with the dextrose in the products of these hydrolyses.

In concluding remarks on the nomenclature of the different chemical constituents of vegetable cell membranes, it is suggested that the name "cellulose," if used without an adjunct, should signify the cell constituent which is only slightly attacked either by dilute mineral acids, dilute alkalis, or by F. Schulze's reagent, but which dissolves in ammoniacal copper oxide and yields dextrose on hydrolysis. If, however, the name "cellulose" be applied as a group-name, it is proposed to name the last-mentioned cell constituent dextroso-cellulose, and the cellulose-like compound which yields mannose on hydrolysis mannos- or manno-cellulose. It is not considered that the wood-gums are sufficiently investigated to be included in this scheme of nomenclature. Hemicelluloses is the generic name proposed for those cell membrane constituents which are so readily converted into glucoses by the action of dilute mineral acids, whilst the individual carbohydrates are to be named galactans, arabans, xylans, &c., according to the sugar produced by the hydrolysis; and when two sugars are produced, such names as galacto-araban, galacto-mannan are to be used. Varieties can be distinguished in the usual way by the use of α , β , γ , "meta," and "para."

Of all the vegetable cell membrane constituents, the semi-celluloses are characterised by the readiness with which they are attacked by reagents; the action of hot dilute acids has already been noted. Lifschütz's mixture of sulphuric and dilute nitric acids appears to destroy them completely even in the cold. They dissolve readily when heated with dilute alkalis, being converted into a soluble variety; moreover, 5 per cent. sodium hydroxide attacks them, although but slowly.—D. A. L.

Organic Acids from Beetroot Juice. E. O. von Lippmann, Ber. 1891, 24, 3299—3306.

THE author has already stated that the lime precipitates which form in the evaporating apparatus, more especially at the commencement of the *campagne*, and in dealing with unripe roots, frequently carry down with them malic and tartaric acids, besides numerous other organic acids; the present communication is a summary of his results.

The acids, obtained from the crude calcium salts, were repeatedly converted into the lead salts and again decomposed into the acids. Ordinary levo-rotatory malic acid and dextro-rotatory tartaric acid were separated by crystallisation, and glutaric acid by taking advantage of its solubility in ether; the latter has not hitherto been observed as a constituent of vegetable products, and its occurrence is of especial interest in the present case on account of its close relationship to glutamic acid, to glutamine, and to α -hydroxyglutaric acid, the first being present in beetroots, whilst the two latter have been found in molasses (Ber. 1882, 15, 1156). The α -hydroxyglutaric acid from molasses has a specific rotation $[\alpha]_D^{19} = +1.76$, whereas that examined by Ritthausen (J. prakt. Chem. [2], 5, 351) had a specific rotation $[\alpha]_D = -1.98$; the two are, therefore, optical antipodes. Two sediments obtained also at the commencement of the *campagne* by heating the lined juice were next examined; besides oxalic acid, which represented the chief portion of each, succinic acid and a small quantity of normal adipic acid were separated from one sediment, the former by its sparing solubility in ether, the latter by its ready solubility in the same solvent; whilst from the other sediment glycollic acid was obtained by extraction with ether and purification of the lead salt. During the filtration of the juices at the same period of the year, a white substance is sometimes precipitated, and the precipitation is in some cases accompanied by the evolution of ammonia. Some of this substance was found on examination to be insoluble in water, alcohol, ether, and every solvent tried; after washing with water it had a dull white

appearance, a neutral reaction, did not contain nitrogen, and only left a very small quantity of ash on incineration. On boiling it with water glycollic acid was formed, and, judging from the latter, as well as from the numbers obtained by an elementary analysis it is identical with H. Schiff's hexaglyoxal hydrate, $C_{12}H_{12}O_{12} + H_2O$ (Annalen, 172, 1). The author has on one occasion separated glyoxylic acid from the juice of unripe roots.

Of the acids mentioned in this communication, succinic, glutaric, and adipic acids belong to the oxalic series, whose first five members have now been recognised in beetroot juice; glycollic and glyoxylic acids are closely related to oxalic acid, malic and tartaric acids to succinic acid. As it can no longer be doubted that aldehydes are the first assimilation products of the plant, it seems probable that such condensation products as hexaglyoxal hydrate (see above) are formed from these, which in their turn yield acids by hydrolysis. Finally, attention is drawn to the probability that the sugars may perhaps result by the condensation of glycollic aldehyde ($3 C_2H_4O_2 = C_6H_{12}O_6$), a compound which stands intermediate between formaldehyde and glyceraldehyde. Indeed, it seems probable that such a condensation might take place in the case of glycollic aldehyde even easier with formaldehyde. In view of Brunner's observations (Ber. 19, 595) on the wide dissemination of glyoxylic acid throughout the vegetable kingdom, this readily yielding glycollic acid on reduction, the question is well worthy of being submitted to further experiment.—A. R. L.

XVII.—BREWING, WINES, SPIRITS, Etc.

Grape-seed Oil and its Technical Application. F. M. Horn. Mittheil. des k. k. tech. Gewerbe-Museums, 1891, 185—187.

See under XII., page 44.

Studies on Yeast. J. Eilfont. Monit. Scient. 1891, 5, 1137—1144.

IN a previous communication (this Journal, 1890, 1055; Monit. Scient. 1890, 449, 790, and 1013) the author has shown that hydrofluoric acid or the alkaline fluorides, in quantities of 5 to 15 mgrms. per 100 cc., prevent the development of harmful organisms without effecting the yeast or diastase.

In the present investigation, attention was more particularly paid to the effect of the fluorides on the various varieties of yeast.

The four varieties used were *Saccharomyces cerevisia*, *Pastorianus I.*, Carlsberg, and Burton.

It was found that quantities of fluorides greater than 100 mgrms. per 100 cc. very appreciably diminished the fermentative power of all the yeasts, and that 300 mgrms. per 100 cc. destroyed it almost completely.

If any one of these yeasts that has grown in a solution containing fluoride be grown in a solution containing none, it will be found to be more active than the original yeast, the activity being more marked the more fluoride was contained in the first solution. This is most markedly the case with Burton yeast and *Saccharomyces cerevisia*. By taking advantage of this phenomenon it is possible to separate Burton yeast from *Pastorianus I.* by growing the mixed yeasts in a wort containing alternately 300 mgrms. per 100 cc. fluoride and no fluoride, when after the experiment has been repeated three times, the final yeast will be found to be pure Burton yeast.—A. L. S.

PATENTS.

Improvements in the Treatment of Cereals for Preventing or Arresting Decomposition, and for Preserving or Improving the Condition thereof. E. Luck, R. Pott, and N. Pott, London. Eng. Pat. 19,168, November 25, 1890. 8d.

THE object of this invention is to improve or preserve the condition of cereals and to prevent or arrest the deterioration thereof by moisture or by insects, &c. This purpose is effected by treatment with sulphurous acid, and it is claimed that by this means grain which has been damaged by moisture, but not excessively so, may be restored to its original colour and condition, and for most industrial purposes rendered equal to new.

The sulphurous acid is preferably employed in the gaseous state, and is produced by burning sulphur in a current of air. The gas is washed and dried by being passed through two vessels containing respectively water and pumice or some other suitable material soaked in strong sulphuric acid. Finally the gas is warmed by passing through a coil heated externally by means of hot air, water, or steam, and is conducted underneath a perforated floor on which the grain undergoing treatment is spread. When the grain has been sufficiently treated the burning sulphur is extinguished and air alone is forced through the apparatus. By this means the grain is dried and rendered fit for storage.

Instead of the gas a solution of sulphurous acid may be employed, either alone or in conjunction with some alkaline substance (such as lime or chalk), the cereal being steeped in the solution and afterwards dried, if required.

For drawings and details of the necessary apparatus the original specification must be consulted.—H. T. P.

Process for the Preparation of Hop Extract. A. Foelsing, Düsseldorf, Germany. Eng. Pat. 21,044, December 24, 1890. 4d.

THE hops are treated in a battery of diffusion apparatus with water at 60° C. under a pressure of $1\frac{1}{2}$ atmospheres. In order to render the extraction the more complete and to prevent the oxidation of the bitter principles of hops, about $2\frac{1}{2}$ per cent. of gum tragacanth is added to the water.

The extract is concentrated in vacuo to about $2\frac{1}{2}$ B.

—A. L. S.

Process and Apparatus for the Manufacture of Champagne and other Beverages charged with Carbonic Acid. F. König, Turin, Italy. Eng. Pat. 852, January 16, 1891. 8d.

THE apparatus consists of two air-tight vessels, in one of which the final fermentation takes place, while the other receives the clear sparkling wine. These vessels are connected by an air pipe at the top and by a liquor pipe at the bottom, filters of porous earthenware, cotton wool, or asbestos, &c. being fitted on the lower pipe.

The wine is introduced into the first vessel and the air remaining in both vessels replaced by carbonic acid gas. All communication with the external air is cut off; the upper pipe between the two vessels is left open and the lower one is kept closed.

After fermentation has gone on for some time, the upper pipe is closed and the lower one opened; as the fermentation proceeds the pressure increases in the first vessel and forces the wine through the filters into the second vessel, from which the wine is bottled.—A. L. S.

A Means of Collecting Hops or other Ingredients when Boiling or in Circulation in a Copper or similar Vessel. F. H. Fortescue, London. Eng. Pat. 12,077, July 16, 1891. 6d.

THE ordinary boiling or circulating fountain as fitted to wort coppers is fitted with a wire cage or strainer. The wort as it issues from the top of the fountain falls into the cage, which retains the hops and allows the clear wort to pass through.—A. L. S.

An Appliance for Distributing and Aërating Brewers' Wort. R. H. Leaker, Bristol. Eng. Pat. 17,681, October 16, 1891. 6d.

THE appliance consists of a trumpet-shaped tube, the narrow end of which is connected with the hop-back or copper. Just within the wide end is suspended a bell-shaped plate. The wort is discharged from the opening between the edges of the trumpet-shaped tube and the bell-shaped plate. The width of the opening is capable of adjustment; when the apparatus is fitted to the discharge pipe of a copper it is fairly wide to admit of the passage of the hops; when it is fitted to the pipe discharging from the hop-back on to the cooler, the opening is narrower and is partly self-adjusting by a spiral spring; in this case the bell-shaped plate is perforated with holes. The wort issues on to the cooler in a dome-shaped sheet and from the holes as a fine rain. The apparatus is said both to cool and aërate the wort.—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOODS.

Examination of Tin-plated Iron Articles used for the Preservation of Foods. J. Pinette. Chem. Zeit. 1891, 15, 1109.

THE attention of foreign importers of tinned foods is particularly called to the following law which has been in force in Germany since October 1, 1889:—

Tin used for the tin-plating of iron must contain no more than 1 per cent. of lead. The solder used for sealing these articles must consist of an alloy of tin, with no more than 10 per cent. of lead.

The author proposes the following easy process for the assay of such tin wares:—The material is (without touching the solder) cut into small pieces and heated in a porcelain dish with dilute nitric acid until the pieces look black. The liquid is then at once poured off, and the residue well washed to remove any adhering stannic acid. The whole is evaporated to dryness, and then again heated with nitric acid to separate the lead and also any iron. The stannic oxide is finally ignited and weighed. The lead is made into sulphate by evaporation with sulphuric acid, and after freeing it from iron by washing with dilute sulphuric acid, it is then collected and weighed as usual. As regards the testing of the solder, the author remarks that the different pieces of solder from the same tin may have a different composition.—L. de K.

PATENTS.

Improvements in Obtaining an Extract of Malt and Hops, and in Preparing a Confection of the Same. E. Sonstadt, Cheshunt. Eng. Pat. 21,006, December 24, 1890. 6d.

A wort is prepared from malt and water in the usual way, this is boiled with hops in a closed boiler, about 1 part of hops being used for every 10 parts of malt. A current of carbon dioxide is passed through the boiler, issuing with the steam. The mixture of steam and carbon dioxide is passed into a condenser, where the steam is condensed, and the carbon dioxide, carrying with it some hop aroma, is passed over fresh butter and ignited asbestos, in order to remove the aroma.

After the boiling has continued for some hours, the boiled wort is discharged and strained from the hops. The clear extract is concentrated in an atmosphere of carbon dioxide to the required concentration, and then cooled. The aroma-charged asbestos is boiled with the condensed water, the first portion of the distillate contains all the aroma, and

is mixed with the cooled extract; this is then bottled, sealed, and sterilised by being heated to boiling. If a solid extract is required, the concentration is pushed as far as possible, and mixed while hot with sugar, the "aroma-water" prepared as above and the aromatised butter.

—A. L. S.

Improvements in Apparatus for Testing the Quantity of Cream in Milk. H. E. Newton, London. From L. J. Augustenborg and R. Hansen, Kolding, Denmark. Eng. Pat. 14,797, September 1, 1891. 6d.

THE improvements claimed are in the construction of the rotating table described below, and in the warming of the space in which it rotates by means of a reservoir of hot water supported immediately above it. The rotation is accomplished by means of a worm on the vertical spindle, which carries the table, worked in a toothed wheel.

The table is furnished with a flange, to which are fixed blocks, the intervals between which are fitted with caoutchouc pads. Round the spindle in the centre of the table is a wooden disc, the circumference of which is covered with a rubber ring. The test tubes containing the milk are placed radially on the table between the rubber ring and the caoutchouc pads.—A. G. B.

An Improved Process for Preserving Eggs. B. J. B. Mills, London. From A. Micault de la Vieuville, Lyons, France. Eng. Pat. 17,717, October 16, 1891. 4d.

THE fresh eggs to be preserved are first washed in milk of lime in order to remove any surface dirt and grease, and also to destroy "the ferments which exist in the porosity of the shell." The eggs thus cleaned and purified are coated with a thin continuous layer of gelatin, obtained by plunging them into a solution of this material. The gelatin employed must be free from bad odour or taste, and should preferably be colourless so that the whiteness of the shells may not be impaired.

It is claimed that eggs thus prepared may be preserved absolutely unchanged for a year or more without any special precautions as regards aëration and temperature of storage. It is further stated that the shells of the eggs are rendered stronger by the treatment, so that increased facility in transport is obtained.—H. T. P.

(B.)—SANITARY CHEMISTRY.

A Delicate Test for Alum in Potable Water. Ellen H. Richards. Technology Quarterly, 1891, 4, 194—195.

See under XXIII., page 60.

Manufacture of Glass Pipes of Large Diameter. L. Appert. Bull. Soc. d'Encouragement l'industrie Nationale, 1891, 6, 114—121.

See under VIII., page 38.

PATENTS.

Improved Method of and Apparatus for Treating Smoke and Gases from Furnaces and other Fires. A. S. Davy, Sheffield. Eng. Pat. 179, January 5, 1891. 8d.

See under II., page 21.

Improvements in or Relating to Means or Apparatus for Treating Gases, Smoke, and Products of Combustion so as to Render them Innoxious. R. Wainwright, Leeds. Eng. Pat. 10,427, June 19, 1891. 8d.

See under II., page 22.

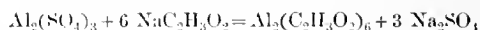
Improvements Relating to Carbonic Acid Baths, and Tablets for use therein. E. Sandow, Hamburg, Germany. Eng. Pat. 16,422, September 28, 1891. 4d.

See under VII., page 37.

XIX.—PAPER, PASTEBOARD, Etc.

The Sizing of Paper. J. Wunder. Chem. Zeit. 1891, 15, 702—703.

PAPER sized with rosin or wax easily becomes saturated with water, but if treated with animal size it is rendered to a certain degree waterproof. To effect this, paper is first passed through a solution of animal size, and then through a solution of aluminium sulphate and sodium acetate mixed in the proportions required by the following equation—



Instead of sodium acetate any other acetate in equivalent quantity, as well as other salts, e.g., sulphites, thiosulphates, chromates, &c., may be taken.

The method may be varied by adding the aluminium sulphate to the size solution, or by dividing the latter into two parts, mixing the one with the aluminium sulphate solution and the other with one of the above-mentioned salts. The final result may be rendered still more complete by drying the paper after having passed it through the first solution, and subsequently soaking it for about 12 hours in the second solution. Such papers are said to be waterproof to a high degree.—H. S.

Aluminium Sulphate. Papier-Zeitung, 1891, 16, 2326—2328.

Pure Neutral Sulphate.—A saturated solution at 15° C. of pure aluminium sulphate has a specific gravity of 1.341 and contains 36.60 grms. $\text{Al}_2(\text{SO}_4)_3$ or 10.99 grms. Al_2O_3 per 100 cc. If such a solution be evaporated until it has the same specific gravity (1.341) at the boiling temperature, it forms on cooling a magma of small crystals which cannot be completely freed from the mother-liquor by pressing, but they lose water by exposure to air. If the evaporation be carried further until the boiling point rises to 109° C., and the specific gravity at this temperature is 1.540, the solution solidifies on cooling to a hard mass, which is the usual commercial form of the sulphate, and contains 46.6 per cent. $\text{Al}_2(\text{SO}_4)_3$, or 14.0 per cent. Al_2O_3 . If the cooling be conducted rapidly the solid mass will be at first amorphous and quite white, but become crystalline after some time and lose somewhat in whiteness. If the solution cools slowly the resulting solid will be crystalline. Less evaporation gives a softer product and more evaporation a harder one, but at the same time it is more vitreous and therefore not so white in appearance; a product containing more than 15.5 per cent. Al_2O_3 persistently refuses to become crystalline. When the boiling temperature rises above 109° C., the solution becomes viscid and begins to froth, and for this reason, normal aluminium sulphate produced on the large scale cannot well contain more than 15.5 per cent. Al_2O_3 .

The following table gives the composition of the salt with different amounts of water:—

	Pure Aluminium Sulphate,			
	with 13% Al_2O_3	with 14% Al_2O_3	with 15% Al_2O_3	Crystallised with 18 aq.
Contains in 100 parts by weight,				
Al_2O_3	13.00	14.00	15.00	15.44
SO_3	30.29	32.62	34.95	35.98
$\text{Al}(\text{SO}_4)_3$	43.29	46.62	49.95	51.42
H_2O	56.71	53.38	50.05	48.58
	100.00	100.00	100.00	100.00

Aluminium sulphate dried at 95° C. retains 8 molecules of water, and contains 21.2 per cent. Al_2O_3 ; it is pure white in colour, can be easily ground to a fine powder, and is readily soluble in water to a clear solution. Aluminium sulphate containing 38 per cent. of water, corresponding to 18.6 per cent. Al_2O_3 , becomes after fusion perfectly transparent, clear, and brittle like glass.

Basic Sulphate.—A solution of the neutral sulphate can be diluted to any extent without precipitating, but the basic sulphates decompose on dilution. A solution containing 36 per cent. of $\text{Al}(\text{SO}_4)_3$ will allow of two-thirds of the acid being neutralised with caustic soda before a permanent precipitate forms; the same solution diluted 10 times gives a permanent precipitate when only one-third of the acid is neutralised with alkali.

Commercial Sulphate of Alumina.—The impurities of this product of special importance to the user are iron and free acid. The amount of iron varies between 0.003 per cent. and 0.5 per cent.; products containing less than 0.01 per cent. Fe are commonly distinguished as free from iron, and are used in dyeworks and in works producing the finer kinds of white paper. Dyers and leather dressers who object to these small quantities of iron continue to prefer alum. The commercial article contains iron in both stages of oxidation, and in varying proportions. For use in sizing good writing paper the percentage of iron may reach 0.15 per cent. without apparent disadvantage, and if all the iron is in the ferrous state the percentage may reach 0.3 without affecting the colour of the paper, but it is liable in this case to acquire a yellowish tinge on longer exposure to the air, especially under direct sunlight. An amount of iron exceeding 0.3 per cent. renders the sulphate of alumina applicable only for low-grade or coloured paper.

The quantity of free acid varies from 0.2 to 1.0 per cent. SO_3 , but is seldom above 0.5 per cent. It is not left in the free state on account of any difficulty in neutralising, but to give a better appearance to the article. Neutral or feebly basic aluminium sulphate containing 0.05 per cent. Fe as Fe_2O_3 is yellowish from the presence of basic ferric sulphate, and if the iron in the ferric state amounts to 0.15 per cent. Fe the colour is as deep as beeswax. If free acid were present this quantity of iron would scarcely colour the article, and if, besides, the iron were in the ferrous state no colouration at all would be perceptible, only a very feeble greenish tint being seen when the ferrous iron amounts to 0.5 per cent. A few tenths of a per cent. of free acid is usually of no importance, especially in the paper manufacture where a small quantity of free acid is of advantage for decomposing the resin soap.

A third impurity, which may at times be objectionable, is the residue insoluble in water: it rarely exceeds 0.3 per cent. Other impurities may be potash, soda, magnesia, chlorine, and nitric acid, but they are only occasional and are not detrimental. In one sample of second grade 2 per cent. of zinc was found, and this metal should be looked for in the alumina determination.

The commercial article usually contains from 13 to 15 per cent. Al_2O_3 .

The raw materials for aluminium sulphate are kaolin and bauxite. An English kaolin much used in Germany has the following composition after drying at 100° C.:—

	Per Cent.
SiO_2	45.3
Al_2O_3	39.9
Fe_2O_3	0.6
H_2O (combined)	13.0

The composition of bauxite is very variable. The following table gives the percentage composition of several kinds:—

	French.			Irish.		German.	
	a.	b.	c.	d.	e.	f.	g.
Al_2O_3	59.0	73.0	63.8	59.8	53.8	52.0	46.1
Fe_2O_3	8.0	1.5	6.7	17.9	1.6	1.6	15.1
SiO_2	16.6	16.5	6.3	1.5	8.7	12.0	10.4
TiO_2 .....	..	..	..	..	5.8	6.2	4.2
Loss on ignition..	16.3	9.0	23.1	21.0	20.3	24.0	23.1
						24.7	

The methods of producing aluminium sulphate vary somewhat according to the materials and the degree of purity required in the product.

Kaolin is usually calcined at a low temperature, ground, finely sifted, and mixed with sulphuric acid of 1.45 sp. gr.

Steam is then injected to promote the reaction, which afterwards proceeds very violently. At the end of the reaction the mass will contain no free acid if the requisite excess of kaolin had been employed. It is dissolved in water to a specific gravity of 1.29, and is filtered. The filtrate is evaporated to the required extent and then allowed to cool and solidify. Uncalcined kaolin may be used, but the reaction must be then conducted under pressure of steam to secure its completion. The crude sulphate of alumina of commerce is the product of the above reaction, omitting the solution in water. It contains 10—12 per cent. Al_2O_3 as sulphate and 25—30 per cent. of insoluble matter (silica and undecomposed kaolin), besides 1 per cent. or more of free acid. It is used for the lower grades of paper, for which the insoluble matter serves as filling. It is also used for the clarification of waste waters.

Bauxite in a finely ground condition, without calcining, is mixed with sulphuric acid and the product of the reaction is treated as above, when a sulphate of dirty white appearance is produced containing 0.5 per cent. Fe. A simple method of separating the chief part of the iron is to treat the solution of 1.29 sp. gr. with bleaching powder or nitric acid to peroxidise all the iron, and to render the solution feebly basic. On allowing it to stand for some months the iron separates out, but not completely, as basic sulphate, accompanied by a little alumina. If it be required to reduce all the iron to the ferrous state to improve the appearance of the article, it is best done by boiling the solution with finely-powdered charcoal.

Another method of treatment is applicable to a raw material containing iron with but very little silica, such as the bauxites c, d, and h. The finely-ground bauxite is intimately mixed with soda ash and calcined at a low heat. The mass is extracted with water, to dissolve out the aluminate of soda. On treating the solution with carbonic acid gas the alumina is precipitated as hydrate, which is filtered off and treated with the requisite quantity of sulphuric acid for the production, without further evaporation, of a sulphate of 14 per cent. Al_2O_3 of great purity. The carbonate of soda left in the solution is recovered by evaporation.

Iron in aluminium sulphate is separated by precipitation with excess of caustic soda. The precipitate is collected on a filter, re-dissolved in sulphuric acid, reduced with zinc, and estimated by titration with permanganate solution.

Small quantities of iron are determined colorimetrically. Free acid is estimated by adding potassium sulphate to the solution and evaporating to dryness. The residue is powdered

and extracted with alcohol to dissolve out the free acid which is then determined by titration with decinormal alkali.

DENSITY AND COMPOSITION OF ALUMINIUM SULPHATE SOLUTIONS (CHEMICALLY PURE).—Temperature 15° C.

Specific Gravity.	Degrees Reaume.	100 Kilos. of Solution contain Kilos.					100 Litres of Solution contain Kilos.				
		Al ₂ O ₃	SO ₃	Sulphate with 13 per Cent. Al ₂ O ₃	Sulphate with 14 per Cent. Al ₂ O ₃	Sulphate with 15 per Cent. Al ₂ O ₃	Al ₂ O ₃	SO ₃	Sulphate with 13 per Cent. Al ₂ O ₃	Sulphate with 14 per Cent. Al ₂ O ₃	Sulphate with 15 per Cent. Al ₂ O ₃
1.005	0.7	0.14	0.82	1.1	1.0	0.9	0.14	0.33	1.1	1	0.9
1.010	1.4	0.27	0.64	2.1	2.0	1.8	0.28	0.65	2.2	2	1.9
1.016	2.1	0.41	0.45	3.1	2.9	2.7	0.42	0.98	3.2	3	2.8
1.021	2.8	0.55	1.27	4.2	3.9	3.6	0.56	1.31	4.3	4	3.7
1.026	3.5	0.68	1.50	5.3	4.9	4.6	0.70	1.63	5.4	5	4.7
1.031	4.2	0.81	1.89	6.3	5.8	5.4	0.84	1.96	6.5	6	5.6
1.036	4.8	0.94	2.20	7.3	6.7	6.3	0.98	2.28	7.5	7	6.5
1.040	5.4	1.07	2.50	8.3	7.7	7.2	1.12	2.61	8.6	8	7.5
1.045	6.1	1.20	2.80	9.3	8.6	8.0	1.26	2.94	9.7	9	8.4
1.050	6.7	1.33	3.11	10.3	9.5	8.9	1.40	3.26	10.8	10	9.3
1.055	7.3	1.46	3.40	11.3	10.4	9.7	1.54	3.59	11.8	11	10.3
1.059	7.9	1.58	3.69	12.2	11.3	10.6	1.68	3.91	12.9	12	11.2
1.064	8.5	1.71	3.98	13.1	12.2	11.4	1.82	4.24	14.0	13	12.1
1.068	9.1	1.83	4.27	14.1	13.1	12.2	1.96	4.57	15.1	14	13.1
1.073	9.7	1.96	4.56	15.1	14.0	13.1	2.10	4.89	16.2	15	14.0
1.078	10.3	2.08	4.84	16.0	14.8	13.9	2.24	5.22	17.2	16	14.9
1.082	10.9	2.20	5.12	16.9	15.7	14.6	2.38	5.55	18.3	17	15.9
1.087	11.4	2.32	5.40	17.8	16.5	15.4	2.58	5.87	19.4	18	16.8
1.092	12.0	2.44	5.67	18.7	17.4	16.2	2.66	6.20	20.5	19	17.7
1.096	12.6	2.55	5.95	19.7	18.3	17.0	2.80	6.52	21.5	20	18.7
1.101	13.1	2.67	6.22	20.5	19.1	17.8	2.94	6.85	22.6	21	19.6
1.105	13.7	2.78	6.49	21.4	19.9	18.6	3.08	7.18	23.7	22	20.5
1.110	14.2	2.90	6.76	22.3	20.7	19.3	3.22	7.50	24.8	23	21.5
1.114	14.7	3.01	7.02	23.2	21.5	20.1	3.36	7.83	25.9	24	22.4
1.119	15.3	3.13	7.29	24.1	22.4	20.9	3.50	8.16	26.9	25	23.3
1.123	15.8	3.24	7.55	24.9	23.1	21.6	3.64	8.48	28.0	26	24.3
1.128	16.3	3.35	7.81	25.8	23.9	22.3	3.78	8.81	29.1	27	25.2
1.132	16.8	3.46	8.06	26.6	24.7	23.1	3.92	9.13	30.2	28	26.1
1.137	17.4	3.57	8.32	27.5	25.5	23.8	4.06	9.46	31.2	29	27.1
1.141	17.9	3.68	8.58	28.3	26.3	24.5	4.20	9.79	32.3	30	28.0
1.145	18.3	3.79	8.83	29.1	27.1	25.3	4.34	10.11	33.4	31	28.9
1.150	18.8	3.89	9.07	30.0	27.8	26.0	4.48	10.44	34.5	32	29.9
1.154	19.2	4.00	9.32	30.8	28.6	26.7	4.63	10.76	35.5	33	30.8
1.159	19.7	4.11	9.57	31.6	29.3	27.4	4.76	11.09	36.6	34	31.7
1.163	20.1	4.21	9.82	32.4	30.1	28.1	4.90	11.42	37.7	35	32.7
1.168	20.6	4.32	10.06	33.2	30.8	28.9	5.04	11.74	38.8	36	33.6
1.172	21.1	4.42	10.29	34.0	31.6	29.5	5.18	12.07	39.9	37	34.5
1.176	21.6	4.52	10.53	34.8	32.3	30.1	5.32	12.40	40.9	38	35.5
1.181	22.1	4.62	10.77	35.6	33.0	30.8	5.46	12.72	42.0	39	36.4
1.185	22.5	4.72	11.01	36.3	33.7	31.5	5.60	13.05	43.1	40	37.3
1.190	23.0	4.82	11.24	37.1	34.5	32.2	5.74	13.38	44.2	41	38.3
1.194	23.4	4.92	11.47	37.9	35.2	32.8	5.88	13.70	45.2	42	39.2
1.198	23.8	5.02	11.70	38.6	35.9	33.5	6.02	14.03	46.3	43	40.1

DENSITY AND COMPOSITION OF ALUMINIUM SULPHATE SOLUTIONS (CHEMICALLY PURE).—Temperature 15° C.—*cont.*

Specific Gravity.	Degrees Beaume.	100 Kilos. of Solution contain Kilos.					100 Litres of Solution contain Kilos.				
		Al ₂ O ₃	SO ₃	Sulphate with 13 per Cent. Al ₂ O ₃	Sulphate with 14 per Cent. Al ₂ O ₃	Sulphate with 15 per Cent. Al ₂ O ₃	Al ₂ O ₃	SO ₃	Sulphate with 13 per Cent. Al ₂ O ₃	Sulphate with 14 per Cent. Al ₂ O ₃	Sulphate with 15 per Cent. Al ₂ O ₃
1.203	24.3	5.12	11.03	39.4	39.6	31.1	6.16	14.35	47.4	44	41.1
1.207	24.7	5.22	12.16	40.2	37.3	34.8	6.30	14.68	48.5	45	42.0
1.211	25.2	5.32	12.39	40.9	38.0	35.4	6.44	15.01	49.5	46	42.9
1.215	25.5	5.41	12.61	41.6	38.7	36.1	6.58	15.33	50.6	47	43.9
1.220	25.9	5.51	12.83	42.4	39.3	36.7	6.72	15.66	51.7	48	44.8
1.224	26.3	5.60	13.06	43.1	40.0	37.4	6.86	15.99	52.8	49	45.7
1.228	26.7	5.70	13.28	43.9	40.7	38.0	7.00	16.31	53.9	50	46.7
1.232	27.1	5.79	13.50	44.6	41.4	38.6	7.14	16.64	54.9	51	47.6
1.236	27.5	5.89	13.72	45.3	42.1	39.3	7.28	16.96	56.0	52	48.5
1.240	27.9	5.98	13.94	46.0	42.7	39.9	7.42	17.29	57.1	53	49.5
1.244	28.3	6.08	14.16	46.7	43.4	40.5	7.56	17.62	58.2	54	50.4
1.248	28.6	6.17	14.38	47.5	44.1	41.1	7.70	17.94	59.2	55	51.3
1.252	29.0	6.26	14.59	48.2	44.7	41.7	7.84	18.26	60.3	56	52.3
1.256	29.4	6.35	14.80	48.9	45.4	42.3	7.98	18.59	61.4	57	53.2
1.261	29.8	6.44	15.01	49.5	46.0	42.9	8.12	18.92	62.5	58	54.1
1.265	30.2	6.53	15.22	50.2	46.7	43.5	8.26	19.25	63.5	59	55.1
1.269	30.5	6.62	15.43	50.9	47.3	44.1	8.40	19.57	64.6	60	56.0
1.273	30.9	6.71	15.63	51.6	47.9	44.7	8.54	19.90	65.7	61	56.9
1.277	31.2	6.80	15.84	52.3	48.6	45.3	8.68	20.23	66.8	62	57.9
1.281	31.6	6.89	16.04	53.0	49.2	45.9	8.82	20.55	67.9	63	58.8
1.285	31.9	6.97	16.25	53.7	49.8	46.5	8.96	20.88	68.9	64	59.7
1.289	32.3	7.06	16.46	54.3	50.5	47.1	9.10	21.20	70.0	65	60.7
1.293	32.6	7.15	16.66	55.0	51.1	47.7	9.24	21.53	71.1	66	61.6
1.297	33.0	7.23	16.85	55.6	51.7	48.2	9.38	21.86	72.2	67	62.5
1.301	33.3	7.32	17.05	56.3	52.3	48.8	9.52	22.18	73.2	68	63.5
1.305	33.7	7.40	17.25	57.0	52.9	49.4	9.66	22.51	74.3	69	64.4
1.309	34.0	7.49	17.45	57.6	53.5	49.9	9.80	22.84	75.4	70	65.3
1.312	34.4	7.57	17.65	58.3	54.1	50.5	9.94	23.16	76.5	71	66.3
1.316	34.7	7.66	17.84	58.9	54.5	51.1	10.08	23.49	77.5	72	67.2
1.320	35.0	7.74	18.04	59.6	55.3	51.6	10.22	23.81	78.6	73	68.1
1.324	35.3	7.83	18.23	60.2	55.9	52.2	10.36	24.14	79.7	74	69.1
1.328	35.6	7.91	18.43	60.8	56.5	52.7	10.50	24.47	80.8	75	70.0
1.331	35.9	7.99	18.62	61.5	57.1	53.3	10.64	24.79	81.8	76	70.9
1.335	36.2	8.07	18.81	62.1	57.7	53.8	10.78	25.12	82.9	77	71.9
1.339	36.5	8.16	19.00	62.7	58.3	54.4	10.92	25.45	84.0	78	72.8

—G. H. B.

Papyrus. Papier-Zeitung, 1891, 16, 2528.

This article gives an account of the uses of the papyrus plant amongst the ancients. It is known to have been cultivated by the Egyptians as far back as 1800 B.C. The young plants were used as a foodstuff, and the old ones furnished material for baskets and other woven utensils. Its chief use was the manufacture of paper, which became an important industry on the banks of the Nile, where the papyrus grew. Papyrus paper was expensive, but very durable, rolls of it having withstood the destructive influence of many centuries at time. Papyrus was imported from Egypt by the Romans for the fabrication of eight different sorts of paper. The cultivation of the plant has now almost

entirely ceased, a last attempt during this century to manufacture papyrus paper in Syracuse having been unsuccessful.

—G. H. B.

"Argentine." A. Harpf. Papier-Zeitung, 1891, 16, 2584—2585, 2612—2614 and 2640—2642.

"ARGENTINE" consists of nearly pure tin in a very fine state of division, and is also called "tin-dust." It is used principally for ornamenting paper, such as silver paper, and is manufactured in only a few places, as the demand is small. The process of manufacture described is that carried on in Herdain, near Breslau. The materials required are tin,

hydrochloric acid, and zinc. Tin is used in the granulated form and also as it exists in all kinds of alloys, such as gun metal and white metal, the turnings forming the waste material of other factories being suitable. The turnings are placed in open copper vessels holding about 250 litres, and ordinary hydrochloric acid of 20° – 22° B. is added and boiled. As long as an excess of tin is present copper and antimony will not dissolve. The solution will contain chiefly tin and a little lead, and is run into wooden casks to cool, when most of the lead crystallises out as chloride. This is separated by filtration through sand, and converted into oxychloride by Pattinson's method for sale as a white pigment. The clear solution has a density of 33° – 40° B., and contains 17–23 per cent. Sn, with small quantities of lead and antimony. It is desirable that these impurities should be small in amount, as they are injurious to the colour of the product. The undissolved metal is exhausted by boiling three times with fresh acid, when it is washed and dried. On account of its admixture with antimony and metallic chlorides, this waste copper is not fit for castings, and is sold to a metal refiner. Not all the tin is removed by this process, as the metal residue retains about 2–3 per cent., the complete extraction of which would be accompanied by too much antimony and lead.

The next operation is the precipitation of the tin in wooden casks holding about half a cubic metre each. They are filled with water, and an iron basket well plated with tin and holding zinc scrap is suspended in each. Each cask receives twice daily an addition of $2\frac{1}{2}$ litres of the strong solution (about 40° B.) of tin chloride, which is thereby diluted to 200 times its volume. The metallic tin precipitated by the zinc from this dilute solution takes the form of a very light sponge, which is carried by adherent hydrogen gas to the surface of the solution, whence it is removed every morning, and well washed in a separate cask. It is then dried in a shallow oblong steam-jacketed zinc pan, in which it is moved about with wooden shovels. The dried dust is sifted in a rotating sieve provided with very fine meshes. It forms an extremely finely-divided metallic powder of a tin-grey colour. It consists of nearly pure tin with a very small quantity of lead and sometimes antimony. The output was about 500 kilos. per month, and its value was 280–300 marks for 100 kilos. of good quality. The liquor in the cask becomes gradually charged with zinc chloride, and is drawn off when its strength reaches 20° – 25° B. It is concentrated to about 50° B. by evaporation in enamelled cast-iron pans, and sold for preserving timber. An almost obsolete process for making silver paper involved the employment of a metallic dust prepared mechanically by grinding to powder an alloy composed of 96.5 per cent. of tin and 2.4 per cent. of zinc which was then mixed with a solution of glue and painted on ordinary white paper, a gloss being afterwards imparted by pressure. A genuine silver paper was also made by cementing silver leaf to paper with white lead and glue. By the modern process "Argentine" is employed and the cementing material is a "wax-solution" prepared in one of the following ways:—Four kilos. of ordinary beeswax and $\frac{1}{2}$ kilo. of potashes are boiled with 50 litres of water; or, 3 kilos. of starch are emulsified and boiled with 75 litres of water containing 5 lb. of beeswax and $1\frac{1}{2}$ lb. of potashes. 25 kilos. of "Argentine" are stirred into this solution contained in a rocking trough through which the roll of paper is caused to pass. The dull grey-coated paper is then passed through a hot calender under great pressure, which gives a high polish to the paper resembling tin-foil. Sometimes the calender is smeared with cocoa-nut butter, which increases the gloss and gives a greasy feel to the paper. A practical test of the quality of a sample of "Argentine" can be made by stirring it up with a little water and painting it evenly on paper with a brush. After drying the polish is given by rubbing the paper laid on a glass plate with a round piece of agate.

A considerable difficulty in the manufacture of the "Argentine" was occasioned by the appearance of small crystalline particles in the finished product, which had the effect of introducing irregular blotches into the silver paper. The author gives an account of experiments made for the purpose of finding a cause and a cure for these crystals, and

found that the precipitated tin sponge is liable to contain small crystalline needles of the metal when the tin chloride solution from which it is precipitated is insufficiently diluted, or when the zinc plates are contaminated with other metals in such a way that electrical currents are set up in the solution. Plates of tin and zinc connected by a copper wire and immersed in dilute tin solution caused the formation of crystalline needles of tin at the tin electrode, whilst the spongy metal separating at the zinc was free from crystals. Plates of zinc and lead employed in the same way gave similar results, and in this case impurities in the zinc plate were found to have a less effect on the result. As it is not possible in practice to employ pure zinc the author proposes to use a lead plate in electrical connexion with the ordinary impure zinc in order to obtain a tin sponge free from crystals. This modification of the process gave very satisfactory results as carried out in the following way. A wooden cask was divided into two compartments by a wooden partition containing a few holes to allow the solution to pass freely. Plates of lead and ordinary commercial zinc were placed in the separate compartments and connected by a copper wire. The cask was filled with water charged with 1 per cent. of the strong tin chloride solution (45° B.). The formation of sponge went on regularly and quickly at the zinc plate and was quite free from crystals, whilst only a few crystals of tin separated at the lead plate, which became covered with a dark-grey film. Large quantities of good sponge were obtained from successive additions of the strong liquor. The distinction between sponge and crystals must be taken as merely relative, for the microscope shows the sponge to consist entirely of very small crystals, which are not recognisable as such by the naked eye.—G. H. B.

French Straw-Paper. Papier-Zeitung, 1891, 16, 2611.

STRAW-PAPER has been in considerable demand in France and a good and firm article has been manufactured for the last 40 years. The process of manufacture has not in the meantime undergone much change. Chiefly rye straw is cut quite short in a cutting machine, and this chaff is heaped into large rectangular brick wells, where it is just covered with dilute milk of lime. A covering of heavy boards weighted with stones is put on, and the straw is left in this condition for two to four weeks, when it is taken out and worked under edge-runners for not less than an hour. Straw worked in this manner is harder than steamed straw and the knots are not softened, consequently the grinding must be well done. The straw now goes direct into the mill and after a short time into the pulp-vat. The French straw-paper machines are provided with shaking-troughs, knot-catchers, presses, and several drying cylinders.

—G. H. B.

Japanese Paper. G. Lauboeck. Mittheil. Techn. Gewerbe-Museums, 1891, 257–260.

FOUR samples of Japanese paper of a quality suitable for writing purposes were examined with the results shown in the table on next page.

The raw material from which these papers were made was derived from "Gampi" (*Wickstromia caulescens*) and "Kodsu" (*Broussonetia papyrifera*). Gampi gives a yellow colouration with an aqueous solution of iodine, while Kodsu becomes brown when similarly treated. The ends of the Gampi fibre are bulb-shaped and rounder; its width varies from 0.007 to 0.020 mm. When Gampi fibre is treated with an ammoniacal solution of copper oxide, it swells previous to dissolving, each fibre presenting the appearance of a string of beads, a reaction which may be considered characteristic.

The Kodsu fibre is of massive structure, and has a diameter of 0.014–0.031 mm. The fibres are partly covered with a very delicate colourless envelope which is most readily discernible at the end of the fibre; an ammoniacal solution of copper oxide acts less readily upon the Kodsu fibre than upon the Gampi fibre. The Kodsu

Composition of the Samples.	Tensile Strength in Kilos,* with the Fibre.	Tensile Strength in Kilos, across the Fibre.	Breaking Length with the Fibre.	Breaking Length across the Fibre.	Weight of Paper per Sq. M. in Grams.	Thickness in Mm.	Percentage of Ash calculated on the Dry Paper.
Gampi.....	13.74	10.70	8,505	6,570	109.20†	0.10‡	2.18
75 per cent. Gampi....	2.54	1.62	8,788	5,832	18.63	0.035	2.15
25 per cent. Kodsui....							
Gampi.....	2.00	1.36	6,800	4,707	20.54	0.05	4.49
Kodsui.....	1.34	1.30	4,020	3,601	21.33	0.05	2.16

* To convert kilos. into lb. multiply by 2.205.

† 1 gram. per sq. m. = 1.4364 grains per sq. ft.

‡ 1 mm. = 0.03937 in.

fibre is very flexible and strong, and its length averages 10—15 mm. All the papers examined, the results of which are recorded above, contained a little rice starch, but no other loading of any kind.

It is noteworthy that the first three samples largely excel the best European papers in strength, a circumstance the more remarkable as their thickness and weight are unusually small. It therefore appears that the good quality of Japanese paper is largely due to the length and fineness of the fibre from which it is made, though something must be ascribed to the rational method of manufacture and the personal skill of the artisans. The papers are not sized with rosin or with animal size, but with a vegetable preparation which does not unite the fibres firmly to each other, a circumstance to which the rough appearance of the surface of the paper may be ascribed. It will be interesting to see what will be the effect of sizing Japanese paper by European methods.—B. B.

Chemical Composition of Vegetable Cell Membranes.

E. Schulze. Ber. 1891, 24, 2277—2287.

See under XVI., page 49.

Properties of Cuprammonium. Prudhomme. Bull. Soc. Ind. Mulhouse, 1891, 510—512.

See under VI., page 33.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Chemical Composition of Vegetable Cell Membranes.

E. Schulze. Ber. 1891, 24, 2277—2287.

See under XVI., page 49.

The Alkaloids of the Areca-Nut. E. Jahns. Ber. 1891, 24, 2615—2617.

In a previous paper (this Journal, 1890, 1116) the author has pointed out that *arecoline*, one of the alkaloids contained in the areca-nut, when decomposed by acids or by alkalis, yields the base *arecaidine*. Further investigations have shown that this same body occurs in varying quantities ready formed in the areca-nut. It can be readily separated from the arecaidine with which it occurs by treatment with hydrochloric acid and methyl alcohol, when the arecaidine is converted into the methyl ester (arecolin) whilst the arecaidine forms a hydrochloride.

In addition to the alkaloids previously isolated it has been found that a new alkaloid, for which the name *Guvacine* (from the old Indian name for the areca palm—Guvaca) is proposed, occurs in varying quantity in several kinds of

areca seeds. This product is somewhat less soluble, both in water and in dilute alcohol, than either arecaine or arecoline, and can be separated from arecaidine by treatment with methyl alcohol and hydrochloric acid, being unaffected by these reagents. It forms small glittering crystals, which melt with decomposition at 271—272° C. These are readily soluble in water and in dilute alcohol, insoluble in strong alcohol and in ether, chloroform, and benzene. The solutions are neutral. Analysis points to the formula $C_6H_9NO_2$ for the new alkaloid. With acids guvacine forms crystalline salts which have an acid reaction, and which behave similarly to the free base with the above-mentioned solvents. The hydrochloride, sulphate, gold and platinum double chlorides are described. The platinum salt has the formula $(C_6H_9NO_2 \cdot HCl)_2 \cdot PtCl_4 \cdot 4H_2O$; it loses its water of crystallisation at 110°, and darkens on heating to 210°, melting a few degrees higher. The gold double chloride contains no water of crystallisation. It melts at 194—195° C. The bases isolated up to the present by the author from the areca-nut are the following:—

Choline.....	$C_5H_{13}NO_2$
Guvacine.....	$C_6H_9NO_2$
Arecaine.....	$C_7H_{11}NO_2 + H_2O$
Arecaidine.....	$C_7H_{11}NO_2 + H_2O$
Arecoline.....	$C_8H_{13}NO_2$

With the exception of choline these bases appear to be closely related one to the other. Full details concerning these bodies will be published in the Archives de Pharmacie. —C. A. K.

The Detection of Turkish Geranium Essence in Rose Oil, G. Panajátow. Ber. 1891, 24, 2700—2701.

See under XXIII., page 61.

Camphrone; a Product of the Action of Dehydrating Agents on Camphor. H. E. Armstrong and F. S. Kipping. Proc. Chem. Soc. 1891—1892, 188—189.

The action of concentrated sulphuric acid on camphor appears to have been first examined by Chautard; it was subsequently studied by Fittig, Schwanert, and Kachler, all of whom agree in stating that under suitable conditions an oily product, having a strong peppermint odour, is formed, isomeric with acetophorone, $C_9H_{14}O$, which consequently has figured in chemical literature under the name *Camphorone*. The various statements regarding the properties of this substance, however, are by no means confirmatory, Fittig stating that it boils at 204°—205 and that it has a relative density of 0.939 at 12°, whereas Schwanert gives 230—235° as its boiling point and 0.9614 at 20° as the relative density.

Armstrong and Miller noticed the presence of a substance having properties similar to those of the product obtained by means of sulphuric acid among the products of the action of zinc chloride on camphor; but attempts which they made to isolate a definite substance from their crude product were unsuccessful.

It appeared probable that, with the aid of the improved methods of treating ketonic compounds now known, it

would be possible to separate the characteristic constituent from the crude oil, and this has proved to be the case.

On treating the fraction boiling at 238° — 242° of the oil prepared by means either of sulphuric acid or of zinc chloride with phenylhydrazine, a mixture of a crystalline hydrazone with dark-coloured, oily products is obtained; the purified hydrazone crystallises in yellowish plates and melts at about 108° . By boiling it in alcoholic solution with ferric chloride and muriatic acid, an oil is obtained which yields a hydrazone identical with that from which it was prepared; on distilling this oil, the thermometer rapidly rises to 245° , the greater part of the liquid passing over at 245° — 247° . On treatment with hydroxylamine, the oil is converted into a hydroxime which crystallises in long prisms melting at 85° — 86° , of which the acetyl derivative melts at 69° — 70° .

Numbers were obtained which agree satisfactorily with the formula $C_{10}H_{12}O$. A more complete study of the compound to place its composition beyond doubt, especially as the formula $C_{10}H_{12}O$ is a very remarkable one, will be made.

PATENTS.

Improvements in the Manufacture of Oxygen. J. C. Lawson, London. Eng. Pat. 15,998, October 9, 1890. 8d.

The object of this invention is to obtain oxygen from the air by means of a continuous process, which consists essentially in passing ozonised air through a compound capable of readily absorbing the oxygen, and of giving it off again when heated in a current of steam. The method of working is to draw air by means of a fan through an ozone generator, which contains a number of plates made of glass or other insulating material. The plates are varnished and coated on their upper sides with perforated tin or other metallic foil. These foils are connected alternately with the terminals of the high potential circuit of an induction current. The air on leaving the ozone generator passes to a retort in which is placed the substance capable of absorbing the oxygen from the air, such as commercial manganate of soda, which may be mixed with oxide of copper. The retort is heated in a suitable furnace and is provided with a pipe and cock for the admission of steam, and also with an exit pipe through which the liberated oxygen can pass through a washer to the gas-holder, a bye-pass being provided for the escape of the nitrogen. The sodium manganate is first treated with steam and the evolved oxygen collected; when no more is evolved the steam is turned off, and the ozonised air led through the hot retort when re-oxidation ensues, the oxygen taken up being again liberated on a second treatment with steam. By employing a suitable arrangement of four retorts the process can be worked continuously.—C. A. K.

A New Product Possessing the same, or nearly the same, Properties as Spirits of Turpentine. T. Drake, Huddersfield. Eng. Pat. 16,916, October 23, 1890. 4d.

See under XIII., page 45.

Improvements in the Manufacture and Production of Salols and Analogous Compounds. C. Kolbe, Radebeul, Germany. Eng. Pat. 17,221, October 28, 1890. 6d.

In the various methods employed by the patentee for the manufacture and production of salols, it has been found that cinnamic acid can be employed in place of the different acids hitherto used, and that the phenols can be replaced by glycerol (Eng. Pats. 8018 of 1886; 10,260, of 1887; 13 and 169 of 1888; this Journal, 1886, 577; 1887, 561; 1888, 587; 1889, 817). In this manner the following new bodies are produced:—Cinnamates of guaiacol, creosol (*i.e.*, methyl guaiacol), and engelol (*i.e.*, allyl guaiacol); mono-di- and tri-salicylates of glycerol; mono-di- and tri-eresotates (ortho, meta, and para) of glycerol and mono-di- and tri-cinnamates of glycerol. These substances form colourless bodies insoluble or only soluble with difficulty in water, but soluble in alcohol, from which solvent they can be recrystallised. They dissolve without decomposition in

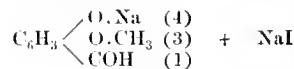
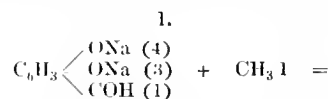
cold dilute soda, but are saponified on heating the solution. When cooled considerably below their point of solidification these bodies often remain liquid. Details regarding the methods of preparation of some of the above substances are given. These new salols can be employed as healing agents.—C. A. K.

Production from Mineral Oils of Sulphonic Acids and Sulphones, and the Manufacture of a New Product by Treating Gelatinous Matters with Sulphonic Acid. A. M. Clark, London. From the "Gewerkschaft Messel," Grube Messel, Germany. Eng. Pat. 19,502, November 29, 1890. 6d.

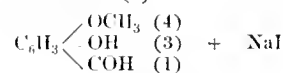
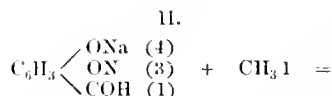
See under III., page 22.

Processes for Obtaining the Two Isomeric Monomethyl-ethers of Proto-catechuic Aldehyde. J. Bertram, Leipzig, Germany. Eng. Pat. 20,264, December 12, 1890. 6d.

THE di-metallic sodium salt of protocatechuic aldehyde when treated with molecular quantities of the halogen compounds of methyl or with the methyl sulphates of the alkalis or alkaline earths, yields the sodium salt of the meta-methyl ether of protocatechuic aldehyde (vanillin), whilst the mono-sodium salt of the aldehyde, when similarly treated, forms the isomeric para-methyl ether (isovanillin). These reactions are represented by the following equations:—



Vanillin.



Isovanillin.

By the action of sodium methylate on mono-acetyl protocatechuic aldehyde vanillin is obtained, whilst from the di-acetyl compound acetyl isovanillin results, from which isovanillin is prepared by isoposition. The quantities required for carrying out the above reactions are given in the specification. The products are purified by distillation in vacuo; vanillin boils at 170° C. and isovanillin at 179° C. under a pressure of 15 mm. (Compare this Journal, 1891, 854.)—C. A. K.

An Improved Process for the Production of Camphor. W. W. Horn, London. From F. de Mare, N. N. M. Saunier, and G. Dambmann, Paris, France. Eng. Pat. 21,294, December 31, 1890. 4d.

THE object of this invention is to take advantage of the oxidising properties of ozone both on terebenthine and camphene. Two methods are used for the oxidation of terebenthine: Firstly, the gum is heated and a current of ozone is caused to pass over it at the very moment of the separation of the terebenthine, camphor being produced, distilled, and condensed in the cold parts of the apparatus; secondly, ozone is caused to act upon the vapour of terebenthine, and the camphor vapour condensed. For the preparation of camphor from camphene, the latter is obtained by treating the monochlorhydrate of terebenthine with an alkaline carbonate at a temperature of 180° C., and distilling. The camphene is then heated in a receiver to 80° C., ozone being meanwhile introduced. The camphor formed is deposited on the sides of the receiver.—E. G. C.

Improvements in the Purification of Chloroform. S. Pitt, Sutton. From "Raoul Pietet & Co.," Berlin, Germany. Eng. Pat. 15,514, September 12, 1891. 8d.

THE purification is effected in a copper cylinder, surrounded by a jacket hermetically sealed at top and bottom and provided with an inlet and outlet pipe. A grating is fixed at the bottom of the cylinder on which any suitable filtering material can be placed, whilst a cock is attached below the grating for running off the contents of the cylinder.

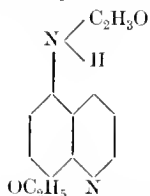
The object of the purification is to remove the various products, such as the tetrachlorides of carbon, with which the chloroform is invariably contaminated, even that obtained from chloral, and is carried out in three stages. First the chloroform in the cylinder is cooled down to 80° C. by allowing ethylchloride, ethylene, protoxide of nitrogen or "Pietet's liquid," to evaporate in the jacketed space outside the cylinder, and filtering the cold liquid mass. Foreign bodies crystallising above this temperature are thus removed, from which the liquid chloroform is filtered off through the above-mentioned grating. The second stage is to solidify the chloroform thus obtained by reducing the temperature of the cylinder to - 82° C., when about two-thirds of it freezes against the sides of the reservoir. The remaining liquid is drained off, and the solid chloroform melted and then run out of the cylinder for the second time. The product thus obtained is finally subjected to distillation at a very low temperature under reduced pressure, the cylinder used in the previous stages of the purification now serving as the receiver. The first and last portions of the distillate are rejected, whilst the intermediate product, amounting to about 80 per cent. of the total, is obtained as chemically pure chloroform.—C. A. K.

Improvements Relating to Carbonic Acid Baths and Tablets for Use therein. E. Sandow, Hamburg, Germany. Eng. Pat. 16,422, September 28, 1891. 4d.

See *under VII.*, page 37.

A New Antipyretic and Antineuralgic Chinolin Derivative, and Process for the Production of the same. A. Bang, Leeds. From G. A. Dahl, Barmen, Germany. Eng. Pat. 17,493, October 14, 1891. 6d.

ORTHO-HYDROXY-QUINOLINE, when boiled with an alcoholic solution of an ethyl haloid ester and sodium hydrate, is converted into ortho-ethoxy-quinoline, as has been shown by Fischer and Renouf (Ber. 17, 759). This product when nitrated is converted into a mixture of mono- and dinitro-compounds, from which the former can be separated owing to its greater solubility in water. The mono-nitro-ethoxy-quinoline yields the corresponding amido-compound on reduction, which latter is converted into a mono-acetyl compound when treated with glacial acetic acid, or when its hydrochloride is boiled with a mixture of sodium acetate and acetic anhydride. The resulting acetyl compound is the new antipyretic and antineuralgic. It forms white needles, which melt at 155° C. They dissolve readily in alcohol, fairly readily in hot water; they possess slightly basic properties, dissolving readily in dilute acids to form salts. Its mineral acid salts are readily decomposed on boiling, and gradually on crystallisation. The constitutional formula for the acetyl-compound is the following:—



Ortho-ethoxy-ana-mono-acetyl-amido-quinoline.

Full details for the preparation of the products concerned are given in the specification.—C. A. K.

XXII.—EXPLOSIVES, MATCHES, Etc.

High Explosives in Warfare. Commander F. M. Barber, U.S.N. J. Franklin Inst. 1891, 131, 117—140.

THE author, while mentioning that all civilised nations are experimenting with and adopting high explosives in place of gunpowder for many military and naval purposes, points out that his subject is hardly practical, as high explosives cannot yet be said to have been regularly used in warfare. The simplest applications of these explosives in warfare are in connexion with torpedoes. While experimenting with different explosives under water Gen. Abbot found that nitroglycerin was 20 per cent. less effective under these circumstances than dynamite No. 1. His idea was that nitroglycerin was too quick in its action, and since water is slightly compressible, a minute fraction of time is required in the development of the full force of the explosive.

Gun-cotton is generally employed in America and Europe for naval purposes, although Russia, Austria, and Italy also use blasting gelatin. Experiments in England have shown that the explosion of 500 lb. of gun-cotton placed 40 ft. below any ship will sink her.

Mines for harbour defence are either buoyant or on the ground. The former contain from 400 to 500 lb. of explosive, the latter from 500 to 1,500 lb., and these are not efficient when the water is over 100 ft. deep.

Torpedoes carry from 75 to 250 lb. of explosive, and those of the automobile variety attain a speed of 25 to 30 knots for 400 yards. The speed of the controllable torpedoes is about 19 knots, and their effective range one mile.

The next application of high explosives is as bursting charges for shells. After discussing the various calculations and experiments which have been made to estimate the force of the different explosives, the author considers the following a fair rough estimate of the bursting charges of shells:—

Powder.....	1
Gun-cotton and dynamite	6—10
Nitroglycerin.....	13—15
Blasting gelatin.....	15—17

There are two ways of applying explosives in shells. The one, in which a comparatively thick shell is employed, for piercing armour plates, and containing a small quantity of explosive, the other, in which a very large amount of explosive is thrown, contained in a shell made as thin as possible.

In this case the efficiency does not depend on the dispersion of the pieces of shell, but upon the devastating force of the bursting charge itself upon everything within the radius of its explosive effect.

There are, however, great difficulties in the firing of high explosives in shells owing to the liability of the shock of firing to explode the charge in the shell before it leaves the gun or mortar. In Europe these difficulties have been attacked by trying to modify the explosive so that it can be fired with safety from the ordinary powder gun, while in America the high explosive has been taken as it is, and the gun adapted to it. In the pneumatic gun the pressure is low and can never exceed that in the firing reservoir, which is 1,000 lb. per square inch. Hitherto with this gun no accidents have happened while firing the most powerful explosives in their natural state and in quantities over fifty per cent. of the weight of the projectile.

Projectiles weighing 950 lb. and containing 300 lb. of blasting gelatin and 200 lb. of dynamite No. 1, have been thrown nearly one mile and exploded after disappearing under water. It is calculated that this projectile would have sunk any ironclad floating within 47 ft. of where it exploded.

The effect of high explosives upon horizontal armour is very great, but vertical armour has not yet been shattered.

—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

Determination of the Specific Gravity of Viscid Substances. J. W. Brühl. Ber. 1891, **24**, 2455—2457.

A PIPETTE containing the viscid substance is inserted into a graduated flask, which being then exhausted by means of a side tube attached for that purpose, becomes charged with the viscid substance as it is sucked from the pipette. This is the arrangement and method adopted by the author (Ber. **24**, 1892), which, he points out, with a 10 cc. flask readily gives results accurate to four places of decimals, and which he considers decidedly preferable for accurate scientific work to Scheibler's arrangement of a pipette closed with two stop-cocks (this Journal, 1891, 657), inasmuch as this apparatus is open to the same objection as the specific gravity bottle supplied with a capillary bored stopper, namely, inconstancy of volume, an error which however would be diminished by using a large pipette with small stop-cocks.—D. A. L.

Vacuum Desiccator with Heating Arrangements. J. W. Brühl. Ber. **24**, 2457—2459.

THE plate which carries the bell-jar is furnished with three openings, one serving the ordinary purpose of exhausting, the other two carrying brass tubes 1 cm. in diameter, about 12 long, and extending 7—8 cm. above the plate, where they are soldered into a circular box about 15 cm. in diameter, and 1 cm. in height, made of copper plate 2 mm. thick, and furnished with several supports soldered inside to prevent its bursting when the bell-jar is exhausted. The tubes are fixed air-tight through the plate by means of brass flanges, caoutchouc stoppers, and screw-nuts. The box serves to support the vessel containing the solution to be evaporated, and can be heated by hot air, water, or steam, while a vessel filled with an absorbent may be placed under the box if required.—D. A. L.

PATENT.

Improvements in or Appertaining to Mercurial Air-pumps. W. P. Thompson, Liverpool. From A. Raps, Berlin, Germany. Eng. Pat. 2969, February 18, 1891. 8d.

THESE improvements, relating to an appliance for automatically actuating mercurial air-pumps, are claimed as consisting, firstly, in the use of a smaller counterweight for the oscillating lever, combined with an adjustable weighted arm. Secondly, in the introduction of an expansion vessel in the pipe leading from the three way cock to the oscillating mercury receptacle.

For further details the specification must be consulted.—B.

INORGANIC CHEMISTRY.—
QUALITATIVE.

A Delicate Test for Alum in Potable Water. Ellen H. Richards. Technology Quarterly, 1891, **4**, 194—195.

THE precipitation of alumina on the addition of alum to natural waters is proportional to the amount of carbonates or bicarbonates present in the water. The precipitation is gradual, and a water which will give a reaction for alum immediately after filtration may give none after 24 hours. Effluents from filters using alum which are originally clear frequently become cloudy on standing from separation of aluminium hydrate. When alum is added to brown surface waters the precipitation of alumina is due to the colouring matters, tannin and other substances.

The author's test is as follows:—"To 25 cc. of the water (concentrated from one liter or more, if necessary) are added a few drops of freshly prepared logwood decoction; any alkali is neutralised, and the colour brightened by the addition of two or three drops of acetic acid. By comparison with standard solutions, the amount of alum present may be determined. One part of alum in 1,000,000

of water can be detected with certainty. In cases of greater dilution, concentration of several litres may be necessary to obtain a decisive test. The logwood chips yield the right colour only after having been treated with boiling water two or three times, and rejecting the successive decoctions. The first portion gives a yellow colour, the third or fourth a deep red."—A. G. B.

INORGANIC CHEMISTRY.—
QUANTITATIVE.

Examination of Tin-plated Iron Articles used for the Preservation of Foods. J. Pinette. Chem. Zeit. 1891, **15**, 1109.

See under XVIII.—A., page 51.

Aluminium Sulphate. Papier-Zeitung, 1891, **16**, 2326—2328.

See under XIX., pages 52—55.

The Chlorine Industry. Laboratory Investigations. A. Reyher. Mont. Scient. 1891, 1249—1256.

See under VII., pages 34—36.

Electrolytic Separations. E. F. Smith and F. Muhr. Ber. 1891, **24**, 2175—2181; and Amer. Chem. J. 1891, **13**, 417—422.

THE electrolytic deposition of gold from alkaline aurocyanides is well known, and the author has now demonstrated how this property may be applied to the separation of the precious metal from palladium, platinum, copper, cobalt, nickel, and zinc. Palladium, for example, in solutions containing excess of potassium cyanide, requires a current of $\frac{1}{1000}$ ampère to pass 36 hours before it is deposited, and when gold is also present the latter can be wholly separated in from 12 to 14 hours, and quite free from palladium. Platinum, and also nickel, resemble palladium in their behaviour under similar circumstances, whilst potassium zinc cyanide requires a current of at least 2—3 cc. of electrolytic gas per minute for its decomposition. The conditions of operation and the results are indicated in the following table, which contains some of the author's results:—

Gold Present.	Potassium Cyanide Present.	Dilution.	Current in cc. Electrolytic Gas Per Min.	Palladium or other Metal Present.	Gold Deposited (extremes).
Grms.	Grms.	Cc.		Grms.	Grms.
0.1162	1.5	150	0.8	Palladium. 0.1209	0.1162—3
0.1162	1.5	150	0.3	0.1200	0.1160—56
0.1162	1.5	150	1.0	0.1200	0.1164—58
0.1167	2.5	150	1.0	Platinum. 0.1233	0.1174—61
0.1725	1.5	150	0.8	Copper. 0.1250	0.1725
0.1725	5.0	150	0.8	0.1250	0.1736
0.1725	3.5	150	0.4	0.1250	0.1735—20
0.1792	3.0	150	0.6	Cobalt. 0.15—0.20	0.1789—99
0.1725	2.5	150	0.5	Nickel. 0.1373	0.1724
0.1725	3.0	150	1.0	0.1373	0.1718
0.1167	2.5	150	0.5	0.1373	0.1162—60
0.1792	3.0	150	0.5	Zinc. 0.2000	0.1796
..	..	..	0.6	0.2000	0.1798—90

The slight excess of gold observed in the precipitate in many instances is stated not to be due to the presence of the foreign metal. A battery of 6 to 10 Crowfoot cells was used for these experiments, and the electrodes were $1\frac{1}{2}$ in. apart during the electrolysis, which was performed in a platinum dish.

Solutions containing 0.0770 grm. of silver, 0.2433 grm. of platinum, and 2.5 grms. of potassium cyanide per 150 cc. yield their silver free from platinum by the action of a current of a strength of 1 cc. electrolytic gas per minute; a stronger current brings down traces of platinum as well. Cadmium cannot be separated either from platinum or nickel by this mode of treatment. Mercury, on the other hand, is readily separated from either of the latter metals in cyanide solution; for example, by means of current of a strength of 0.2 cc. electrolytic gas per minute all the mercury can be separated from a solution containing 0.1902 grm. mercury, 0.2433 grm. of platinum, and 2.5 grms. of platinum cyanide per 150 cc.—D. A. L.

The Electrolysis of Metallic Phosphates in Acid Solution.

E. F. Smith. J. Franklin Inst. 1891, **13**, 206—209. (See this Journal, 1890, 898—899.)

The author now finds that cadmium can be separated from manganese electrolytically without any particular difficulty. Some of the heavier metals were studied in the same manner as copper and cadmium (*loc. cit.*).

Platinum is deposited very rapidly from its acid phosphate solution by the current, and can be separated from the metals of the third and fourth groups.

Palladium also separates rapidly and completely from a solution containing free phosphoric acid, but efforts to separate palladium from cadmium, zinc, and other metals were fruitless, for though the palladium was always fully precipitated, it was either associated with the other metals or separated in black spongy masses.

Gold.—No difficulty was experienced in the case of gold by itself, but attempts to separate it from cadmium were unsuccessful, though the separation of gold from zinc could be carried out without the least difficulty. The separation of gold from cobalt was also satisfactory.

The electrolysis of zinc, nickel, cobalt and iron phosphates have thus far not yielded encouraging results. Strong currents seem necessary; even then the deposition of the metals is rather slow.—O. H.

The Electrolysis of the Metallic Sulphocyanides. L. K. Frankel. J. Franklin Inst. 1891, **13**, 144—150.

In a previous paper on the above subject by the present author in conjunction with E. F. Smith (this Journal, 1890, 80) the statement was made that manganese when deposited from a solution containing an excess of potassium sulphocyanide separates as a greyish-white deposit on the negative pole, differing in this respect from solutions of the nitrate or the sulphate from which manganese is deposited as oxide. Furthermore, it was stated that nickel, cobalt, iron, and several other metals separate very rapidly from cold sulphocyanide solutions under the influence of a weak current. In the present paper the above experiments have been repeated, and the action of the current has been tried on various other metallic sulphocyanides, but the results have been for the most part of a negative order.

The decomposition of concentrated alkaline sulphocyanide is described, and the production of a lemon-yellow amorphous deposit, which the author finds to be similar and identical with Bunge's "pseudosulphocyanogen" (Ber. **3**, 297), also described by Lidon, and with "Canarin" (perthiocyanogen, or persulphocyanogen), a yellow colouring matter obtained by the action of chlorine or bromine on sulphocyanic acid (see this Journal, 1884, 166—167, 255, and 476).

In dilute sulphocyanide solutions, however, the formation of the lemon-yellow compound takes place in but small quantities and only after the lapse of considerable time, so that if the current be sufficiently weak and the solution sufficiently dilute, no turbidity will take place in the solution. It was anticipated that this behaviour of the

dilute solution could be utilised for the electrolytic deposition of the metals, but the other products of decomposition exerted such an influence on the solution that in but very few cases were quantitative results obtained. Mercury and gold were the only two metals which gave satisfactory results, the other metals, viz., cadmium, palladium, nickel, cobalt, zinc, iron, manganese, lead, antimony, bismuth, and tin, yielding no satisfactory results whatever.—O. H.

ORGANIC CHEMISTRY.—QUALITATIVE.

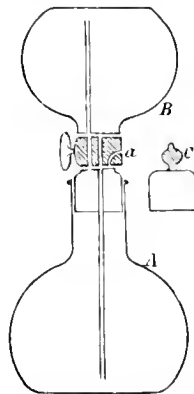
The Detection of Turkish Geranium Essence in Rose Oil. G. Panajotow. Ber. 1891, **24**, 2700—2701.

THE rose oil which is brought into the market both from South Bulgaria and from Turkey is very often adulterated with Turkish geranium essence (*Indris yaghi*). The adulterant can be detected by means of a solution of rosaniline decolourised by sulphur dioxide (Schiff's reagent). 2—3 drops of Turkish geranium oil, when shaken with 2 cc. of the reagent in the cold, give first a blue-violet and after two hours a fine blue colouration. Rose oil similarly treated gives a red colouration after prolonged standing (24 hours). Even the smallest traces of the geranium oil can be thus detected by the blue colouration formed on shaking the sample of the rose oil with the above reagent, owing to the fact that it forms so much more quickly than the red colouration produced by the pure rose oil. The geranium oil can also be detected by treatment with strong sulphuric acid. Turkish geranium oil dissolves in this acid to form a thick brown-red liquid which, when treated with 95 per cent. alcohol, turns turbid and separates a flocculent yellow precipitate, whilst the solution becomes red, and after standing some time, yellow. Rose oil also forms a brown-red solution when treated with strong sulphuric acid, but this, when treated with alcohol, dissolves to a clear, colourless solution (compare this Journal, 1891, 63 and 269).—C. A. K.

ORGANIC CHEMISTRY.—QUANTITATIVE.

On an Extraction Apparatus for the Determination of Fat in Milk. E. Molinari. Ber. 1891, **24**, 2204—2209.

IN 1888 Schmid devised a method (this Journal, 1888, 395) for the determination of fat in milk in which 10 cc. of the milk were boiled in a graduated tube with 10 cc. of concentrated hydrochloric acid. 30 cc. of ether were then added to the cooled liquid, and after shaking the volume of the upper layer, was read off, an aliquot part taken, evaporated to dryness, and the residue of fat weighed. The chief objections to this method are that a brown colouring matter is formed by the action of the acid on the casein, which interferes with the observation of the line of separation of the liquids, and also that one extraction with ether is not sufficient to remove all the fat. To avoid these difficulties the author has devised the apparatus figured below:—



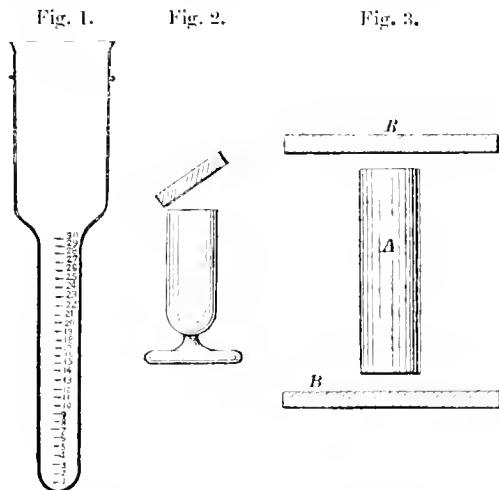
APPARATUS FOR DETERMINATION OF FAT IN MILK.

In order to use the apparatus, 10 cc. of milk are weighed or measured into A, 10 cc. of hydrochloric acid are added, and the liquid heated to boiling and boiled for 1½ minutes, with occasional shaking. The liquid becomes first rose-coloured and afterwards brown (not black). The liquid is now cooled, 25 cc. of ether are added, and the two well shaken together. The apparatus is now inverted, allowed to stand for 5–6 minutes, when the dark-brown aqueous portion is run into the flask B, the tap being turned, so that the air-opening *a* communicates with B. After separation of the acid liquid, the apparatus is now replaced in its original position and A is removed. 10 cc. of ether are poured into the cap of B and allowed to enter. After shaking, B is inverted and the brown aqueous liquid drawn off. A is now replaced, and the two ether extracts and washings allowed to mix in A and washed twice with water, the aqueous liquid being drawn off as before. Finally, the ether is evaporated in A, and the residual fat weighed.—H. K. T.

The Use of the Centrifugal Machine in Analytical and Microscopical Work. W. Thorner. Chem. Zeit. 1891, 15, 1201–1203.

THE author has applied the principle of centrifugal separation, which has been already successfully used for the determination of fat in milk by means of the “Lactocrite,” to the analysis of flour, butter, and other food products. The machine used is that known as the Victoria hand separator, which permits a speed of 6,000–7,000 revolutions per minute being obtained.

(1.) *Analysis of Flours and Starches.*—One gram. of the substance to be tested was mixed with water, alcohol, or ether in the tube shown in Fig. 1 to within about 2 cm. of



APPARATUS FOR CENTRIFUGAL SEPARATION.

the upper edge, the contents of the tube well shaken until all lumps had been broken up, and rotated for precisely five minutes at a speed of 2,000–2,500 revolutions per minute. The tube illustrated has a capacity of about 15 cc., while its lower, narrower part holds about 3 cc. and is divided into divisions of 0.1 cc., while these again are sub-divided into fifths so that a volume of 0.2 cc. can be read. The following table shows some of the results.

The results given are the mean of several concordant determinations. The figures in the last three columns represent the volume occupied by the 1 gm. of the sample taken expressed in tenths of a cc. It is apparent, on inspection, that water is the most suitable liquid to use, as it gives greater differences with samples of different origin than either alcohol or ether. The large volume occupied by rye flour as compared with flour from wheat, affords a

	Percentage of Water.	Water.	Alcohol.	Ether.
Wheat flour, I.	14.6	14.3	16.6	15.2
Wheat flour, II.		14.5	16.5	15.6
Wheat flour, III.		15.3	16.0	15.0
Rye flour, I.	14.0	30.0	16.4	16.0
Rye flour, II.		30.0	16.0	15.7
Oat flour.	11.9	30.0	17.8	17.0
Barley flour.	12.5	22.0	16.5	14.0
Pea flour.	17.6	22.4	20.6	18.0
Buckwheat flour.	14.8	19.5	15.8	15.5
Rice flour.	13.8	19.8	14.2	13.9
Rice starch.	15.0	12.6	15.8	15.8
Potato starch.	11.1	13.3	11.0	12.0
Mondamin.	14.1	13.6	12.0	12.4

means for the detection of the former when mixed with the latter as an adulterant. How far this is possible is shown by the following table:—

Percentage of Rye Flour.	Volume in Tenths of 1 cc.
0	14.3
10	15.2
20	16.3
30	17.7
40	18.6
50	20.4
60	21.2
70	23.2
80	26.0
90	28.5

The results hitherto recorded were obtained with ordinary air-dried samples; the percentage of water had a certain influence on the results, though its exact amount has not yet been discovered. The remaining figures are, however, obtained from samples dried at 100°–102° C.

	Volume in Tenths of 1 cc.
Wheat flour, I.	15.4
Rye flour, I.	33.0
Oat flour.	30.0
Barley flour.	22.8
Pea flour.	25.3
Buckwheat flour.	22.8
Rice flour.	23.8
Rice starch.	15.0
Potato starch.	16.8
Mondamin.	15.3

The figures given by a mixture of wheat and rye flour similarly dried were not greatly different from those recorded above for air-dried samples.

The weighing of 1 gm. or 2 grms. of the sample may be conveniently avoided by the use of the little measuring

glass shown in Fig. 2, which contains a definite quantity of flour when gently filled and closed by sliding a small glass plate over the top.

The author has applied the method to the determination of mineral additions, such as chalk and barium sulphate. The centrifugal machine can be usefully applied to the preparation of articles to be examined microscopically. For this purpose 5 grms. of flour are heated with 500 grms. of water on a water-bath. 100 cc. of the resulting liquid are treated with 5 cc. of glacial acetic acid, and another 100 cc. with 1 cc. of caustic potash solution (1:2), then heated for ten minutes on the water-bath and rotated for five minutes. The residue of husks, &c. left at the bottom of the tube after rotation lends itself readily to microscopic examination.

(2.) The method above described is applicable to the determination of the watery constituents in butter or margarine. The measurement of the butter for technical purposes is best effected by the little apparatus shown in Fig. 3, which has a capacity of 10 cc. The tube A having been filled with butter, its ends are closed with plates B B and it is, after being wiped, transferred to the tube of the centrifugal machine, which is placed in a water-bath so as to melt the butter and allow it to run out of A into the centrifugal tube. The tube is then rotated at about 2,000 revolutions per minute for two or three minutes. At the end of this time the lower layer, which has separated from the fat, is seen to consist of two portions, the lower being almost clear and generally containing some crystals of salt and other mineral additions that may be present, as well as such organic materials as flour or starch, and the upper consisting mainly of a layer of caseine suspended in water. The relation of these two layers varies considerably, but their sum represents the total amount of butter-milk present.

The author has also attempted to apply the above method to the determination of fatty acids in butter, using a special form of tube with a narrow graduated neck for reading off the volume of the separated fatty acids. The saponification and subsequent separation of the fatty acids are carried out in the same tube. In conjunction with the above method for the examination of butter, the author recommends the use of the refractometer, the form devised by Pulfrich being convenient. By such means, data said to be sufficient for judging the quality of a sample of butter may be obtained in a short space of time.—B. B.

The Determination of Indigotin in Indigo. F. Ulzer. Mittheil. Techn. Gewerbe-Museums, 1891, 178—184.

THE author has examined the various methods in use, or recently proposed (this Journal, 1885, 489, 491; 1887, 455; 1888, 459; 1889, 640; 1891, 488 and 721) for testing indigo, and considers satisfactory those only which aim at effecting a separation of the indigotin in a pure state. Such a method is the following, which to some extent is an improvement upon a method employed in the laboratory of L. Biach:—A solution of sodium stannite is prepared by the addition of sodium hydrate to 10 cc. of a solution of stannous chloride containing 88 grms. of the crystallised salt per litre. About 0.8 gm. of finely-powdered indigo is mixed with this solution and allowed to stand, with occasional agitation, for an hour, to effect the reduction of the indigotin; 15 cc. of hydrogen dioxide solution (10 vols) are added, and the whole allowed to stand for another hour; then the mixture is acidified with dilute sulphuric acid, heated to boiling and filtered through a weighed filter. The precipitate so obtained, after being washed successively with boiling water, dilute potassium hydrate solution, and hot alcohol, is dried at 100° and weighed. It is then ignited, and the weight of the ash deducted from the previous weighing, the difference giving the amount of indigotin present. The treatment with dilute sulphuric acid removes from the indigo indigo-gluten and similar matters, that with potash and alcohol the indifuscin (indigo-brown) and indirubin (indigo-red) respectively. The washing with alcohol must be discontinued when the filtrate, which initially has a brown

or red colour, shows a clear, pale-blue colour. The following results were obtained:—

	Indigotin.		
	I.	II.	III.
Indigotin (prepared by Fritsche's method).	Per Cent. 97.85	Per Cent. 97.80	Per Cent. ..
Commercial indigo (inferior quality)	44.19	43.91	44.50
Bengal indigo	75.91	75.40	74.81
Tirhoot indigo	57.92	..	..
Benares indigo.....	54.39	..	..
Indigo (manufactured by ammonia process).	30.05	..	..

In a series of experiments made with a view to dispensing, if possible, with the dissolution of the reduced indigo, finely-powdered indigo was treated directly with hot alcoholic potash, then with dilute hydrochloric acid and finally with water. The results obtained, however, were in all cases much too low, the indigotin being apparently acted upon by alcoholic potash. Simultaneous treatment of the indigo with alcohol and alkali being, therefore, unfeasible, recourse was had to Berzelius' method of purification:—A mixture of 0.6 gm. of powdered indigo and 50 cc. of a 5 per cent. solution of sodium hydrate was heated to the boil, cooled, diluted, and filtered through a weighed filter-paper, and the residue washed with boiling water, dilute hydrochloric acid (1:10), and finally with alcohol, then weighed and ignited. In this manner the following results were obtained:—

	Indigotin.		
	I.	II.	III. = First described Method.
Indigotin.....	Per Cent. 98.58	Per Cent. ..	Per Cent. 97.85
Commercial indigo (superior quality).	66.87	66.21	64.35
Commercial indigo (inferior quality).	15.12	44.22	42.01

As it is improbable that any considerable over-reduction of the indigotin takes place in the first-described method of analysis, the author concludes that the last method yields results 2—2.5 per cent. too high. Should further experience prove that this relationship is constant, the latter method would be preferable by reason of its greater rapidity, the results obtained being corrected to the extent mentioned. A correction must also be made for the loss of weight sustained by the filter-paper used for collecting the indigotin, this loss amounting to approximately 1 per cent. of the weight of the dry paper.—E. B.

Method for the Valuation of Extracts of Logwood. v. Cochenhausen. Monit. Scient. 1891, 5, 943—948.

See under VI., page 32.

PATENT.

Improvements in Apparatus for Testing the Quantity of Cream in Milk. H. E. Newton, London. From L. J. Augustenborg and R. Hansen, Kolding, Denmark. Eng. Pat. 14,797, September 1, 1891. 6d.

See under XVIII.—A., page 52.

Chestnut-Wood Tannin. H. Trimble. Jour. Franklin Inst. 1891, **132**, 303—307.

See under XIV., page 47.

Reduction of Oxygen Compounds by Magnesium. C. Winkler. Ber. 1891, **24**, 1966—1984.

See under X., pages 39—40.

ANALYTICAL AND SCIENTIFIC NOTES.

On the Colloidal Sulphides of Gold. E. A. Schneider. Ber. 1891, **24**, 2241—2247.

See under X., page 40.

Metallic Hydrosulphides. S. E. Linder and H. Picton. Proc. Chem. Soc. 1891—1892, 176.

THE authors have investigated the sulphides of copper, mercury, arsenic, antimony, cadmium, zinc, bismuth, silver, indium, and gold. With the single exception of bismuth, all these metals form hydrosulphides of a more or less complicated character, which, in most cases, undergo molecular condensation with elimination of sulphuretted hydrogen when submitted to the action of acids. Taking copper as a type, on treatment with sulphuretted hydrogen, copper hydrate forms a solution of the hydrosulphide $7\text{CuS} \cdot 11\text{H}_2\text{S}$. Acetic acid, in presence of excess of sulphuretted hydrogen, promotes molecular condensation, a product being formed which has approximately the composition $9\text{CuS} \cdot 11\text{H}_2\text{S}$; while acetic acid, in absence of sulphuretted hydrogen, promotes the formation of a product approximately represented by the formula $22\text{CuS} \cdot 11\text{H}_2\text{S}$. Hydrochloric acid produces still further condensation. Mercuric sulphide forms products approximately represented by the formulae $31\text{HgS} \cdot 11\text{H}_2\text{S}$; $62\text{HgS} \cdot 11\text{H}_2\text{S}$. The latter formula represents the precipitate formed in presence of acid, and is a remarkably stable substance. Zinc sulphide solution obtained from the hydrate contains about 14 per cent. excess of sulphur as sulphuretted hydrogen; in presence of acetic acid, a product represented approximately by the formula $12\text{ZnS} \cdot 11\text{H}_2\text{S}$ is formed.

The authors regard their results as evidence tending to support the conclusions that the metallic sulphides are in most cases polymerides of very high molecular weight.

The Physical Constitution of some Sulphide Solutions. H. Picton. Proc. Chem. Soc. 1891—1892, 176—177.

THE author has specially examined the solutions of mercuric, antimonious and arsenious sulphides. In each case the whole of the dissolved sulphide is found to be present in the form of very finely-divided particles. Arsenious sulphide is found capable of existing in "solution" in three distinct types of sub-division. The following examples illustrate the main characteristics of sulphide "solutions":—

Mercuric sulphide.—Particles are visible under the microscope (1,000 diameters); not diffusible even in absence of a membrane.

Arsenious sulphide (α).—Particles are just visible.

Antimonious sulphide.—Particles are not visible, and it is not diffusible, but particles are detected by their power of scattering light, the scattered light being polarised.

Arsenious sulphide (β).—Not diffusible; the particles scatter and polarise light.

Arsenious sulphide (γ).—Diffusible in the absence of a membrane; particles are shown to exist by optical behaviour.

The solutions examined exhibit a series passing from those in which the particles of the solid are visible to those in which the particles simulate the phenomena of liquid diffusion, and, although not visible to the eye, are detected by their power of scattering light.

Solution and Pseudo-Solution. Part I. H. Picton and S. E. Linder. Proc. Chem. Soc. 1891—1892, 177.

THE authors advance what they regard as a good *prima facie* case for the belief that there is a continuous series of grades of solution passing without break from suspension to crystallisable solution. They hold that in the lowest grades of solution a certain loose attraction exists between the particles and the molecules of the solvent. This conclusion they support with experimental evidence gathered from their own work and from other sources. They regard the very finely-divided particles in the lower grades of solution (colloid solution) as large molecular aggregates retaining many of their molecular properties. They consider that in passing up through the different grades of solution, these aggregates on the whole become smaller and the forces by which they are held in solution become more definitely those of chemical attraction. They describe a new property, which seems to hold for a large range of solutions, extending from suspension to crystallisable solution. This property consists in the repulsion of the dissolved substance, as a whole, from one of the electrodes of a battery immersed in the solution. Thus, in the case of colloidal arsenic sulphide, the sulphide aggregates are repelled from the negative electrode. They are also repelled, but much less strongly, from the positive electrode. In the case of the crystallisable colouring matter Magdala red in absolute alcohol, an exactly similar phenomenon is observed, but the repulsion is this time from the positive electrode, and there is no perceptible repulsion from the negative electrode at all. The property is of much interest in itself, but also as exhibiting similarities between the different grades of solution.

In discussion, Mr. Page suggested that observations on the nature of solutions, such as those described by the authors, might with great facility be carried out in capillary tubes under the microscope. Mr. Walenn said that in working with electro-coppering solutions containing resin in suspension he had had occasion to notice a clearing of the liquid at the anode, such as had been referred to. Professor Ramsay said that the problem of Brownian motion, or pedesis, had engaged his attention since 1878, when he published a paper in the "Proceedings of the Geological Society" bearing on the settling of mud in salt water. The problem attacked by Messrs. Linder and Picton was one in which he thought pedesis played an all-important part, as the small particles, the existence of which had been proved by their power of polarising light, were in exceedingly rapid motion. The authors had shown that there is a regular transition from visible particles to particles or molecules such as those of oxyhaemoglobin. It must, therefore, be concluded that such exceedingly small particles are also in rapid motion; and the smaller the particle the more rapid the motion. Pedesis had not received, as yet, any satisfactory explanation; the only fact which appeared to throw any light on its nature was that the addition of a salt to the solvent, rendering it an electrolyte, hindered pedesis, and finally caused coagulation and settling. The discovery of the true nature of pedesis would in all probability be the key to the problem of the nature of solution. Mr. Warrington pointed out that the coagulation of clay by salts had been studied by Schloesing (Chimie Agricole, p. 62; Frey's Encyclopédie, tome X) and W. Skey (Chem. News). Mr. Herbert Jackson said that the phenomena discovered by the authors were similar to those observed in the case of the liquids produced during the washing of many precipitates, such, for instance, as lead hydrate or silver nitroprusside, which refuse to settle completely as soon as the liquid in which they are diffused becomes approximately pure water, or which show a tendency to come through the paper when washed on a filter. Such precipitates can be made to furnish turbid liquids in which the particles are so fine that they will not settle for many months, although, as is well known, the addition of a drop or two of a saline solution, e.g., sodium acetate or potassium nitrate, will cause rapid deposition of the solid.

These opalescent liquids give the results described and shown by the authors when examined at right angles to a narrow beam of strong light.

He had found in the case of lead hydrate that the microscope revealed moving particles with an average diameter of $\frac{1}{300000}$ of an in. Some, in the case of silver nitroprusside, were less than $\frac{1}{700000}$ of an in.

It is quite clear that it is impossible to call a liquid homogeneous because the microscope fails to show structure. All that can be said is that the particles in water, if not visible with lenses of the greatest possible angle for water, are probably not much greater than the $\frac{1}{300000}$ of an inch in diameter. Of course it must be understood that changes in the limits will be observed when the refractive index of the particles differs very greatly from that of the fluid in which they are diffused, as is the case with As_2S_3 in water. It seems probable, therefore, that the phenomena observed in the cases of As_2S_3 , and others which were mentioned, differ only in degree, and not in kind, from those in the cases of Sb_2S_3 , and similar bodies, and from the opalescent liquids obtained in washing many precipitates.

New Books.

CHEMISCH-TECHNISCHES REPERTORIUM. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der Technischen und Industriellen Chemie, mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. EMIL JACOBSEN, 1890. Zweites Halbjahr. Zweite Hälfte. Berlin, 1892, R. Gaertner's Verlagsbuchhandlung. Hermann Heyfelder, S.W. Schöneberger str. 26. London: H. Grevel and Co., 33, King Street, Covent Garden.

THE Technological Repertorium closes for the year 1890 in a volume, the pages of which run from 97 to 224. It ends with an Alphabetical Index. The text is embellished with numerous woodcuts, and pages 217 to 223 are filled with a report of New Books which have appeared in the period covered.

The subjects treated are as follows:—Food Stuffs; Paper; Photography; Residuals, Manures, Disinfection, and Sanitation; Soaps; Explosives; Preparation and Purification of Chemicals; Chemical Analysis; Apparatus, Machinery; Electro-technology; Thermo-technology. Appendix. Special Preparations, Adulterants. New Books,

KURZES LEHRBUCH DER ANALYTISCHEN CHEMIE. Dr. W. v. MILLER und Dr. H. von KILLIAN, Professoren an der k. Technischen Hochschule. München. Zweite vermehrte und verbesserte Auflage. Munich: Theodor Ackermann, Königl. Hof. Buchhändler, 1891. London: H. Grevel and Co., 33, King Street, Covent Garden.

OCTAVO volume bound in the usual paper cover. It contains Title Page, preface to the second edition, Table of Contents, Table of Abbreviations, Table of Atomic Weights, and 598 pages of subject-matter, followed by two tables, one of the Tension of Aqueous Vapour and the other of the Density of Gases. The work is concluded by an Alphabetical Index. Ninety-six woodcut illustrations are contained in the text.

The division of the matter is somewhat novel, though undeniably very effective. It is as follows:—GENERAL METHODS. Qualitative and Quantitative Analysis. Drying of Solid Substances. Weighing of the Substance for Analysis. Solution of Solid Substances. I. Gravimetric Analysis. II. Volumetric Analysis. III. Gas Analysis. I. PART.—THE METALS. First Group: The Alkalies. Second Group: The Alkaline Earths. Third Group, Fourth Group. Fifth Group. II. PART.—THE NON-

METALS. Phosphorus. Nitrogen. Sulphur. Silicon. Boron. Chlorine. Bromine. Iodine. Fluorine. Carbon. Elementary Analysis of Organic Bodies. Analysis of Smoke, Heating, Illuminating, and other Gases. Estimation of Water in Solid Bodies. Spectrum Analysis. The last page of the book contains a chromo-lithograph of the Solar Spectrum. The price of the work is 10s.

ANALYSE DER FETTE UND WACHSARTEN. VON DR. RUDOLF BENEDIKT, Professor an der k. k. Technischen Hochschule in Wien. Zweite Auflage. Berlin: Verlag von Julius Springer, 1892. London: H. Grevel and Co., 33, King Street, Covent Garden.

THIS work now runs into a second edition, and consists of an 8vo. volume strongly bound in cloth. It commences with a Preface, and this is succeeded by a Table of Contents. The text covers 460 pages, and concludes with an Alphabetical Index. Thirty-two well executed wood engravings illustrate descriptions of apparatus, &c., given, and the general mode of treatment of the subject may be gathered from the following excerpt of the sub-divisions of the work:—I. Constituents of the Fats and Waxes. A. Acids. B. Alcohols. II. Physical and Chemical Properties of the Fats and Waxes. 1. Fats. 2. Waxes. 3. Behaviour of the Fats during Saponification. III. Estimation of the Substances not Fats, in Mixtures of Fats, and Preparation of the Substance for Analysis. IV. Methods for Determining the Physical Properties of the Fats. V. Elementary Analysis of the Fats. VI. Quantitative Scientific Investigation of a Fat of unknown Origin. VII. General Methods for Determining the Quantitative Composition of Fats and Fatty Mixtures. A. Quantitative Reactions. B. Quantitative Estimation of Single Constituents of the Fats. VIII. Recognition and Quantitative Estimation of such foreign Substances as are contained dissolved in the Fatty Substance, or melted up with it. A. Estimation of Unsaponifiable Substances. B. Detection of small quantities of Fats in Mineral Oils. C. Investigation of the Unsaponifiable Constituents. D. Detection and Estimation of Resins and Colophony in Fat. IX. Investigation of Materials and Products of the Fat Industry. A. Candles. B. Soaps. C. Turkey-red Oil. D. Lubricating Oils, &c. 1. Glycerin. X. Investigation of Oils. XI. Investigation of Solid Fats and Waxes. XII. Description of Individual Fats and Waxes. XIII. Examples. The price of the work is 9s.

EXPLOSIVES AND ORDNANCE MATERIAL, considered with reference to some recent experiments with Emmensite, Gelbite, and Aluminium Bronze. By STEPHEN H. EMMENS, Member of the U.S. Naval Institute, of the Society of Chemical Industry, &c. Reprinted from the Proc. U.S. Naval Institute, Vol. XVII., No. 3. Baltimore Press of Isaac Friedland Co. 1891.

THIS is a treatise reprinted from the Proceedings of the U.S. Naval Institute, and is handsomely bound in cloth, forming a volume of large 8vo. size. The pages, numbering 91, are adorned with 11 well-executed photo-lithographic plates. The treatment of the subjects may be gathered from the following sub-division of the text:—Chap. I. The Ballistic Theory of Explosives. II. The Ballistic Theory of Explosion Stress. III. The Comparison of Explosives. IV. Some Remarks upon the Foregoing Tables, and upon the Humanity of Text-books. V. Emmensite. VI. Gelbite. VII. Aluminium Bronze and Ferro-Nickel. The work closes with an ADDENDUM giving some additional results acquired after the preceding matter had been written.

A TEXT-BOOK ON THE SCIENCE OF BREWING. By EDWARD RALPH MORITZ, Consulting Chemist to the Country Brewers' Society, and GEORGE HARRIS MORRIS, Ph.D., F.C.S., F.I.C. Based on a Course of Six Lectures delivered by E. R. Moritz at the Finsbury Technical College of the City and Guilds of London Institute. London: E. and F. N. Spon, 125, Strand. New York: 12, Cortlandt Street. 1891.

LARGE 8vo. volume bound in cloth, with Preface, Introduction, Table of Contents, List of Plates, 514 pages of subject matter, illustrated by 13 well-executed wood engravings and 10 excellent plates exhibiting Microscopic Images. The matter is arranged and sub-divided as follows:—SECTION I. MATERIALS. Chap. I. Brewing Waters. II. Barley and Malt. III. Malt Substitutes. IV. Hops. SECTION II. PROCESSES. Chap. V. Mashing and Sparging. VI. The Boiling of the Wort. VII. Fermentation. VIII. The Racking and Storage of Beer. SECTION III. Chap. IX. The Analysis of Water. X. The Analysis of Malt and Wort. XI. The Analysis of Sugars and Hops. XII. The Analysis of Beer. APPENDIX. Preparation of Standard Solutions. The price of the work is 21s.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

(From the Board of Trade and other Journals.)

RUSSIA.

Customs Decisions.

Note.—Pound = 36 lb. avoirdupois. Rouble = 100 copecks = 3s. 2d.

The following decisions affecting the classification of articles in the Russian Customs tariff have recently been given by the Russian Customs authorities:—

Bones treated with muriatic acid and forming a raw cartilaginous mass (osseine) under section 43, point 2 of tariff.—Duty, 1 rouble 20 cop. gold per pound.

An antimonial preparation representing a raw and an unpurified oxide of antimony under section 92, point 1.—Duty, 20 cops. gold per pound.

Manufactures of Britannia metal not gilt or silvered, even though with stamped ornamentation in relief, under section 149, point 1 (duty, 4 roubles and 80 cops. gold per pound); and the same manufactures with cast or engraved ornamentation in relief, under point 2 of the same section.—Duty, 16 r. gold per pound.

Zinc in rods, under section 147, point 1.—Duty, 50 cops. gold per pound.

Manufacture of copper and copper alloys not gilt or silvered, with cast ornamentation in relief, even though these ornaments form the lids, handles, feet, &c., of these goods, under section 149, point 2.—Duty, 16 r. gold per pound.

Coal tar under section 83, point 3.—Duty, 20 cops. gold per pound.

SWEDEN.

Oleomargarine is henceforward to be treated as butter. Lead wire is freed. At present it pays 1d. per kilo.

SWITZERLAND.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220.4 lb. avoirdupois. Franc = 9 $\frac{1}{10}$ d.

The following decisions affecting the classification of articles in the Swiss Customs tariff were given by the Swiss Customs authorities in the month of November last:—

"Benzolina" (a liquid for removing stains, benzole with the addition of a little ether).—Category 9. Duty, 10 francs per quintal. "Benzolina" is also liable to a monopoly tax (*finance de monopole*) of 3 francs 50 cents. per quintal gross weight.

Manufactures of aluminium.—Category 143. Duty, 16 francs per quintal.

Sulphurous acid, compressed, in tank waggons, is classified at the rate of 2 francs per quintal, according to the net weight, increased by a tare of 30 per cent. of this net weight.

ITALY.

Changes in Customs Duties and Regulations.

Note. — Quintal = 220.4 lb. avoirdupois. Kilog. = 2.204 lb. avoirdupois. Hectolitre = 22 Imp. gallons. Franc = 9 $\frac{1}{10}$ d.

Communications, dated the 8th and 31st December last, have been received from the Foreign Office, transmitting a copy and translation of an Italian decree dated the 22nd November last relative to changes in the Italian Customs duties and regulations, and also copies and translation of a later decree of the 24th December affirming and modifying the stipulations of the same. The various changes introduced by these two decrees are as follows:—

Modifications in Internal Taxes on Manufactures as effected by the Decree of the 22nd November.—Art. 1. The internal tax on the manufacture of sugar is fixed at 63.15 francs for each quintal of sugar of the first class, and 55.95 francs for each quintal of sugar of the second class.

Art. 2. The internal tax on the manufacture of spirits, and the surtax on the importation of spirits from abroad, are fixed at a scale of 140 frs. for each hectolitre of pure alcohol of the temperature of 15.56° measured by centesimal thermometer.

Art. 3. This article is suppressed by the later decree.

Art. 4. The following products which have an alcoholic basis, when imported, are liable to a surtax at the following scale:—

No. in Tariff.	
5	Ether and chloroform, 3.40 frs. per kilo. of ether or chloroform, without abatement for the weight of the actual receiver.
8	Spirituous essences of rum, cognac, or others containing spirit, 0.86 fr. per kilo., without abatement for the weight of the vessel containing the essence.
66	Perfumes containing alcohol, 100.00 frs. per quintal, without abatement for weight of vessel containing.
73	Spirit varnish, 95.00 frs. per quintal at net legal weight.

Art. 5. The tax on the manufacture of beer is fixed at 1.20 frs. for each degree of strength measured with the centesimal saccharometer at a temperature of 17.50° C. for every hectolitre of beer.

In paying this tax the maximum limit of saccharometric degrees is fixed at 16 and the minimum at 10.

(Details follow as to method of test.)

Art. 6. The surtax on beer imported from abroad is fixed at 19.20 frs. per hectolitre, with a facultative reserve to the importer of paying at the scale of its saccharometric or alcoholic degrees if effectually ascertained.

Art. 2 of the decree of the 24th December provides that the tax referred to in Art. 2 of the aforesaid decree is understood to refer only to those who receive goods direct from the place of their origin (*ai soli recipienti d'origine*).

Arts. 3 to 6, inclusive, refer to distilling.

Art. 7. In the case of beer exported to foreign countries, the excise paid in the kingdom shall be restored at the rate of 12 lire (about 10s.) per hectolitre.

Art. 8. Barley intended for the manufacture of beer is allowed a free entry under the conditions established by Royal decree.

Art. 9. Glucose exported to foreign countries is granted a relief from taxation of 90 per cent. by means of a corresponding subtraction from the certified amount manufactured (*accertamenti di fabbrica*).

Art. 10. The amount of the tax on the fabrication of spirit used in the manufacture of vinegar (*aceto*) is fixed at the rate of 70 lire per hectolitre of pure alcohol.

Art. 11. The temporary import of sugar destined for use in the production of sweets (*canditi*) for export is permitted without consulting the Superior Council of Commerce, according to the forms and methods which shall be ordained by Royal decree.

NEW CUSTOMS TARIFF OF MEXICO.

(See *Board of Trade Journal* for January, p. 55 seq.)

TARIFF ON PETROLEUM IN FRANCE.

Report by C. Lavollée for the Committee of Commerce. Bull. de la Société d'Encouragement pour l'Industrie Nationale, 1891, 6, 277—284.

This report compares the duties levied on petroleum oils imported into France, with the tariffs in existence in other European countries, and also gives a history of the origin of the various duties imposed since 1864. The main object of the report is to show the necessity of reducing the protective rates on this import. The author refers to a paper read before the Society on 8th February 1889 by Mr. Besnard relating to the state of perfection to which the manufacture of mineral oil lamps had then been brought, and to the advantages that at that time would have followed a decrease in the Customs dues. M. Rousselle in April 1890 brought to the notice of the Society the small quantity of mineral oil used in the country, and solicited an investigation on this matter by the Committee of Commerce. In accordance with this suggestion a report was drawn up supplementary to the communication of M. Besnard.

The first duty levied on petroleum dates from 4th June 1864, crude petroleum being admitted free and refined oil at 3 francs per 100 kilos. The consumption of oil steadily increased till the eventful year 1871. The use of mineral oil by incendiaries produced an unfavourable impression on this import at that time, and at a sitting of the National Assembly on 29th May 1871 a statute was passed "forbidding the sale or storage of petroleum (or any other mineral oil) without the district police prefect's permission. The penalties for breaking this law were very stringent (fines varying from 16—1,000 frs., and imprisonment from one month to two years). In July in the same year, however, crude oil was admitted at a duty of 20 frs., and refined oil at 32 frs. per 100 kilos. respectively. This tariff was augmented in 1873 to 30 and 37 frs. on the crude and refined oils. In 1881 the duties were altered to 18 frs. on crude and 25 frs. on refined oil per 100 kilos. The Government at present (June 1891) proposes a tax of 18 and 24 frs. for crude and refined oils respectively, the Commission suggesting 1 fr. less for the refined oil. The tariff in 1871 was a measure of social defence, and has become little by little a protective duty for the benefit of the refining industry. The refiners state a high protective tariff is necessary to maintain their industry, their opponents declaring, however, that their industry is very flourishing, and that favour accorded to refiners, who are few in number and employ few hands, prejudices other commerce. From American statistics we find a great excess of petroleum imported by us is crude, a different feature in comparison with other countries. The following figures speak for themselves.

OIL EXPORTED FROM NORTH AMERICA, 1888-89.

	Crude Oil.	Refined Oil.
	Gallons.	Gallons.
France	53,955,708	2,602,061
Germany	3,064,421	138,518,352
England	8,634	58,763,730
Belgium .....	.. ..	38,000,000
Holland .....	.. ..	41,000,000

Now it seems a strange thing to induce such an extensively industrious country as North America to export a natural earthy product in a crude state when economy in transit and manipulation would be made by exporting the refined oil.

It is stated that lighter dues levied on the mineral oils would very nearly ruin the vegetable oil trades, the colza oil industry, being the one of most importance, supplying 70 per cent. of the total bulk to these oils: the colza oil produced in France during 1887 being valued at 32,000,000 francs. The quantity of oil is annually decreasing in production, owing, firstly, to extension of other lighting agencies, and, secondly, to the farmers preferring to grow other crops, principally beetroot. This diminution of colza production is also noticed in Belgium and Germany.

The receipts resulting in the mineral oil tariff are perhaps the most important question. In 1871 revenue was 5,000,000 francs; in 1880 (on 63 million kilos.) 21,000,000 francs; in 1888 (on 155 million kilos.) was 32,000,000 francs.

The French consumption has enormously increased during the last 10 years, and the Parisian consumption has multiplied three-fold in the last 10 years, notwithstanding the double duty of Customs and city fees. It is natural that a reduction in tariff must affect the receipts, but it is not more certain that the deficit will be almost immediately supplied by the augmented consumption.

As an example of comparative consumption Belgium uses four times the quantity of oil proportionally to France. In Belgium and England neither crude or refined oils pay duty. In Holland equivalent to 1.17 francs per 100 kilos.; Switzerland, equivalent to 1.25 francs per 100 kilos.; Italy, equivalent to 4.00 francs per 100 kilos.; Germany, equivalent to 7.50 francs per 100 kilos.

If these tariffs are compared with the French scale of duties, the excessive amount of the latter can easily be seen. A strong point of argument in favour of lowering the mineral oil tax is in the fact that a tax is, as a rule, in some measure proportionate to the value of the goods taxed. Now, taking the tax of 18 francs imposed on crude petroleum in 1881, the price of the oil has so much decreased that at the present time the duty is about 120 per cent. of the value of the product. To be just and equitable all taxes ought to be calculated in moderate proportion to the value of the material taxed. It appears very necessary to reduce these excessive rates at once; a very large number of consumers would be benefited, and an impetus given to the trade now that lamps and better rectification of the oils has largely increased the value of these oils as illuminants. The extending uses of these oils for petroleum engines and other devices render the taxation on this article a serious and shortsighted policy which the Committee of Commerce strongly wish to see altered.—E. F. H.

GENERAL TRADE NOTES.

COCAINE IN INDIA.

An inquiry was some time ago instituted through the Secretary of State by Dr. McNamara, Examiner of Medical Stores, Madras, if the hydrochlorate of cocaine, which in England costs 12l. per pound, could not be more economi-

cally manufactured either at the Government opium agencies or at one of the quinine factories in India. The Allahabad *Pioneer Mail* says that the matter was considered, and it was found that there ought to be no difficulty in extracting the alkaloid in a laboratory such as that possessed by the Medical Stores Department, Madras. In a reference, however, to the surgeon-general it was found that the total annual consumption of the drug was only $4\frac{1}{2}$ lb., and so it was decided that, for the present at least, it would not be worth while making it. The *Erythroxylon coca* has now been cultivated for many years in several parts of the Presidency. It grows like a weed, and the yield of cocaine from the leaves is fully equal to that obtained from the American shrub. Should there, therefore, be at any time a larger demand for this alkaloid, there would be no difficulty in obtaining a very large amount of the leaves, but it is doubtful if, with the prices now ruling in the market, the cultivation of the plant in any large quantities would pay the planter.

HUNGARIAN INDUSTRY.

Industry in Hungary made rapid strides in 1890. According to the *Journal de la Chambre de Commerce de Constantinople* a number of the old factories have been

re-organised in accordance with all the exigencies of modern science, while a large number of new establishments have sprung up throughout the country. The capital sunk for this purpose was nearly 2,500,000*l.* (taking the Austrian florin as equivalent to 2*s.*), whilst the number of factories amounted to 1,132, with those in Croatia and Slavonia to 1,249, and with the alcohol factories to 1,516. The Hungarian Minister of Commerce has ordered a new census of all the industrial establishments in the country, inclusive of Transylvania; this shows that at the present time there are in Hungary 1,871 factories.

Among the new industrial establishments the following are worth mention: the gelatin factory of Pilich and Co. at Szeged; the industrial company for linen and hemp products at Ujszeged; the tallow factory of Redlich and Sons at Kobanya; the condensed carbonic acid factory of Baron Gabriel Apor at Kukullo; the match factory of Michel Salzer at Kova-zua; a large cement factory of M. Lazare Blau at Hunyad; the cotton spinnery of William Low at Segesvar; lastly, the French Mercury Mining Company of Zalatisa, with a capital of 80,000*l.*, the director of which is M. Labreux, a French engineer.

Several other factories and a large number of steam mills have been established within the last few months in different parts of Hungary and Transylvania.

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

	Imports into the United Kingdom from Spain.		Exports of British and Irish Produce from United Kingdom to Spain.		Exports of Foreign and Colonial Produce from United Kingdom to Spain.	
	1890.	1891.	1890.	1891.	1890.	1891.
Quarter ended:—	£	£	£	£	£	£
31st March	3,162,151	2,718,618	1,279,362	1,339,710	160,226	151,426
30th June	2,997,513	2,541,091	1,276,365	1,281,879	181,894	128,553
30th September	2,617,256	2,221,086	1,252,919	1,243,072	182,100	148,620
31st December	3,744,526	3,069,234	1,177,655	1,099,706	175,877	118,357
Total for Year	12,521,456	10,549,939	4,977,252	4,667,367	700,097	547,556

SULPHATE OF AMMONIA.

Production, Deliveries, and Exports during Four Years, 1888—1891.

	1891.	1890.	1889.	1888.
PRODUCTION:—	Tons.	Tons.	Tons.	Tons.
England, Scotland, and Ireland, from all sources.	113,000	131,000	133,000	122,800
DELIVERIES AND EXPORTS:—				
Germany, Denmark, Sweden, Russia, &c.	28,000	30,000	32,000	32,000
France, Spain, and Italy	19,000	16,000	18,000	19,000
Belgium and Holland	23,000	22,000	20,000	18,000
America and Colonies	20,000	18,000	17,000	14,000
Home consumption for agricul- tural and chemical purposes (including the liquor used in various processes of manu- facture).	43,000	42,000	41,000	31,300
Stocks at works	10,000	6,000	5,000	8,500
	113,000	131,000	133,000	122,800

THE SOURCES OF SULPHATE OF AMMONIA.

	Tons.
Gas works	107,000
Iron works	6,500
Shale works	27,000
Coke and carbonising works	3,000
	143,500

The production during the previous five years, adjusted from the carefully compiled report of Mr. Alfred Fletcher, the Chief Inspector under the Alkali Works Regulation Act, 1881, was:—

	1890.	1889.	1888.	1887.	1886.
Gas works	102,150	100,700	93,000	85,600	82,500
Iron works	5,050	6,150	5,300	5,000	4,000
Shale	21,750	23,950	22,000	21,000	18,000
Coke and carbonising works.	2,300	2,800	2,500	2,700	2,000
	131,250	133,600	122,800	113,700	106,500

—Bradbury and Hirsch.

—*Ibid.*

PRODUCTION OF BEET SUGAR IN RUSSIA IN 1888—89.

Bull. Soc. d'Encouragement l'industrie Nationale, 1891, 6, 166—171.

This article refers to the sudden rise in the output of sugar in Russia during the season 1888—89, as shown in the following figures :—

Season.	Number of Works open.	Quantities Produced.
		Pounds.
1881—82	235	15,336,714
1882—83	237	17,537,890
1883—84	244	18,879,739
1884—85	245	20,958,120
1885—86	241	20,039,594
1886—87	229	25,949,631
1887—88	218	23,749,028
1888—89	224	28,333,027

(1 pound = 16·381 kilos.)

The sudden rise in output in 1888—89 is connected with the increase of the area under beetroot cultivation, an increase of not less than 6 per cent. of the three regions (South-West and Central Governments, and Poland), in which beetroot is grown, the increase is greatest, 27 per cent., in the South-West district, and least, 4 per cent., in Poland.

Of the 220 works in operation during 1888—89, 186, or more than four-fifths, were for raw sugar.

Of the 220 works, only 8 employed hydrauic presses, the other 212 using the diffusion method.

The number of works in which the output was above 100,000 pounds, was 101 in 1887—88 and 135 in 1888—89, the principal increase being in the South-Western district.

—V. C.

MINERALS IN PERSIA.

Chem. Zeit. 1891, 15, 1240—1241.

Up till now the following ores have been found in paying quantities: Iron, copper, lead, antimony, manganese, nickel, cobalt; also coal, asbestos, borax, and cinnabar. There also exists petroleum springs. Copper and lead ores have been worked by the natives for many ages, but it seems that they chiefly smelted the more readily reducible ores, such as red copper ore, malachite, azurite, white or yellow lead ore, and galena. Ores rich in sulphur, such as black or grey copper ore, were either not used at all, or mixed in small quantities with the other minerals. Near old smelting works may be seen vast accumulations of litharge, which points to the ancient production of silver from argentiferous galenas.—L. de K.

THE RUSSIAN QUICKSILVER MINES.

In addition to the quicksilver mines in operation near Bakhmout, in European Russia, which produce at the present time 20,000 pounds of mercury annually, deposits of mercury have been discovered in the province of Daghestan, in Caucasus, and the mining administration has every reason to believe that private enterprises will be established which will make undertakings of this kind very profitable. The Ministry of Domains has decided to tax Russian mercury, as is done with all other Russian metals. It is proposed to establish taxes of 50 copecks per pound of pure mercury and of 45 copecks per pound of cinnabar made from Russian mercury.—*Chemist and Druggist*.

BOARD OF TRADE NOTICE.

RIVER POLLUTION IN SPAIN. (TENDERS FOR SEWAGE WORKS.)

The municipality of Bilbao are about to invite engineers to submit preliminary plans for a system of sewers to prevent the pollution of the river Nervion. The best four plans will receive premiums varying between 10,000 and 1,000 pesetas. Five months are allowed for the preparation of the plans. Copies of the conditions can be obtained of the secretary of the Ayuntamiento of Bilbao, and a copy can be seen at the Commercial Department of the Foreign Office, London, between the hours of 11 and 5.

ARTICLES OF INTEREST TO TECHNOLOGISTS AND OTHERS.

The following articles in the *Board of Trade Journal* for January will repay perusal:—

"Artificial Butter Legislation in France," p. 22.

"Belgian Coal and Iron Industries," p. 24.

"The Salmon Industry in British Columbia," p. 31.

"Mining Industry of Colombia," p. 68.

"The Production of Aluminium," p. 70.

"Quicksilver Mining in Russia," p. 71.

"Cryolite Production in America," p. 77.

"Anthracite Coal in West Virginia," p. 82.

"Fibre Industries in the Punjab," p. 85.

"The Wealth of Nova Scotia," p. 89.

"Mineral Production of New South Wales," p. 90.

"Mineral Production in Queensland," p. 92.

"The Coal Industry of Natal," p. 95.

POST OFFICE NOTICE.

ALTERATIONS OF BOOK POST RULES.

On and from the 1st January 1892, the following alteration of the Book Post rules came into operation:—

Open Envelopes for Book Packets.

In addition to covers entirely open at the ends, ordinary envelopes left wholly unfastened will be admitted as covers for book packets, whether addressed to places in the United Kingdom or to places abroad.

UNITED STATES MINERAL STATISTICS.

(From the *Engineering and Mining Journal*.)

IMPORTS AND EXPORTS OF MINERAL PRODUCTS FOR TEN MONTHS ENDING OCTOBER 31ST, 1890 AND 1891.
(Extract from Report by the Bureau of Statistics.)

IMPORTS TEN MONTHS ENDING OCTOBER 31.

		Quantity.		Value.	
		1890.	1891.	1890.	1891.
Asphaltum or bitumen, crude	Tons	57,673	87,875	Dollars, 198,070	Dollars, 250,291
Mineral waters, all, not artificial	Galls.	2,289,602	1,479,109	423,144	293,449
Chlorate of potash	Lb.	341,920*	2,591,633	33,580	247,900
Muriate of potash	"	45,879,477	63,301,008	707,064	991,708

* From October 6th.

IMPORTS—TEN MONTHS ENDING OCTOBER 31, 1891—*continued*.

		Quantity.		Value.	
		1890.	1891.	1890.	1891.
Nitrate of potash, crude.....	Lb.	12,322,614	13,589,677	Dollars. 361,670	Dollars. 417,163
Other potassium salts.....	"	654,592*	11,240,212	24,850	360,104
Nitrate of soda.....	Tons	91,867	89,965	2,691,707	2,341,516
Sulphur and brimstone, crude.....	"	113,287	103,613	1,792,247	2,362,950
Guano.....	"	4,987	11,762	51,195	125,908
Phosphates, crude or native.....	"	25,149	22,687	183,687	159,189
Other fertilisers.....	"	..	..	621,731	843,979
Manufactures of iron and steel, n.e.s.....	..	..	..	22,412*	272,437
Ores, gold-bearing.....	..	..	..	122,768	215,970
Ores, silver-bearing.....	..	..	..	7,197,382	8,178,266
Platinum, unmanufactured.....	Lb.	4,967	4,649	806,340	594,242
Plumbago.....	Tons	11,024	8,075	543,181	412,692
Tin, in bars, blocks, pigs, or grain or granulated.....	Lb.	29,731,975	34,202,758	6,005,573	6,726,030
Brass, and manufactures of.....	..	..	..	170,036	206,808
Cement.....	Lb.	854,145,025	1,001,768,795	2,535,762	3,794,476
Coal-tar colours and dyes.....	"	..	..	1,553,117	1,289,065
Bicarbonate of soda.....	"	797,155	1,190,148	14,304	20,617
Caustic soda.....	"	73,777,959	5,758,958	1,516,414	1,110,867
Sil soda and soda ash.....	"	291,493,939	276,697,309	3,403,004	3,567,379
Other salts of soda, n.e.s.....	"	18,872,858	13,638,853	110,946	94,234
Clays or earths.....	Tons	47,201	59,850	318,829	374,408
Coal, bituminous.....	"	659,612	1,084,896	2,243,783	3,673,128
Copper ore (fine copper contained therein).....	Lb.	4,656,889	10,381,651	303,343	772,641
Copper, in pigs, bars, ingots, old and other unmanufactured.....	"	194,716	2,897,334	30,355	253,691
Manufactures of copper.....	..	..	..	90,616	93,768
Iron ore.....	Tons	1,079,060	777,183	2,364,643	2,023,246
Pig iron.....	"	115,029	16,461	3,314,227	993,812
Scrap iron and steel.....	"	42,743	133,524	645,069	463,616
Bar iron.....	"	47,906,849	39,645,820	86,678	587,111
Bars of iron or steel, railway.....	"	204	233	5,035	7,616
Cotton ties, or baling hoops.....	Lb.	33,769,082	..	520,641	..
Hoop, band, or scroll, iron or steel.....	"	12,538,092	1,261,371	341,133	36,600
Ingots, blooms, and billets of iron or steel.....	"	51,061,881	67,331,463	1,320,910	1,443,031
Sheet, plate, and tangers, iron or steel.....	"	16,210,376	21,543,808	506,975	593,877
Tin plates,terne plates, and tangers, tin.....	"	611,729,703	697,732,207	19,436,503	24,708,582
Wire rods of iron or steel.....	"	108,998,878	87,936,031	2,045,702	1,645,104
Wire and wire rope.....	"	8,571,375	8,511,785	714,840	499,383
Manufactures of iron and steel, n.e.s.....	..	..	..	..	..
Precious stones, n.e.s.....	..	..	..	11,672,544	10,093,476
Lead, and manufactures of.....	..	..	..	877,365	2,452,639
Metals, and manufactures of, n.e.s.....	..	..	..	4,448,923	6,444,296
Marble and stone, and manufactures of.....	..	..	..	483,023	416,583
Mineral substances, n.e.s.....	..	..	..	87,900	148,801
Mineral oils.....	Galls.	193,363	1,055,973	38,365	46,688
Salt.....	Lb.	437,915,459	382,275,064	785,580	637,738
Zinc, in blocks or pigs, and old.....	"	1,889,990	702,870	95,142	35,627
Zinc, manufactures of.....	..	..	..	50,146	15,712

* From October 6.

EXPORTS TEN MONTHS ENDING OCTOBER 31, 1891.

		Quantity.		Value.	
		1890.	1891.	1890.	1891.
Brass, and manufactures of .....		..	..	Dollars. 352,230	Dollars. 389,169
Bricks, building		5,621	3,852	33,303	29,180
Bricks, fire .....		..	..	41,963	37,015
Coal, anthracite	Tons	702,522	796,169	2,878,646	3,311,118
Coal, bituminous	"	1,100,609	1,337,684	3,450,389	4,224,215
Copper ore	"	17,798	34,132	3,090,686	5,857,684
Copper ingots, bars, and old	Lb.	7,909,076	60,976,648	949,770	7,821,116
Copper, all other manufactures of .....		..	..	129,526	297,806
Fertilisers	Tons	217,778	180,394	1,694,309	1,993,492
Gunpowder	Lb.	327,403	710,614	53,441	80,469
All other explosives .....		..	..	600,640	777,543
Pig iron	Tons	14,269	11,982	231,991	203,818
Band, hoop, and scroll iron	Lb.	12,104	325,630	475	8,568
Bar iron	"	2,046,617	2,696,158	83,736	76,944
Car wheels	No.	9,818	12,443	79,440	101,268
Castings, n.e.s. ....		..	..	743,158	763,666
Ingots, bars, and rods of steel	Lb.	283,874	1,131,658	16,678	33,643
Machinery, n.e.s. ....		..	..	7,565,480	8,273,697
Cut nails and spikes	Lb.	11,074,319	8,347,075	273,289	200,852
Nails and spikes, all others, including tacks	"	1,556,671	1,516,710	125,454	114,513
Plates and sheets, iron	"	1,091,989	712,537	41,862	22,664
Plates and sheets, steel	"	445,118	233,058	13,663	7,424
Railroad bars or rails, iron	Tons	36	169	1,156	3,358
Railroad bars or rails, steel	"	16,055	19,349	538,691	333,459
Wire	Lb.	19,139,285	23,092,647	707,444	772,378
All other manufactures of iron and steel .....		..	..	2,965,783	3,469,977
Lead, and manufactures of .....		..	..	168,923	146,209
Lime and cement	Bbls.	67,929	73,775	120,640	113,971
Marble and stone, unmanufactured .....		..	..	190,617	149,672
Roofing slate .....		..	..	108,885	61,824
All other stone .....		..	..	429,681	404,301
Mineral oils, crude	Galls.	81,534,702	75,594,591	5,529,256	4,318,202
Naphtha	"	10,275,964	8,947,946	862,110	691,987
Illuminating oils	"	461,298,040	442,150,455	33,348,336	29,587,545
Lubricating oils	"	25,576,275	27,166,274	3,899,640	4,053,889
Residuum oil	Brls.	41,610	23,227	88,256	58,225
Ore, gold and silver bearing .....		..	..	1,993,873	29,423
Quicksilver	Lb.	151,307	273,143	88,609	139,492
Tin, manufactures of .....		..	..	223,392	219,028
Zinc ore or oxide	Tons	2,504	5,391	162,355	126,627
Zinc, pigs, bars, plates, and sheets	Lb.	3,004,206	3,278,352	108,340	204,880
Zinc, all other manufactures of .....		..	..	18,017	27,411

MINERAL PRODUCTION OF THE UNITED STATES IN 1890 AND 1891.

		1890.	1891.			1890.	1891.
Gold.....	Oz.	1,588,889	1,620,000	Tin.....	Lb.	..	123,366
Silver.....	"	51,500,000	58,000,000	Antimony ore.....	Tons of 2,240 lb.	..	700
Pig iron.....	Tons of 2,000 lb.	10,307,028	8,976,000	Anthracite coal.....	" "	38,006,483	42,839,799
Steel rails.....	Tons of 2,240 lb.	2,095,906	1,090,090	Bituminous coal.....	" "	93,000,000	98,000,000
Copper.....	Lb.	264,920,000	292,620,000	Phosphate rock.....	Tons of 2,000 lb.	637,000	653,731
Lead.....	Tons of 2,000 lb.	181,194	205,188	Salt.....	Brls. of 280 lb.	9,727,697	10,229,691
Zinc.....	" "	66,342	76,500	Bromine.....	Lb.	310,000	415,000
Nickel.....	Lb.	200,332	114,811	Pyrites.....	Tons of 2,000 lb.	109,131	122,438
Quicksilver.....	Flasks	22,926	21,022	Sulphur.....	" "	..	1,200
Aluminum.....	Lb.	94,881	163,820				

MINERAL PRODUCTS OF THE UNITED STATES.

		Quantity.		Value.	
		1889.	1890.	1889.	1890.
METALLIC.					
Pig iron, spot value.....	Tons of 2,240 lb.	7,603,642	9,202,703	Dollars. 120,000,000	Dollars. 151,200,410
Silver, coinage value.....	Troy oz.	51,354,851	51,500,000	66,396,988	70,464,645
Gold, coming value.....	"	1,500,860	1,588,880	32,886,744	32,845,000
Copper, value at New York.....	Lb.	231,246,214	265,115,133	26,907,809	30,818,797
Lead, value at New York.....	Tons of 2,000 lb.	182,967	161,754	16,137,689	14,266,703
Zinc, value at New York.....	"	58,860	63,683	5,791,824	6,266,407
Quicksilver, at San Francisco.....	Flasks	26,484	22,926	1,191,500	1,203,615
Nickel, at Philadelphia.....	Lb.	252,603	223,488	151,508	134,003
Aluminum, at Philadelphia.....	"	47,468	61,281	97,335	61,281
Antimony, at San Francisco.....	Tons of 2,000 lb.	115	129	28,000	40,756
Platinum, at New York.....	Troy oz.	500	600	2,000	2,500
Total.....		..	..	269,591,487	307,334,207
NON-METALLIC (Spot Values).					
Bituminous coal.....	Tons of 2,240 lb.	85,385,050	90,392,871	94,346,809	110,420,891
Anthracite coal.....	"	40,714,721	41,489,858	65,879,514	61,445,683
Building stone.....		..	..	51,926,721	54,000,000
Lime.....	Barrels	50,000,000	60,000,000	25,000,000	28,000,000
Petroleum.....	"	35,163,513	45,000,000	26,963,349	35,000,000
Natural gas.....		..	..	21,007,000	29,000,000
Cement.....	Barrels	7,000,000	8,000,000	5,000,000	6,000,000
Salt.....	"	10,000,000	8,683,943	500,000	4,707,860
Limestone for iron flux.....	Tons of 2,240 lb.	6,318,000	5,521,622	3,152,000	2,760,811
Phosphate rock.....	"	550,245	510,199	2,937,776	3,213,795
Zinc white.....	Tons of 2,000 lb.	23,000	..	1,600,000	1,600,000
Mineral water.....	Gallons sold	12,789,471	11,321,876	1,748,458	2,338,140
Borax.....	Lb.	8,000,000	9,500,000	5,000,000	617,500
Gypsum.....	Tons of 2,000 lb.	267,749	182,905	764,118	574,523
Manganese ore.....	Tons of 2,240 lb.	24,197	25,001	240,559	250,000
Mineral paints.....	"	32,307	45,732	463,766	661,992
Marls.....	Tons of 2,000 lb.	139,522	150,000	63,956	65,000
Pyrites.....	Tons of 2,240 lb.	93,705	114,836	202,119	273,745

MINERAL PRODUCTS OF THE UNITED STATES—*continued.*

		Quantity.		Value.	
		1889.	1890.	1889.	1890.
Flint	Tons of 2,240 lb.	11,113	13,000	Dollars. 49,137	Dollars. 57,400
Mica (cut)	Lb.	49,500	..	50,000	32,569
Corundum	Tons of 2,000 lb.	2,215	1,970	105,565	89,395
Sulphur	"	1,150	†	7,850	..
Precious stones .....	}	..	..	188,807	118,833
Specimens, gold-quartz souvenirs, &c.					
Crude barytes	Tons of 2,240 lb.	19,161	21,911	106,313	86,505
Bromine	Lb.	418,891	387,847	125,667	104,719
Feldspar	Tons of 2,240 lb.	6,970	8,000	39,370	45,200
Chrome iron ore	"	2,000	3,539	30,000	53,985
Graphite	Lb.	..	..	*72,062	*77,500
Fluorspar	Tons of 2,000 lb.	9,500	8,250	45,835	55,328
Slate, ground	Tons of 2,240 lb.	2,000	2,000	20,000	20,000
Cobalt oxide	Lb.	12,955	10,000	31,492	25,000
Novaculite	"	2,354,000	..	32,980	69,909
Asphaltum	Tons of 2,000 lb.	51,735	49,441	171,557	190,416
Asbestos	"	30	71	1,809	1,569
Rutile	Lb.	1,000	400	3,000	1,000
Potters' clay	Tons of 2,240 lb.	234,344	350,000	655,578	756,000
Grindstones .....	..	..	..	439,587	450,000
Millstones .....	..	..	..	35,155	73,720
Ozokerite, refined	Lb.	50,000	350,000	2,500	23,250
Infusorial earth	Tons of 2,000 lb.	3,466	2,532	23,372	50,240
Soapstone	"	12,715	13,670	231,708	252,309
Fibrous talc	"	23,746	41,354	244,170	389,196
Lithographic stone	"	18	†	243	..

	Value.	
	1889.	1890.
Total value of non-metallic mineral products	Dollars. 398,687,163	Dollars. 334,959,893
Total value of metallic products	269,591,487	307,334,207
‡ Estimated value of mineral products unspecified	10,000,000	10,000,000
Grand total	588,278,650	652,294,100

* Value of the crude product.

† Not reported.

‡ Including fire clay, common brick-clay, terra-cotta, building sand, glass sand, limestone used as flux in lead smelting and glass making, iron ore used as flux and lead smelting, tin ore, iridising stone, nitrate of soda, carbonate of soda, sulphate of soda, native alum, mineral soap, strontia and pumice stone.

NICKEL.

THE production of nickel in the United States was considerably smaller in 1891 than in the previous year, owing to the falling off in the output of the famous old Lancaster Gap mine, which was idle for three months of the year. This mine, as is well known, is rapidly approaching exhaustion, and in the future it may be expected to show a constantly diminishing output. Its product in 1891, however, as in previous years, represents practically the entire product of nickel in the United States. The St. Joseph Lead Company, of Boume Terre, Mo., and the Mine La Motte, of St. Francois County, Mo., made their usual out-turn of nickel and cobalt, but the amount is trifling. The ore of these mines is galena in a gangue of magnesian

limestone, with which is associated some iron pyrites carrying a small percentage of nickel and cobalt, and this pyrites is saved as a by-product, being shipped to the American Nickel Works, at Camden, N.J., for reduction.

No work of any consequence was done at the Oregon mines during the year, but some exploration work was done in the Nevada mines. The latter are located at the junction of Bolivia and Cottonwood cañons in Churchill County, about 41 miles east of Lovelock's Station. One of these mines, the London, is owned by the National Nickel Mining Company, of New York and London, which has been working a force of 10 men for the past 12 months and has produced some nickel ore. A small lot of selected ore, perhaps 40 tons, was shipped to England for a test; this is

not included in our statement of the production of nickel in the United States in 1891.

The production of nickel in the United States from 1876 to 1891, both years inclusive, together with the imports into the country and the exports from it, are given in the following table:—

PRODUCTION OF NICKEL IN THE UNITED STATES; ALSO IMPORTS AND EXPORTS.

Year.	Production.			Value of Imports.	Value of Exports.
	Amount.	Average Price.	Value.		
	Lbs.	Dols.	Dols.	Dols.	Dols.
1876	201,367	2.60	523,344	10	203,150
1881	265,668	1.10	292,235	122,120	30,480
1886	182,345	0.60	109,407	141,546	51,323
1888	150,637	0.60	114,382	138,290	39,376
1890	206,332	0.65	136,216	376,279	471
1891	141,841	0.60	86,905	..	..

During the past year the consumption of nickel has undergone a large increase, due principally to the growing demand for the metal for use in the manufacture of nickel-steel, the Creusot works, in France, alone having contracted for a large part of the product of the Société du Nickel, while the United States Government purchased the great quantity of 6,500 tons of Canadian matte, containing probably about 20 per cent. nickel. There has also been a natural increase in demand from the nickel-platers, the German silver manufacturers, and other consumers. At the present time, moreover, the prospects seem to be that the consumption of nickel will further increase in 1892. During the past autumn the United States Government made elaborate tests of nickel-steel and other kinds of armour-plate at Indian Head, Md., which resulted in a decisive victory for the nickel steel, and this has now been adopted as the protective material for the new cruisers and battleships. The use of other nickel alloys is constantly growing and a steady expansion in demand may be expected from this source.

The exports of nickel from New Caledonia in 1890, according to a recent consular report, amounted to 3,360 lb., and of nickel ore to about 5,000 metric tons, which, averaging about 8 per cent. nickel, was equivalent to about 882,000 lb. of metallic nickel, representing a total export of 885,360 lb. The production of nickel (in nickel-copper matte) in Canada in 1890 was 1,336,627 lb., that being the first year for which statistics of the Sudbury district were published. The last official statistics of the mining industry of Norway, those of 1889, gave the production of nickel in that country as 149,872 lb.; the output in the preceding year was 145,464 lb., and that of 1890 was probably about the same. The product of Sweden in 1890 was but 17,632 lb., which was a great falling off from the preceding year.—*Engineering and Mining Journal*.

ALUMINIUM.

Aluminium was first made in any quantity in 1855, its value at that time being 90 dols. per lb.; with improvements in the methods of manufacture the price was gradually reduced to 4.86 dols. (11.) in 1887, but the recent development of the industry dates only from 1889, when the Pittsburgh Reduction Company placed aluminium made by the Hall process on the market at 2 dols. per lb. The Pittsburgh Reduction Company commenced operations in November 1888, the Cowles Electric Smelting and Aluminium Company being engaged at that time in the manufacture of aluminium alloys, but is now producing pure aluminium; these were the only companies producing pure aluminium in the United States in 1889, in which year the production amounted to 47,468 lb., valued at 97,335 dols. The total production of aluminium in the world from 1860 to 1889 inclusive is estimated by Mr. R. L. Pickard, Special Agent of the Eleventh Census, at 232,000 lb.

PRODUCTION AND IMPORTS OF ALUMINIUM IN THE UNITED STATES SINCE 1881.

Year.	Production.		Imports.	
	Amount.	Value.	Amount.	Value.
		Dols.		Dols.
1881	..	..	517.10	6,071.00
1882	..	..	566.50	6,495.00
1883	1,000	875	426.25	5,079.00
1884	1,890	1,350	591.00	8,416.00
1885	3,400	2,500	439.00	4,736.00
1886	..	27,000	452.19	5,369.00
1887	..	71,905	1,260.00	12,119.00
1888	19,000	65,000	1,318.53	14,086.00
1889	47,468	97,335	998.83	4,840.00
1890	*94,881	189,762	2,951.00	7,062.00
1891	*163,820	163,820	†1,625.05	†4,073.00

* Partly estimated.

+ Fiscal years.

The principal producers of aluminium in Europe at the present time are the Cowles Syndicate Company, Limited, and the metal Reduction Syndicate, Limited, of England, using the Cowles and Hall processes respectively, and the *Aluminium Industrie Actien Gesellschaft*, of Lauffen-Neuhausen, in Switzerland, which uses the Heroult process. In the United States are the Pittsburgh Reduction Company, with works at Kensington, Pa., and the Cowles Electric Smelting and Aluminium Company, with works at Lockport, N.Y. The United States Aluminium Metal Company, which controls the Heroult patents in the United States, has a plant at Boonton, N.J., which was originally erected for demonstrating this process and has produced some metal, but has not been in regular operation. The Wilson Aluminium Company is now establishing works at Leakesville, N.C., for the application of a process invented by Thos. L. Wilson, and expects to be in operation early in the present year. Works are also being erected at St. Michel, Savoy, France, at which the Minet process will be used.

The production of aluminium and aluminium in alloys in the United States in 1890 was about 95,000 lb. In 1891 there has been a noticeable increase, and the total output for the year may be set down as 163,820 lb. The Cowles works have run steadily throughout the year, but the Pittsburgh works were idle from April to November, during which time the plant was removed from Pittsburgh to Kensington, Pa., this change having been made necessary by the failure of natural gas in Pittsburgh. The new works were put in operation on November 12.—*Ibid*.

BROMINE.

The production of bromine in 1891 was 415,000 lb., divided as follows:—Pennsylvania, 140,000 lb.; Michigan, 45,000 lb.; Ohio, 110,000 lb.; West Virginia, 120,000 lb. The production for the past nine years is shown in the following table:—

PRODUCTION OF BROMINE IN THE UNITED STATES.

States.	1883.	1885.	1887.	1889.	1890.	1891.
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
Ohio	194,450	123,000	104,662	150,000	200,600	{ 110,000 120,000
West Virginia	106,650	85,000	16,425			
Pennsylvania	..	60,000	78,000	60,000	70,000	140,000
Michigan....	..	40,000	..	40,000	40,000	45,000
Total....	301,100	310,000	199,087	250,000	310,000	415,000

The output has been for several years and still remain somewhat in excess of consumption.—*Ibid*.

BICHROMATES.

Baltimore is the great centre of the American bichromate manufacture. The firm of Jesse Tyson and Sons for many years had a monopoly of the business. Their process is

a secret one. Within the last few years, however, the salt has been also produced at the Kalion Works, in Philadelphia. Large amounts of bichromate are annually imported in addition to the local product.

PRODUCTION, IMPORTS AND EXPORTS OF CHROMIUM COMPOUNDS.

Year.*	Production.		Imports.				Exports.	
	Chromic Ore.	Value in California.	Chromate and Bichromate of Potash.		Chromic Ore.		Total Value.	Total Value.
			Quantity.	Value.	Quantity.	Value.		
1882	Long Tons. 2,500	Dols. 50,000	Dols. 2,449,875	Lb. 261,006	Long Tons. ..	Dols. ..	Dols. 261,048	Dols. 1,548
1884	2,000	35,000	2,593,115	210,677	2,677	73,586	284,383	..
1886	2,000	30,000	1,985,809	139,117	3,356	43,731	182,940	..
1888	1,500	20,000	1,755,489	143,312	4,140	46,735	190,328	..
1890	3,509	53,985	1,166,001	95,231	663	8,190	169,240	..
1891	..	..	1,234,085	95,951	1,092	56,982	184,498	..

* The statistics of production are for the calendar years; imports and exports for fiscal years ending June 30.

† Including value of imports of chromate and bichromate of soda.

—*Ibid.*

SULPHUR.

Brimstone.

The amount of brimstone produced by American mines during the year 1891 was only 1,200 tons, all coming from the Cove Creek mines, 22 miles from Beaver, Utah. About 25 men are now employed at the mines, and about 20 tons a day of brimstone are being shipped. It is not to be expected that Utah or Nevada sulphur can be sold in the Eastern States so long as freight rates remain as at present, yet there is no reason why they should not compete with Japan sulphur products and supply the entire Pacific slope at remunerative prices. The possibility of supplying certain trade centres from outlying mining districts depends almost entirely upon freighting facilities, and Japan sulphur, according to a recent consular report, cannot be carried from San Francisco for less than 16 dols. freight, so that a very small margin is left to the producers after mining and refining costs are discharged. The lowest estimate we have seen for Japan sulphur laid down in California is 26 dols. per ton, whereas there should be no question of the ability of Utah or Nevada mines to supply any reasonable tonnage at a cost not to exceed 17 dols. delivered. The production of brimstone and pyrites in the United States is shown in the following table :—

PRODUCTION OF BRIMSTONE AND PYRITES IN THE UNITED STATES.

Year.	Brimstone.		Pyrites.		Total Value.
	Amount.	Value.	Amount.	Value.	
1882	Short Tons. 600	Dols. 21,000	Short Tons. 13,440	Dols. 72,000	Dols. 93,000
1884	500	12,000	39,200	175,000	187,000
1886	2,500	75,000	61,600	220,000	295,000
1888	..	..	60,850	167,658	167,658
1890	..	..	109,431	109,431	244,265
1891	1,200	36,000	122,438	122,438	353,280

Progress is noted in operations aimed to open up the great sulphur bed of Louisiana, 230 miles west of New Orleans, on the Southern Pacific Railroad. The sulphur-bearing stratum at this location lies about 500 ft. below the surface, and is shown, by diamond-drill borings, to be of exceptional richness.

The importations of brimstone from Sicily continue on the same generous scale as noted for the past three years, notwithstanding the violent fluctuations in prices over the year as shown by the following table :—

IMPORTS OF SULPHUR INTO THE UNITED STATES FROM 1867.

Years.*	Crude.		Flowers of Sulphur.		Refined.		Total Value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Long Tons.	Dols.	Long Tons.	Dols.	Long Tons.	Dols.	Dols.
1867	24,544.10	620,573	119.05	5,509	250.55	10,915	636,797
1871	36,131.46	1,213,202	65.54	3,514	92.26	4,328	1,221,044
1876	46,431.72	1,475,250	41.07	2,114	43.87	1,927	1,479,291
1881	105,096.54	2,713,485	97.66	4,226	70.96	2,553	2,720,266
1883	94,539.75	2,288,946	79.13	3,262	115.33	8,487	3,296,695
1885	90,839.44	1,941,943	120.56	5,351	111.08	4,060	1,951,354
1887	96,881.55	1,688,360	278.56	9,980	81.55	2,383	1,700,723
1888	120,104.00	1,927,336	60.00	1,921	..	3	1,929,260
1889	135,935.00	2,068,208	282.00	8,184	16.00	299	2,076,691
1890	131,086.00	2,147,481	1181.02	45,159	110.33	1,299	2,152,919

* Fiscal years ending June 30th, from 1867 to 1887, inclusive; subsequently, calendar years ending December 31st, unless otherwise specified.

† Fiscal years.

This steady consumption is accounted for by the fact that so many new plants for the manufacture of sulphuric acid are being erected in the Southern States and by men who, having no training in the use of pyrites, prefer the good old way of handling brimstone whatever may be the difference in cost.

There is a point in this choice of methods towards an end which the newer class of fertiliser manufacturers do not as yet fully understand, and they will no doubt cling to a use of foreign sulphur until competition of the sharpest kind, with a lowering of prices of all commodities, compels them to make the change or brimstone producers to lower prices.

The older chemical concerns have been working for years in the same rut, and it may be stated as follows :—

COST OF SULPHURIC ACID FROM BRIMSTONE (WORKS BURNING FOUR TONS IN 24 HOURS).

	Dols.
Four tons brimstone, freights, losses in transit and burning, at 30 dols.	120.00
Nitrate of soda, 6 per cent. of sulphur, 53s lb. at 2.50 dols.	13.45
Labour, five men at 1.25 dols. per day	6.25
Coal, 2 tons at 3 dols. per ton	6.00
Superintendent and office cost.	6.00
Wear and tear.	10.00
Total cost for 18 tons 48 B. acid	161.70

Or 1 ton of 48 B. acid costs 8.98 dols.

Now, if this acid were to be sold on the market, it would bring in Boston, New York, Philadelphia, Baltimore, &c., not to exceed 8 dols. net at the factory, and for large quantities even lower prices. These costs and this condition of the market have held for years past, and while circumstances may modify them at times, yet the facts are that no manufacturer of brimstone acid alone has had a remunerative business for many years.

Why, then, do we hear of new plants being erected every year, and the older plants still continuing the use of brimstone? The answer for the fertiliser concern will be an answer for all classes of trade. One ton of 43° B. acid costing 8.98 dols., one ton of ground and dried rock costing 10 dols., labour and power costing 2.02 dols., a total of 21.00 dols., will produce two tons acid phosphate, which is sold to average in commercial fertilisers for 50 dols.; in other words, so long as the ton of 48 B. sulphuric acid can be put into any condition by mixture or change whereby it sells for a large advance on its cost, there is no incentive for the manufacturer to study differences between brimstone and pyrites as available sources for supply of sulphur.

Owing to the enormous prices charged for brimstone, which went up from a normal price of about 20 dols. to 22 dols. a ton to 35 dols., at which it sold this year, there has been a general inquiry for data bearing upon the subject, and during the year past several of the oldest chemical concerns have changed their plants or added new plants to accommodate themselves to manufacture of sulphuric acid from ores.

This has brought in prominence several entirely new sources for the supply of high grade pyrites ores, notably the Spanish and Newfoundland ores, which have been burned at several works along the Atlantic coast with more or less success during the year 1891.

Causes which we have several times referred to, such as the gradual exhaustion of the sulphur-producing territory in Sicily, the lessened percentage of sulphur in the mine products, the increased prices of labour, &c., have combined to lessen the imports for the year 1891, so that an exceptional state of affairs exists at present, viz., brimstone in store commands any price asked from 30 dols. to 40 dols., and "Ex ship to arrive January" brings 29 dols. to 32 dols. per ton.

PRICES OF BRIMSTONE IN NEW YORK IN 1891.

Best Unmixed Seconds. Thirds from 50 c. to 1 dol. less.

	Jan.	Feb.	March.	April.	May.	June.
Highest:	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.
Spot	28.00	27.00	37.00	35.00	35.00	31.00
Futures,	27.50	28.00	35.00	32.00	32.00	27.50
Lowest:						
Spot	27.50	27.00	33.00	35.00	30.00	30.00
Futures,	25.75	27.50	31.00	30.00	26.50	21.50

PRICE OF BRIMSTONE IN NEW YORK IN 1891—cont.

	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Highest:	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.
Spot	27.00	28.00	33.00	33.00	31.50	40.00
Futures,	24.70	27.00	30.00	30.12	31.00	30.75
Lowest:						
Spot	24.00	26.00	30.00	30.50	31.00	34.00
Futures,	22.00	24.50	27.50	27.75	28.00	30.00

—*Ibid.*

PYRITES.

We note under this head only such pyrites as are mined for sulphur contents and utilised in manufacture of sulphuric acid, although it is well known that a very large tonnage of pyrites is produced annually as concentrates in dressing gold and silver ores, and that the roasting process necessary to free them from sulphur for the after treatment might be modified or changed to utilise most of the sulphur they contained. We have stated in our annual reports for past years the fact of the general distribution of pyrites over the several sections of the United States, and have published from time to time all the data obtainable to localise values of this now staple commodity. We are constrained to again note the production of pyrites for the year 1891 as limited to two of the Northern States, viz., Massachusetts, 37,320 tons of 2,240 lb., valued at 137,280 dols.; and Virginia, 72,000 tons, valued at 216,000 dols. (these figures being partly estimated). This shows, as compared with last year's reports, that these mining sections have been filling regular orders for established trade, within easy transportation reach, and increasing their production only as required by the natural growth of trade in their own territory. As reported to us the actual sales made by these mines will amount to about 120,000 tons of 2,240 lb., equivalent to 44 per cent. sulphur, or 52,800 tons pure sulphur produced.

IMPORTS OF PYRITES INTO THE UNITED STATES SINCE 1881.

Year.	Quantity.	Average Sulphur Contents.	Year.	Quantity.	Average Sulphur Contents.
	Long Tons.	Per Cent.		Long Tons.	Per Cent.
1881	11,927	35	1889	100,000	43
1883	35,811	34	1890	115,000	43
1885	50,000	38	1891	130,000*	44
1887	60,000	38			

* Estimated.

We estimate the sulphur consumed in the United States during 1891 as follows:—Imports of brimstone, 120,000 tons of 2,240 lb.; imports of pyrites, 130,000 tons (44 per cent. S) 57,200 tons; product of American mines (120,000 tons, with an average of 44 per cent. S), 52,800 tons. We might give details of this consumption, showing how radically the changes are taking place in manufacture of sulphuric acid, and how surely the tendency is to centralise plants in localities near to phosphatic materials—the increase in production of acids being almost entirely for dissolving the hard and river rocks mined in Carolina and Florida. There are 35 acid works in the States south of Maryland, 27 of them built since 1887. It is safe to say that within the coming three years there will be double the acid produced in territory contiguous to the newly-discovered Florida phosphate fields, as it would seem as if the solution of the problem of marketing the enormous tonnage sure to be mined from the hard rock and pebble deposits depends upon a manufacture of these phosphates into acid phosphate.

There exists at present a market for about 100,000 tons of Florida phosphate annually. For acid phosphate there are larger demands, and if prices were lowered to fair manufacturing points these probably can be increased.

With this prospect for Southern industries it is reasonable to suppose we shall have new deposits of pyrites developed in the South pending the opening of the Louisiana sulphur beds. This seems more than likely, as freights into the interior of the Southern States have so far been a bar to entrance of foreign ores, and the local mines will therefore always be able to command a certain trade.

This is shown by taking prevailing prices (which are abnormally high for brimstone) and comparing—

	Dols.
Brimstone, at coast cities, cost	30'00
Freight to interior factories	2'50
	32'50
Foreign pyrites, basis 48 per cent. sulphur, ex-ship 12 c	5'76
Freight to interior cities	2'50
	8'26
Virginia pyrites, at mines	3'50
Freight to interior cities	2'75
	6'25

At points where consumed, the prices of sulphur in each of the above sulphur products would be at present :—

	Dols.
100 units of sulphur in brimstone	31'00
100 units of sulphur in foreign pyrites	18'15
100 units of sulphur in Virginia pyrites	14'50
	— <i>Ibid.</i>

W. T. SARGANT AND SONS' ANNUAL METAL CIRCULAR.

Messrs. W. T. Sargent and Sons report as follows :—

We think the best way to describe the condition of the metal markets during 1891 is to give the following table of prices of some of the chief articles :—

		31st Dec. 1890.	31st Dec. 1891.
		£ s. d.	£ s. d.
Hematite pig iron....	Per ton	2 13 3	2 8 0
Middlesbro' No. 3....	"	2 2 3	1 18 1
Scotch G. M. B.	"	2 6 3	2 7 0
Copper G. M. B.	"	52 15 0	46 15 0
Tin Straits	"	91 0 0	90 10 0
Spelter	"	22 10 0	22 15 0
Lead	"	13 0 0	11 5 0
Quicksilver	Per bottle	9 0 0	7 15 0

The first idea on examination of such a serious and all-round decline in values would be that supplies have exceeded consumption and brought about an increase of stock. The table below effectually disproves this theory.

	31st Dec. 1890.	31st Dec. 1891.
	Tons.	Tons.
Hematite pig iron stock	257,700	191,600
Middlesbro' iron stock	256,262	262,916
Scotch warrant stock	587,652	500,957
Total	1,101,614	955,473
Copper visible supply	65,366	56,544
Tin visible supply	10,930	12,600

That moderate prices should have shrunk 10 to 20 per cent. in face of direct evidence that consumption is distinctly larger than production, proves that some extraordinary power has been at work strong enough for the time to reverse the natural laws of supply and demand.

We are disposed to attribute this unusual and contradictory course of the markets to a combination of the following causes :—

1st. Financial and political disturbances in South America, in conjunction with the McKinlay tariff in the United States, have reduced the volume of metal exports in 1891 to 39,230,009*l.* against 45,251,434*l.* in 1890.

2nd. The deficient harvests in Europe have so raised the value of corn-stuffs that this country's imports for 1891 are valued at 61,571,504*l.* against 53,044,507*l.* in 1890.

3rd. The failure of the United States Act of August 1890 to bring up the value of silver, and the abandonment for the near future of any attempt at a Free Coinage Bill.

Tin.

In its more important aspects, this metal is in striking contrast to the other larger ones. Whilst they show signs of contraction this gives evidence of important expansion. The total production of the year is 57,551 tons against 53,434 tons. The Straits shipments show an increase of 3,987 tons; Dutch tin an increase of 654 tons; and Australian a decrease of 424 tons. English returns are not yet published, but it is admitted that there is no change worth consideration. We leave out of our returns the Bolivian, because we cannot give accurate figures, but although the quantity is small by comparison with other sources it seems to be increasing. The usual reports are in circulation as to new sources of supply in Dakota, Mexico, and California, but beyond the reports of sanguine engineers and interested promoters, there is not a shred of evidence that tin can be produced in any of these countries on terms that can compete with the rich accessible deposits of the Straits, aided by the cheapest labour that exists on the face of the globe. These favourable and unbeatable conditions have last year been greatly assisted by the fall in the price of silver, which raised the dollar price to a very satisfactory level. The Banca mines are being worked more vigorously, and an increased supply of 700 to 1,000 tons will be sold in Holland this year. Therefore the elements of expansion in supply which have been at work in 1891, will apparently be in full force in 1892, and the question for consideration is whether consumption will continue to develop in a similar ratio. According to our calculations, the consumption of 1891 increased by 1,708 tons, but was less than the production by 1,806 tons. The actual stocks in warehouse have remained small, and at the end of last year were only sufficient for about five weeks' supply. Taking the magnitude of the trade into account, this seems very small. As to fluctuations in market value they have been in a smaller compass than for many years. The lowest monthly average was 90*l.* 0*s.* 3*d.*, and the highest 93*l.* 4*s.* The average of the year was 91*l.* 3*s.*, against 94*l.* 3*s.* 6*d.* in 1890, showing a decline of 3*l.* 0*s.* 6*d.* per ton.

Stocks of Foreign Tin and Quantities Afloat for England, Holland, and America.

	31st Dec. 1891.	31st Dec. 1890.	31st Dec. 1889.
	Tons.	Tons.	Tons.
Stock of foreign in London	2,135	2,524	2,280
Foreign landing in London	1,162	880	1,406
Straits afloat for London, including wire advices	2,225	1,295	2,225
Australian afloat for London, including wire advices	802	856	600
Banca on warrants in Holland	511	867	680
Billiton in Holland	357	277	984
Filliton afloat for Holland	1,912	1,396	1,355
	9,124	8,005	9,520
Estimated stock in America and quantity floating	3,528	2,925	2,670
	12,652	10,930	12,190
Trading Company's Reserves of unsold Banca:			
Stock in Holland	3,140	2,787	4,813
Floating for Holland .....	..	303	60

Production during the past Three Years.

	1891.	1890.	1889.
	Tons.	Tons.	Tons.
English production	9,000	9,000	9,000
Straits' shipments to Europe and America.	31,157	27,170	28,295
Australian shipments to Europe and America.	5,991	6,415	6,890
Banca Sales in Holland	5,350	5,317	4,114
Billiton sales in Java and Holland	5,753	5,232	4,857
	57,551	53,134	53,066

Consumption of Tin.

	1891.	1890.	1889.
	Tons.	Tons.	Tons.
Deliveries from London, after deducting all shipments to America.	17,667	16,126	18,194
Deliveries from Holland, after deducting exports to London and America.	8,246	8,155	7,581
English consumed at home.....	3,834	3,872	3,830
Exports of English, minus quantity shipped to America.	4,990	4,567	4,829
American consumption of all sorts	15,457	16,000	15,000
Billiton sent to other ports than Holland.	1,972	1,617	1,287
Straits direct to Continent, less re-exports to America.	3,579	3,700	3,680
	55,745	54,037	54,392

Prices of Foreign Tin.

	1891.	1890.	1889.
	£ s. d.	£ s. d.	£ s. d.
Average.....	91 3 0	94 3 6	93 0 9
Highest.....	94 10 0	104 5 0	99 2 6
Lowest	88 15 0	88 7 6	87 17 6

TIN PLATES.

The exports both to America and other places show an increase. The total shipments of the entire year give, however, a very inadequate idea of the strain which has been sustained, and, we trust, surmounted. During the first half of the year the American shipments amounted to 263,225 tons, out of the total of 325,145 for the entire year. These were all sold at very satisfactory prices, reaching America before the new duties were imposed. Since then the balance of 61,920 tons has been shipped, but at prices that can barely make both ends meet. It is believed that the surplus shipments to America have been pretty well worked off, and that a good steady trade may be looked for. The establishment of this industry in United States has attained only very small proportions, and as good steel plates with coke finish are obtainable at 12s. 9d. per box f.o.b. Liverpool, we think this country will retain the trade.

Exportations from United Kingdom.

	1891.	1890.	1889.
	Tons.	Tons.	Tons.
To United States	325,145	318,108	336,692
To other places	123,587	100,617	95,931
Total tons	448,732	418,725	432,623

COPPER.

The first half of 1891 developed a good demand with firm and rising prices. Notwithstanding considerable arrivals from America, and large offerings of further quantities at prices relatively cheap to G.M.B., the market for the latter was buoyant, and in June touched 56l. 10s. Reports were industriously circulated of strong combinations in existence, or about being formed, for the purpose of sustaining prices at a level in accordance with the improved statistics of the article. But these reports were inaccurate and misleading. For, in fact, the large financiers were steadily unloading their stocks. Under what circumstances and to what extent this has been done is even now a mystery to the general public; but it is suspected that this move was made with a view of depreciating the shares of the Rio Tinto Company and other large concerns, and perhaps coercing the owners of the Anaconda Mine to entertain more modest views as to the value of their property, which was an offer to a syndicate. But whatever may have been the motives or objects of the sellers, the result was to drive prices rapidly down, and in the month of November 44l. 1s. 3d. was accepted for G.M.B. Early in December the sale of the Société's works in France was effected to a new group through the intermediary of the Crédit Industriel, and since then the market has again shown more animation, and, with rather frequent fluctuations, has netted an advance of 30s. per ton, closing to-day at 45l. 13s. 9d. per ton.

The statistics show in Europe a decrease of visible supply during the year of 8,822 tons, to which must be added a very large quantity of privately stored metal. Scarcely anything has been drawn for a long time past by the makers of sulphate of copper, but they have been selling their manufactured article freely, and are now believed to hold very little of either metal or sulphate. The American stock has decreased 10,000 tons. We estimate that the production of 1891 is about 2,000 tons more than that of 1890, but we believe that the current prices, if continued, will both curtail production and stimulate deliveries; and although strong interests have succeeded in depreciating values considerably of late, it is quite within the bounds of probability that equally strong interests may eventually work actively to appreciate them.

Comparative Statement of the Chief Sources of Copper Supplies.

	1891.	1890.	1889.
	Tons.	Tons.	Tons.
Spain, precipitate and metals imported into L. and S.W.....	21,929	23,351	22,122
Produce of pyrites, chiefly Spanish	13,685	14,779	14,489
Spanish produce disposed of in other markets than L. and S.W. United States, America:—	16,000	14,000	18,000
Lake Superior.....	57,000	44,450	38,769
Butte District	45,000	49,560	46,518
Arizona District	22,000	15,945	14,419
Other United States supplies..	6,000	6,370	6,068
Chili, year's charters.....	20,100	25,750	23,400
Sundry minor sources,* imports into L. and S.W.....	19,532	22,308	23,426
Australia, shipments to Europe...	6,450	7,000	7,250
Germany	18,000	17,800	17,356
Japan, surplus shipped to Europe	7,852	10,674	2,523
	253,518	251,967	234,340

* Cape, New Quebrada, Italy, &c.

N.B.—We are a little doubtful about the divisions of American in 1891, but the total is correct.

Stocks and Quantities Afloat for England and France.

—	31st Dec. 1891.	30th Dec. 1890.	31st Dec. 1889.
Liverpool and Swansea stocks of Chili bars, ores, and regulus, reduced to the standard of fine copper.	Tons. 27,008	Tons. 18,908	Tons. 22,106
Other furnace materials, same ports.	7,470	13,547	26,691
Continental stock and afloat	8,781	21,191	39,016
London stock, chiefly Australian and Japan.	9,885	7,439	5,331
Chilian produce afloat, per mail and wire advices.	3,200	3,250	4,500
Australian do. per mail and wire advices.	700	650	900
Total tons.....	56,544	65,336	98,847

*Quantity chartered at West Coast during December,
1,700 Tons, making for the Year as follows :*

—	1891.	1890.	1889.
Estimated fine copper in round numbers.	Tons. 20,100	Tons. 25,750	Tons. 24,100

Importation of Pyrites.

—	1891.	1890.	1889.
Tons	616,227	656,881	643,879

Yielding of Pure Copper on the Basis of 2½ per Cent.

—	1891.	1890.	1889.
Tons	13,685	11,779	11,489

*Importations of other Sorts of Copper into United
Kingdom.*

—	1891.	1890.	1889.
Ore from sundry places	Tons. 90,654	Tons. 111,925	Tons. 136,514
Regulus from Chili.....	1,322	4,715	1,265
Regulus and precipitate from elsewhere.	122,915	100,192	108,954
Chili bar.....	11,514	19,716	17,631
Australian	5,960	5,355	5,567
Other sorts	26,874	24,102	15,161
We estimate totals of above to produce in fine copper	104,000	105,000	108,000

Summary of Copper Supplies in English Market.

—	1891.	1890.	1889.
Production of English mines	Tons. 1,500	Tons. 1,500	Tons. 2,000
Imports of pyrites	15,685	14,779	14,489
Imports of pyrites, } as above { Imports of pyrites, } other sorts.	104,000	105,000	108,000
	119,185	122,279	124,489

Summary of Copper Exported from English Market.

—	1891.	1890.	1889.
	Tons.	Tons.	Tons.
Colonial and foreign ..	11,752	16,941	14,170
English, unwrought ..	35,541	45,003	32,517
English, wrought	16,223	13,472	15,671
Yellow metal.....	14,244	17,523	15,325
	77,760	93,029	77,983

IRON.

No metal has experienced more depression than this. The total exports for 1891 have declined to 3,241,035 tons, against 4,001,430 tons in 1890. Although the Argentine Republic shows the most considerable decrease in her takings, yet almost every other customer has also taken less. The home consumption has been fairly good, ship-building in particular having taken increased quantities. The production has been much smaller, each sort showing a diminution; so, notwithstanding the great decrease in exports, our stocks have actually diminished and are extremely small. Prices have been most unremunerative to producers, and furnaces have been dropping out of blast. At the present time the number of Cleveland and hematite furnaces in blast is smaller than for many years, and so soon as demand revives, it would necessitate the establishment of higher prices. The speculative markets for pig metal have been extremely inactive. Owing to the weakness of demand for export, there has been no inducement for dealing on a large scale, and the only important event of the year was a run on Scotch warrants in June and July, when, in consequence of over sales, the dealers had to pay fancy prices to close their accounts. But this being over, the market has lapsed into inactivity, and there is no reason to expect any movement in Scotch warrants, which are quoted nominally at 47s., so long as Middlesbrough No. 3 can be obtained at 38s., as the relative difference is only about 4s. per ton. Whenever the state of trade brings about a rise in Middlesbrough, then the speculative dealings in Scotch will be resumed.

Production.

—	1891.	1890.	1889.
	Tons.	Tons.	Tons.
Scotland.....	671,425	798,333	998,928
Cleveland.....	2,322,732	2,846,089	2,771,181
Barrow	1,272,800	1,392,700	1,415,200
Total	4,566,957	5,037,122	5,185,309

Stock at End of Year.

—	1891.	1890.	1889.
Scotland.....	579,677	613,145	1,035,840
Cleveland.....	262,916	256,262	262,385
Barrow.....	191,600	257,700	447,700
Total	1,034,193	1,127,107	1,745,925

Scotch Pig.

	1891.	1890.	1889.
	Tons.	Tons.	Tons.
Total production.....	674,125	798,333	998,928
Exports and home consumption.....	694,310	1,207,521	1,207,521
Stocks on warrant.....	500,057	587,652	913,777
Stocks in makers' yards at end of each year.....	78,720	25,793	92,093
Average price of warrants for whole year.....	47s. 1½d.	49s. 6¼d.	47s. 9d.
Furnaces in blast 31st Dec. .	78	6	88

Cleveland Pig, including Hematite, &c.

	1891.	1890.	1889.
	Tons.	Tons.	Tons.
Total production.....	2,622,732	2,816,080	2,771,181
Stock remaining 31st Dec. .	262,916	256,262	262,385
Average price of G.M.B. No. 3.....	40s.	47s. 7d.	43s.
Furnaces in blast 31st Dec. .	59	101	163

Hematite Iron in West Cumberland and Barrow Districts.

	1891.	1890.	1889.
	Tons.	Tons.	Tons.
Total production.....	1,272,800	1,392,700	1,415,200
Stock remaining 31st Dec. .	191,600	257,700	447,700
Average price of year.....	49s. 8¼d.	58s. 1¼d.	54s. 6½d.
Furnaces in blast 31st Dec. .	44	49	56

Exports of Iron and Steel to United States of America.

	1891.	1890.	1889.
	Tons.	Tons.	Tons.
Pigs.....	46,635	101,885	116,346
Bars, &c.....	3,975	3,757	4,587
Nails.....	3,819	11,210	18,561
Hoops, &c.....	4,576	20,378	29,701
Cast.....	3,335	3,580	3,332
Old.....	19,620	39,365	25,900
Unwrought steel.....	27,425	19,497	33,799
Total tons.....	109,416	199,773	232,226

Total Exports of Iron and Steel from United Kingdom.

	1891.	1890.	1889.
Quantity in tons.....	3,211,665	4,001,579	4,188,388
Value in sterling..... £	26,871,784	31,582,172	29,153,401

LEAD.

There has been a free supply, with a diminished export. Prices have steadily declined, and close at the worst point of the year.

	1891.	1890.	1889.
	Tons.	Tons.	Tons.
Production of British mines.....	30,000*	35,000*	46,000*
Importation of foreign into United Kingdom.....	169,724	158,649	145,151
Exports from United Kingdom....	18,726	55,536	52,153
Highest price of soft pig.....	£ s. d. 12 12 6	£ s. d. 14 15 0	£ s. d. 14 15 0
Lowest price of soft pig.....	11 5 0	12 5 6	12 5 0

* Estimated.

QUICKSILVER.

Importations have been the smallest recorded for four years. Exports have been large, and exceeded the imports by 1,700 bottles. The actual diminution of stock is this quantity plus the home consumption. During the last 10 years, with only one exception, viz. in 1888, a process of diminution of stock has been going on. The market has had a declining tendency. Opening at 9l. it declined to 7l. 5s. in September, from which it rallied to 7l. 17s. 6d. actual business and 8l. asked. Buyers, being well provided at lower rates, are now holding off; and to-day importers were ready to accept 7l. 10s.

	1891.	1890.	1889.
	Bottles.	Bottles.	Bottles.
*Production of Spanish.....	47,993	50,202	49,778
*Italian.....	10,140	12,470	10,498
Austrian.....	15,000	14,000	14,000
Californian.....	23,000	24,000	25,650
Total.....	96,133	100,672	99,926
*Exports from United Kingdom ..	63,113	56,702	55,306
Highest price of Spanish.....	£ s. d. 9 0 0	£ s. d. 10 7 6	£ s. d. 9 15 0
Lowest price of Spanish.....	7 5 0	8 17 6	7 7 6

* Calculated November to November.

N.B.—In Borneo, Servia, Russia, and Mexico, mines exist, but accurate returns are not obtainable.

SHEET ZINC.

	1891.	1890.	1889.
	Tons.	Tons.	Tons.
Importations of foreign into United Kingdom.....	20,157	17,542	19,261

Prices Realised for London rolled Zinc sold in our Public Sales.

	£ s. d.	£ s. d.	£ s. d.
Highest.....	26 0 0	27 0 0	25 2 6
Lowest.....	25 0 0	23 5 0	18 15 0

SPELTER.

Consumption and supply seem still very evenly balanced, and high rates have been current throughout the year. At the close some weakness was manifested which is said to be

caused by the unusual circumstance of spelter being sent to Europe from America.

	1891.	1890.	1889.
	Tons.	Tons.	Tons.
Importations into United Kingdom ..	53,483	56,205	56,112
Highest price for Silesian.....	£ s. 24 0	£ s. 25 10	£ s. 24 5
Lowest price for Silesian.....	22 5	19 15	16 10

ANTIMONY.

Opened at about 72*l.* per ton, and remained very dear during the first three months of the year. It then rapidly declined, and in September as low as 38*l.* was accepted. It afterwards advanced to about 56*l.*, finally closing at about 50*l.* to 32*l.* Furnace material has been scarce and difficult to deal in.

BAR SILVER.

Dealings in this important branch of the metal trade were inaugurated last March under the auspices of the General Produce Clearing House. At the outset a moderate amount of support was given by some merchants who believed in the importance of the trade. But it was insufficient, and after about four months' working the dealings were so small that the affair has for practical purposes become lapsed. But the utility of a large open market is indisputable, and we think more will be heard of it. The price of silver has on the whole been decidedly downwards, and in view of the want of effect on quotations by the monthly lock of 4½ million oz. in the American Treasury since August 1890, it is difficult to avoid the conclusion that the over-supply is extremely great, and that if ever free coinage should be adopted it will be at an altered ratio. To day's closing rate was 43.

BOARD OF TRADE RETURNS

SUMMARY OF IMPORTS.

	Year ending 31st December	
	1890.	1891.
	£	£
Metals.....	23,710,301	23,030,124
Chemicals and dyestuffs.....	8,190,380	7,314,337
Oils.....	6,991,653	7,339,904
Raw materials for non-textile industries.	41,626,155	40,035,435
Total value of all imports	429,885,035	435,691,279

SUMMARY OF EXPORTS.

	Year ending 31st December	
	1890.	1891.
	£	£
Metals (other than machinery)	45,222,737	39,230,009
Chemicals and medicines	8,965,849	8,882,059
Miscellaneous articles.....	31,535,417	32,193,728
Total value of all exports.....	263,530,585	247,272,273

IMPORTS OF METALS FOR YEAR ENDING 31ST DECEMBER.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
Copper:—			£	£
Ore..... Tons	111,628	90,661	902,798	739,530
Regulus..... "	104,507	123,337	3,008,150	3,319,938
Unwrought "	49,473	44,348	2,766,059	2,372,250
Iron:—				
Ore..... "	4,669,390	3,180,543	3,586,456	2,453,407
Bolt, bar, &c. "	92,899	77,440	925,318	751,587
Steel, unwrought.. "	8,114	8,436	85,142	87,569
Lead, pig and sheet ..	158,649	169,724	2,069,046	2,137,071
Pyrites..... "	656,881	616,227	1,219,188	1,126,247
Quicksilver..... Lb.	4,155,733	4,707,804	588,761	507,593
Tin..... Cwt.	540,769	593,144	2,547,316	2,565,072
Zinc..... Tons	56,205	58,483	1,288,358	1,328,750
Other articles...Value £	..	..	4,023,709	5,640,538
Total value of metals	..	..	23,710,301	23,030,124

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES FOR YEAR ENDING 31ST DECEMBER.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
Bark, Peruvian .. Cwt.	116,811	106,551	£ 341,377	£ 259,607
Bristles..... Lb.	2,988,100	3,413,175	443,200	498,383
Caoutchouc..... Cwt.	294,009	278,845	3,265,088	3,351,938
Gum:—				
Arabic..... "	52,790	62,352	159,704	162,232
Lac, &c..... "	91,834	101,551	389,538	426,519
Gutta-percha "	70,176	60,911	798,296	734,841
Hides, raw:—				
Dry..... "	455,098	453,268	1,191,240	1,185,360
Wet..... "	584,948	555,692	1,323,476	1,251,278
Ivory..... "	14,319	10,952	755,164	519,259
Manure:—				
Guano..... Tons	28,005	23,623	167,181	138,612
Bones..... "	69,949	82,915	372,048	416,849
Paraffin..... Cwt.	499,189	559,352	636,600	805,044
Linen rags..... Tons	34,889	32,037	354,306	318,855
sparto..... "	217,018	212,693	1,045,742	1,030,298
Pulp of wood "	137,837	156,464	706,841	848,986
Rosin..... Cwt.	1,627,446	1,811,740	376,625	490,939
Tallow and stearin ..	1,585,517	1,371,291	1,729,349	1,772,268
Tar..... Barrels	181,141	121,868	129,821	79,940
Wood:—				
Hewn..... Loads	2,278,374	2,231,577	5,004,554	4,508,787
Sawn..... "	4,778,314	4,378,452	11,002,221	9,379,808
Staves..... "	155,905	130,101	699,243	590,543
Mahogany..... Tons	39,812	48,021	360,965	449,433
Other articles....Value £	..	..	10,253,876	10,883,906
Total value .....	..	..	11,626,155	10,035,435

Besides the above, drugs to the value of £12,531*l.* were imported as against 863,534*l.* in November 1890.

IMPORTS OF CHEMICALS AND DYESTUFFS FOR YEAR
ENDING 31ST DECEMBER.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
Alkali..... Cwt.	37,741	87,168	£ 20,240	£ 50,404
Bark (tanners, &c.) ..	579,438	489,846	263,259	216,815
Brimstone..... "	568,641	428,778	129,470	129,512
Chemicals..... Value £	..	..	1,411,909	1,399,973
Cochineal..... Cwt.	7,808	7,911	51,067	47,547
Cutch and gambier Tons	27,415	23,926	717,820	565,453
Dyes:—				
Aniline..... Value £	..	..	264,538	239,391
Alizarine..... "	..	..	307,832	331,374
Other..... "	..	..	22,063	15,867
Indigo..... Cwt.	81,844	50,879	1,521,369	1,043,442
Madder..... "	11,373	11,477	15,545	15,853
Nitrate of soda.... "	2,177,842	2,140,652	963,632	1,049,818
Nitrate of potash . "	312,757	278,782	282,669	251,921
Valonia..... Tons	25,272	17,202	501,669	334,268
Other articles... Value £	..	..	1,738,367	1,654,759
Total value of chemicals	..	..	8,190,989	7,314,237

IMPORTS OF OILS FOR YEAR ENDING 31ST DECEMBER.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
Cocoa-nut..... Cwt.	184,469	186,493	£ 261,683	£ 261,228
Olive..... Tuns	20,187	18,105	785,787	733,435
Palm..... Cwt.	873,923	1,018,420	1,000,535	1,186,705
Petroleum..... Gall.	104,809,146	130,615,360	2,389,299	2,685,158
Seed..... Tons	22,810	23,011	611,891	609,890
Train, &c..... Tuns	20,362	21,969	419,296	454,794
Turpentine..... Cwt.	424,453	422,530	614,886	576,207
Other articles .. Value £	..	..	878,303	829,367
Total value of oils...	..	..	6,991,653	7,339,994

EXPORTS OF DRUGS AND CHEMICALS FOR YEAR ENDING
31ST DECEMBER.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
Alkali..... Cwt.	6,331,700	6,225,953	£ 2,089,295	£ 2,335,112
Bleaching materials ..	1,736,793	1,514,119	506,076	522,625
Chemical manures. Tons	317,596	322,166	2,072,973	2,112,563
Medicines..... Value £	..	..	1,000,379	1,053,598
Other articles... "	..	..	3,237,126	2,858,161
Total value.....	..	..	8,965,849	8,882,059

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR
YEAR ENDING 31ST DECEMBER.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
Brass..... Cwt.	106,211	114,061	£ 501,058	£ 516,769
Copper:—				
Unwrought..... "	900,538	710,826	2,629,214	1,974,585
Wrought..... "	270,917	324,171	917,510	1,077,930
Mixed metal..... "	551,451	231,888	1,004,830	798,614
Hardware..... Value £	..	..	2,764,446	2,525,542
Implements..... "	..	..	1,338,011	1,313,869
Iron and steel..... Tons	4,001,430	3,241,035	31,565,337	26,874,784
Lead..... "	55,537	48,276	812,330	683,015
Plated wares... Value £	..	..	403,794	391,063
Telegraph wires, &c. "	..	..	1,002,205	1,434,873
Tin..... Cwt.	102,642	103,322	503,371	491,822
Zinc..... "	164,176	153,555	162,678	161,902
Other articles .. Value £	..	..	1,017,953	985,211
Total value.....	..	..	45,222,737	39,230,609

EXPORTS OF MISCELLANEOUS ARTICLES FOR YEAR
[ENDING 31ST DECEMBER.]

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
Gunpowder..... Lb.	10,330,499	11,228,690	£ 252,828	£ 275,749
Military stores.. Value £	..	..	1,342,383	1,151,344
Candles..... Lb.	13,556,800	15,889,100	261,408	314,847
Caoutchouc..... Value £	..	..	1,222,400	1,241,298
Cement..... Tons	628,441	576,201	1,281,933	1,142,294
Products of coal Value £	..	..	1,414,677	1,572,286
Earthenware ... "	..	..	2,048,501	1,956,776
Stoneware..... "	..	..	190,009	149,344
Glass:—				
Plate..... Sq. Ft.	3,070,456	3,290,557	190,218	212,434
Flint..... Cwt.	111,855	109,691	261,105	242,952
Bottles..... "	934,908	792,065	433,390	371,675
Other kinds.... "	203,475	215,508	180,720	186,490
Leather:—				
Unwrought..... "	155,753	149,082	1,388,306	1,364,719
Wrought..... Value £	..	..	349,746	385,032
Seed oil..... Tons	65,118	79,442	1,499,556	1,535,814
Floorcloth..... Sq. Yds.	16,616,400	19,666,300	783,693	833,950
Painters' materials Val. £	..	..	1,577,480	1,618,154
Paper..... Cwt.	966,055	1,601,131	1,678,971	1,733,763
Rags..... Tons	53,885	49,652	404,655	355,227
Soap..... Cwt.	496,930	524,507	534,327	577,916
Total value.....	..	..	34,535,417	32,193,728

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

1891.

21,916. G. H. Simpson and W. C. Buntin. An improved condenser. December 15.

22,089. P. Labérie. Improvements in apparatus for evaporating saccharine or other solutions or liquids. December 17.

22,248. J. Pullman and H. S. Elworthy. *See* Class XVII.

22,333. W. R. Earp. Improvements in or relating to boiler anti-incrustation compounds or compositions and in the utilisation of waste substances for their manufacture. December 21.

22,349. A. S. Newman and J. Guardia. An appliance for regulating the flow of compressed gas from cylinders or other containing vessels. December 22.

22,465. A. Kerschbaum and F. J. Zwick. *See* Class XVII.

22,474. E. Bennis. Improvements in elevating or carrying apparatus applicable for sulphate of ammonia. December 23.

22,607. D. Rylands. Improvements in furnaces, retort chambers, and the like. December 28.

22,639. E. S. Arrighi. Improvements in and in the manufacture of clinical and other thermometers, and in apparatus therefor. December 28.

22,654. T. Veevers. Improved means or apparatus for boiling and evaporating purposes. December 29.

22,655. H. Williams. *See* Class VII.

22,656. H. Williams. Improvements in the method of and in apparatus for drying malt, hops, grain, pulse, and other substances. December 29.

22,677. P. Bender and H. Stockheim. *See* Class XVII.

22,744. S. F. Samuelson and L. A. Wilstahm. Apparatus for separating liquids of different densities. December 30.

22,870. J. Pullman and H. Lane. Improvements in the construction of compressing machinery or apparatus for the condensation and liquefaction of gases. December 31.

1892.

11. E. C. Peek. Improvements in taps or cocks for liquids. Complete Specification. January 1.

116. J. Bennett. An improved method of preventing incrustation, corrosion, and pitting in steam boilers and other vessels used for converting water into steam. January 4.

138. E. Brook. Improvements in furnaces. January 4.

154. A. T. Danks. Improvements in appliances for saturating air, oxygen, or other gases with the vapours of ether or other volatile fluids. Complete Specification. January 4.

COMPLETE SPECIFICATIONS ACCEPTED.*

1891.

1194. A. Chapman. Multiple-effect evaporating apparatus. December 31.

3051. L. Archbutt and R. M. Deeley. Process for treating chemically softened water so as to prevent the formation of an adherent deposit in the feed apparatus of steam boilers. December 23.

3514. B. Willcox.—From F. Fouché. Apparatus for condensing steam or vapour. January 6.

3916. F. Lennard. *See* Class II.

3952. F. Lowe. Apparatus for straining or filtering liquids. December 23.

3955. E. Luck. Improvements connected with vacuum distillatory apparatus. December 31.

4065. G. E. Belliss and A. Morecam. Machinery for compressing atmospheric air and compressing and condensing gases. January 6.

4308. E. B. Caird and T. J. Rayner. Surface condensers. January .

12,469. E. Hesketh and A. Marect. Apparatus for producing cold by the employment of carbonic anhydride. December 23.

12,676. E. Hesketh and A. Marect. Apparatus for producing cold by the employment of carbonic anhydride. December 31.

17,623. W. H. Bowers. Retorts for the carbonisation of wood and other vegetable substances, and the drying of manures, sewage, sludge, peat, and other substances and products. December 31.

19,983. J. K. Broadbent. Apparatus for regulating the supply of air to furnaces. January 6.

21,518. H. S. Elworthy. Apparatus for cooling liquids. January 13.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

1891.

21,816. C. Schubel. Improvements in incandescent lamps. December 14.

21,881. W. Fairweather.—From the Aeme Liquid Fuel Co., United States. Process of and apparatus for the manufacture of gas. Complete Specification. December 15.

22,106. C. E. Bell. Improvements in coke ovens to facilitate the cooling of the coke before drawing. December 17.

22,149. A. Edelmann. Improved manufacture of artificial fuel. Complete Specification. December 18.

22,167. G. T. Beilby. Improvement in the manufacture of cyanides. December 18.

22,286. J. Hamer. An improved fire-lighter. December 21.

22,292. J. A. Yeadon and W. Adgie. Improvements in heating retorts or furnaces for the distillation of coal or other analogous purposes. December 21.

22,297. J. H. Hedley. Improvements in the production of solid substances containing petroleum. December 21.

22,340. J. Pullman and H. S. Elworthy. A new or improved process for the manufacture of carbonic acid gas and hydrogen gas, and for the separation of the two gases, and apparatus therefor. December 21.

22,347. W. L. Rowland. A process for recovering cyanides from coal-gas. Complete Specification. December 2.

1892.

24. H. Williams. Improvements in gas purifying apparatus. January 1.

322. R. Pollok, jun. Improvements in and relating to the obtaining of cyanogen compounds. January 7.

471. D. Rylands and H. Naylor. Improvements in washing and preparing and coking of smudge, slack, or other coal, and in the application of the gases resulting therefrom, and in apparatus therefor. January 9.

482. J. C. Martin. Improvements in the manufacture of coal-gas and apparatus employed therewith. January 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

764. D. Rylands and R. Potter. Improvements in flues or other similar means for conveying combustible gas from the producer to the point where such gas is consumed. January 13.

1386. J. Hargreaves. Generation and combustion of gas for smelting and heating purposes, and appliances connected therewith. January 6.

2948. J. H. R. Dinsmore. Manufacture of illuminating and heating gases. December 23.

3042. J. Y. Johnson.—From P. Nadar. Apparatus for producing artificial light for photographic and other purposes. December 23.

3475. H. M. Carter and C. E. Fraser. Manufacture of brick or briquette fuel. December 31.

3862. W. Iyson. Process of making gas and a product arising therefrom. January 13.

3916. F. Lennard. Apparatus for carburetting gas or air, or for distilling, evaporating, or concentrating. January 13.

5036. W. P. Thompson.—From J. M. A. Gerard. Treatment and desiccation of peat. January 6.

17,371. K. Laves. Improved coke furnace or oven. December 31.

19,148. J. G. Cooper. Treatment of petroleum. December 23.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

COMPLETE SPECIFICATION ACCEPTED.

1891.

844. F. Lennard. Apparatus for distilling, more especially intended for distilling tar. December 23.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

1891.

21,249. E. von Portheim. Manufacture of new colouring matters from naphthyl-glycines. Complete Specification. December 15.

22,167. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Germany. Improvements in the production of colouring matters. December 23.

22,623. J. Murray.—From La Soc. L. Durand, Huguenin et Cie., Switzerland. A new manufacture of colouring matters. Complete Specification. December 28.

22,641. B. Willecox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture of new colouring matters. December 28.

22,839. J. Hickisson. Improvements in the manufacture or preparation of mordants or fixers for use in connection with marking ink points or pencils. December 31.

1892.

277. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Germany. Manufacture of new colouring matters. January 6.

366. R. Holliday and Sons, Lim., and T. Holliday. Improvements in the manufacture of azo colouring matters. January 7.

367. R. Holliday and Sons, Lim., and T. Holliday. Improvements in the manufacture of a new sulpho-acid of alpha-naphthylamine and of colouring matters therewith. January 7.

375. R. Greville-Williams. Improvements in colouring matters. January 7.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

1616. F. L. Leech and A. Horrobin. Waterproof solution. December 23.

2805. H. H. Lake.—From Wirth and Co., Agents for A. Leonhardt and Co. Manufacture of colouring matters. December 23.

2818. O. Murray.—From The Farbwerke vormals Meister, Lucius and Brüning. Production of azo colours in discharge printing on indigo dyed fabrics. December 23.

3247. E. Coen. Manufacture of copying ink. December 31.

3439. B. Willecox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of azo dyes. December 23.

4543. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Manufacture of improved dyestuffs suitable for dyeing vegetable fibre with or without a mordant. January 6.

4688. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Manufacture and production of new mordant-dyeing colouring matters related to the rosaniline series. January 13.

5184. J. Y. Johnson.—From F. von Heyden. Process for the production of mono-bromo and di-bromo-para-oxybenzoic acid, suitable for conversion into proto-catechuic acid, pyro-catechuic, and the like. January 13.

20,010. H. N. F. Schaeffer. Manufacture of alizarin colours, and method of employing same in the process of dyeing. December 23.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

1891.

22,234. G. H. Wolstencroft. Improved means of and apparatus for neutralising the acid in woollen piece goods and recovering the by-products. December 19.

22,303. F. Reddaway. Improvements in and in the manufacture of oil baizes, American leather, cloth, and other waterproof fabrics. December 21.

1892.

34. O. A. Berend and H. W. Miller. Process for producing artificial cotton threads from hydro-cellulose. January 1.

209. D. E. Coe. Improvements in the manufacture of yarn from waste. Complete Specification. January 5.

243. C. Hanson. Improvements in the process of extracting deleterious matters from wool and other textile materials. January 6.

477. G. Hagemann. See Class XIX.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

1891.

21,801. B. Baigh. Improvements in dyeing and apparatus therefor. December 11.

22,028. H. H. Lake.—From La Société Bonnet, Ranael, Savigny, Giraud, and Marnas, France. An improved method of printing silk and similar fabrics. December 16.

22,168. T. Lye and W. T. Lye. Improvements in the bleaching or dyeing of "chip" and "chip-plaits." December 18.

22,263. L. Kern. Improvements in the method of and apparatus for preventing the escape of noxious gases in the processes of bleaching and otherwise treating textile materials. Complete Specification. December 19.

22,437. C. Kellner. An improved process and apparatus for bleaching paper pulp and other similar vegetable substances. December 23.

22,438. C. Kellner. A process and apparatus for increasing the bleaching properties of chlorine gas. Complete Specification. December 23.

22,538. E. Zillessen, sen. Improvements in dyeing silk or half silk goods. December 24.

1892.

148. A. Dreze. Improvements in dyeing vats. January 4.

282. E. Woodcock, sen., N. O. Woodcock, and E. Woodcock, jun. An improved machine for dyeing, scouring, bleaching, sizing, carbonising, and drying. January 6.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

3385. W. Watson and E. Bentz. Improved method of manufacture of certain compounds of chromium used in dyeing and calico printing. December 31.

20,010. H. N. F. Schaeffer. Manufacture of alizarin colours, and method of employing same in the process of dyeing. December 23.

20,866. F. Hughes.—From A. Tiberghien. Dyeing, mordanting, or bleaching textile fibres. January 6.

20,931. L. Weldon. Yarn-dyeing machines. January 6.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

1891.

21,969. E. J. Barbier. Process for the treatment of bisulphate of soda and mixtures thereof with other substances for the purpose of producing neutral sulphate of soda, sulphuric acid, nitric acid, hydrochloric acid, and other products. December 15.

22,018. A. Vogt. Improvements in the manufacture of nitric acid. December 16.

22,320. La Soc. A. R. Pechiney et Cie. Improvements in the manufacture of chlorine. Complete Specification. Filed December 21. Date applied for July 2, 1891, being date of application in France.

22,340. J. Pullman and H. S. Elworthy. See Class H.

22,481. E. Edwards.—From O. Guttman and L. Rohrmann, Germany. An improved process for the preparation of pure nitric acid. December 23.

22,541. J. Brock and J. T. Marsh. Improvements in the manufacture of carbonates of strontium and barium. December 24.

22,558. A. M. Clark.—From The Deutsche Gold und Silber-Scheideanstalt, vormals Roessler, Germany. Improvements in the production of salts of ferricyanogen. December 27.

22,655. H. Williams. Improvements in the method of and means for recovering salts from brine and solutions, and for concentrating solutions. December 29.

22,704. H. H. Lake.—From Madame V. Hammettel, France. Improvements in apparatus for use in the concentration of sulphuric acid. December 29.

22,716. H. C. Bull. See Class IX.

22,828. J. J. Meldrum and T. F. Meldrum. Improvements in or connected with the supply of liquor to ammonia stills. December 31.

1892.

1. H. C. Bull. Improvements in or connected with the ammonia-soda process, applicable also to other purposes. January 1.

88. H. H. Lake.—From E. B. Cutten, United States. Improvements relating to the production of soda and chlorine, and to apparatus therefor. Complete Specification. January 2.

89. H. H. Lake.—From E. B. Cutten, United States. Improvements relating to the production of liquid chlorine, and to apparatus therefor. Complete Specification. January 2.

101. H. H. Lake.—From C. J. C. Wichmann, Germany. Improvements in the treatment of ferro-sodium sulphide. January 2.

192. A. S. Caldwell. Improvements in apparatus for evaporating and incinerating spent or used alkaline lyes or similar waste products. January 5.

212. S. C. C. Currie. Improvements in the art of producing insoluble chlorides direct from the metals. Complete Specification. January 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

3345. J. S. Fairfax.—From F. Crane. Sulphuretted solutions and compounds used for the production of films or coatings. December 23.

3657. J. J. Howitt. Apparatus for the manufacture of carbonates of soda. January 6.

3785. J. Simpson. Treatment of a certain material (mineral) containing phosphate of lime for the purpose of obtaining the latter in a highly concentrated condition as dialcic phosphate, together with certain by-products. January 13.

4068. F. M. Lyte. Production of chlorine. December 31.

20,037. C. Kellner. Apparatus for the manufacture or production of bleaching powder. January 13.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

1891.

21,826. M. Epstein. Improvements in filtering tubes with ball filtering material for purifying molten glass. Complete Specification. December 14.

21,997. J. K. Thompson. An improved fire-resisting brick and material for lining, facing, or coating fire-places, fire-boxes, furnaces, ovens, and kilns of every kind. Complete Specification. December 16.

22,354. E. T. Smith. Improvements in the art of decorating earthenware. December 22.

1892.

16. R. F. Yorke. Improvements in earthenware pipes. January 1.

117. D. Rylands. Jars and similar receptacles for sterilised milk and similar preparations. January 4.

118. T. J. Shaw. An air-tight salmon and preserve jar made in earthenware, china, glass, stoneware, or any metallic substance. January 4.

165. T. H. Hunt. Improvements in appliances employed in the glazing of earthenware pipes, tiles, and analogous articles. January 5.

489. H. Warrington. Improvements in kilns or ovens for bricks, earthenware, porcelain, and similar material. Complete Specification. January 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

3532. C. Breuer. Manufacturing artificial stones with glass surfaces. January 6.

18,939. J. W. Bonta. Method of and apparatus for rolling plate or sheet glass. December 31.

20,437. W. P. Thompson.—From R. S. Pease. Method and apparatus for manufacturing plate-glass. December 31.

20,439. W. P. Thompson.—From R. S. Pease. New or improved method of and apparatus for the manufacture of glass plates, cylinders, pipes, and certain other bodies. December 31.

21,350. F. Welz. Process of making rose or orange-red stained glass. January 13.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

1891.

22,111. E. Nelson. Improvements in material for use as a damp course in building foundations. December 17.

22,171. T. Smith. Improvements in metallic compounds or cements, and in the methods of making and using the same. December 18.

22,198. F. H. Willis and R. Astley. An improved form of fireproof floor. December 19.

22,243. T. Bretherton. Ironcrete pavement. December 19.

22,428. J. Jackson. Improved manufacture or production of decorative material, more especially intended for application to walls, ceilings, or like surfaces. December 23.

22,716. H. C. Ball. Improvements in the production of and apparatus for obtaining carbonic acid gas and lime. Complete Specification. December 30.

1892.

50. P. A. Moreau. Improvements in the manufacture of artificial marble. January 1.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

20,918. C. G. Wernaer and O. Wernaer. Method of manufacturing artificial granite and marble. December 23.

1891.

1449. A. J. B. Ward. Fireproof floors, staircases, and roofs. December 31.

3532. C. Breuer. See Class VIII.

3797. G. H. Skelsey. Manufacture of Portland cement. January 13.

12,429. F. J. Reynolds and J. Brown. Building cements. December 31.

13,491. C. H. Kopke. Improved fireproof material. December 31.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

1891.

21,835. J. Harvey. Separating tin and other ores. December 14.

21,950. W. P. Breeding.—From The Agax Metal Co., United States. Improvements in the cleaning and preparation of metallic sheets and other articles, and in the coating of same with lead or alloys of same. December 15.

22,041. C. James. An improved method of treating plumbiferous copper mattes and ores. Complete Specification. December 16.

22,042. A. Walker. An improved process of extracting gold and silver from refractory and other ores containing those metals. December 17.

22,097. J. B. Alagaray. Improvements in metal alloys. December 17.

22,098. J. B. Alzugaray. Improvements in metallic alloys. December 17.

22,177. T. J. Tresidder. Improvements in the manufacture of armour plates. Complete Specification. Filed December 18. Date applied for September 3rd, 1891, being date of application in France.

22,207. C. J. L. Leffler. Alloys of lead. December 19.

22,504. I. S. McDougall. Improvements in furnaces for burning ores containing sulphur and sulphur compounds. December 24.

22,694. E. Dor. A novel system of regenerative gas furnace for the reduction of zinc ores. Complete Specification. December 29.

1892.

53. J. Pullman and H. Lane. Improvements in the manufacture of shell for ordnance of forged steel, iron, or other malleable metal. January 1.

261. T. D. Bottomuc. Tempering anti-friction and other white metals. January 6.

392. H. Hall. Improvements in apparatus for coating metal plates with tin, terne, or other metals or alloys. January 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

11,966. J. B. Hannay. Improvements in extracting precious metals from ores or minerals containing them. December 31.

19,181. J. B. Hannay. Process and apparatus for extracting gold from minerals containing it. December 31.

21,009. G. H. Smith and B. Cooper. Method and means for casting white metal couplings and other similar white metal objects required to stand confined pressure. October 28.

1891.

1161. B. H. Thwaite. An improved form of high temperature furnace especially adapted for the conversion of a high carbide of iron into the low carbide condition known as steel. January 13.

2747. W. Hutchinson and F. W. Harbord. The utilisation of blast-furnace and other slags in conjunction with finely-divided oxides of iron. December 23.

3278. A. French and W. Stewart. Obtaining gold, silver, and copper from ores. December 31.

20,977. J. H. Hunt. Method of reducing the bulk of scrap iron or other metals. January 6.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

1891.

21,870. H. H. Lake.—From E. A. Clark, United States. Improvements in voltaic cells or batteries. Complete Specification. December 15.

21,959. E. Hermite and A. Dubosc. Improvements in and apparatus for the manufacture of alkaline or earthy alkaline bases and of their salts or compounds by electrolysis of saline solutions. December 15.

22,030. C. Hoepfner. Improvements in the electrolytic treatment of copper and silver ores. December 16.

22,126. A. E. Porter. An improvement in secondary batteries. December 17.

22,178. F. Morin. Improvements in electric accumulators or secondary batteries. December 18.

22,339. N. Wladimiroff. Improvements in primary and secondary batteries. December 21.

22,482. H. H. Lake.—From E. Weston, United States. Improvements in voltaic cells. Complete Specification. December 23.

22,554. H. H. Leigh.—From J. F. Weyde and F. Clas, Austria, and J. Elsner, France. Improvements in batteries and accumulators. December 24.

22,708. W. Hellesen. Improvements in the manufacture of porous carbon for galvanic batteries and for filters. December 29.

22,851. E. Placet and J. Bonnet. Improvements relating to the electrolysis of metals. Filed December 31. Date applied for July 17, 1891, being date of application in France.

22,855. E. Placet and J. Bonnet. A method of extracting chromium by the aid of electrolytic baths with a base of salts of chromium. Filed December 31. Date applied for July 17, 1891, being date of application in France.

22,856. E. Placet and J. Bonnet. A method of extracting chromium by the aid of electrolytic baths with chromic acid base. Date applied for July 17, 1891, being date of application in France.

1892.

334. H. Nehmer. Improved form of a dry galvanic element. January 7.

355. E. C. Furby. Improvements in or relating to the electro-deposition of tin upon metals. January 7.

372. N. Benardos. Improvements in soldering, melting, and coating metals by the aid of electricity. January 7.

495. G. H. Robertson. An improved electric battery electrolytic. January 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

20,838. H. Birkbeck.—From O. Henriksen. New or improved couple or element for electrical purposes. December 23.

21,031. P. J. Davies. Production of lead plates for secondary batteries, and the connections, straps, or lugs to the same. December 23.

1891.

2518. W. Gibbings. Method of depositing copper or other metals by electrolysis, with the object of refining it or them, or of recovering the precious and (or) other metals contained in or alloyed with the metal under treatment. January 13.

3170. D. Rylands. Manufacture of Leclanché cells. December 31.

3738. J. Marx. Apparatus for electrolysing and bleaching. January 6.

11,702. H. Hauser. Secondary batteries. January 6.

19,900. W. P. Thompson.—From C. L. Coffin. Welding or working metals electrically. December 31.

19,901. W. P. Thompson.—From C. L. Coffin. Welding or working metals electrically. December 23.

21,442. H. H. Lake.—From I. L. Roberts. Secondary or storage batteries. January 13.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

1891.

22,297. J. H. Hedley. See Class II.

22,363. J. Kennedy. An improved soap. December 22.

22,413. W. Saint-Martin. See Class XVII.

22,430. A. Smith. Improvements in apparatus for separating certain impurities from oil, and especially from oil which has been used in lubricating machinery. December 23.

20,512. R. R. Graf. Method of treating oils used for lubricating and tempering purposes to render the same incombustible or fireproof.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

1891.

22,331. W. R. Earp. A new or improved material which may be used in arts and manufactures in the stead of india-rubber, gutta-percha, and other similar substances, and process for making the same and for the utilisation thereof of waste liquors from tanneries. December 21.

22,348. W. Grimshaw. An improved mode of making up for sale certain colour and pigment preparations for laundry and other purposes. December 22.

22,391. R. B. Johnson and T. C. Palmer. Improvements in the manufacture of white lead and apparatus therefor. December 22.

22,610. A. O. Gill and W. S. Gill. Improvements in and relating to paints and lacquers. December 28.

22,809. M. Williams. Improvement in the manufacture of oil paints and paint medium. December 31.

1892.

81. R. Matthews and J. Noad. Improvements in the treatment of oxide of lead in the production of white lead or pigments, and certain by-products. January 2.

134. W. J. Beale. Improvements in the production of substances for elastic tyres for the wheels of road vehicles, applicable to other purposes. January 4.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

3573. T. Holden. Improved anti-fouling compound or preparation for bright or polished metallic surfaces. January 6.

21,515. E. Waller and C. A. Sniffen. Manufacture of white lead and neutral lead acetate from lead ores. January 13.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

3176. W. Bolt. A process for tanning all kinds of hides or skins. December 31.

3910. O. Brunner. Waterproofing leather. January 13.

4385. A. Focking. Clarifying and bleaching tannin extracts or tannin liquors. January 13.

XV.—AGRICULTURE AND MANURES.

APPLICATION.

1891.

22,192. L. Lamattina. Improvements relating to the conversion into manure of the refuse and foul matter from cities and towns. Complete Specification. December 18.

XVI.—SUGARS, STARCHES, GUMS, ETC.

APPLICATIONS.

1891.

22,089. P. Labérie. Improvements in apparatus for evaporating saccharine or other solutions or liquids. December 17.

22,679. C. M. Higgins. Improvements in mucilages, sizes, and adhesive compounds. Complete Specification. December 29.

22,682. C. M. Higgins. Improvements in mucilages, sizes, and adhesive compounds. Complete Specification. December 29.

22,685. C. M. Higgins. Improvements in mucilages, sizes, and adhesive compounds. Complete Specification. December 29.

1892.

420. E. Langen. Improvements in refining sugar. Complete Specification. January 8.

XVII.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

1891.

22,124. C. H. Jolliffe. Improved means and apparatus for rousing, aerating, and attenuating brewers' worts during the process of fermentation. Complete Specification. December 17.

22,248. J. Pullman and H. S. Elworthy. A method of and appliances for the collection, purification, and utilisation of carbonic acid gas given off during fermentation of saccharine and other substances. December 19.

22,399. W. P. Thompson. — From O. E. Nycander, Germany. Improvements in or in the preparation of extracts for use in the manufacture of yeast and spirit. December 22.

22,413. W. Saint-Martin. Improvements in means or apparatus for maturing and improving fermented alcoholic and oleaginous liquids. December 22.

22,432. A. Fremdlich. Process and apparatus for recovering certain lye-products from the waste gases or vapours of breweries. December 23.

22,465. A. Kerschbaum and F. J. Zwick. Improvements in fermenting and apparatus therefor. December 23.

22,606. W. G. Barrett. Improvements in the manufacture of beers of low alcoholic strength. December 28.

22,677. P. Bender and H. Stockheim. Improvements in and connected with apparatus for cooling beer or other liquids. December 29.

1892.

301. H. Prior. Improvements in apparatus for cooling and attenuating beer during fermentation. January 6.

192. B. J. B. Mills.—From T. W. Q. Honeywill, New Zealand. Improvements in or connected with brewers' cleansers. January 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

3207. G. F. Relfern.—From J. Hradil. Method of increasing the formation of cells during the process of fermentation. December 31.

3378. F. L. Calmant. The manufacture of charcoal from sawdust, wood shavings, and the like, and the treatment of wine alcohol, brandy, cider, beer, and other matters therewith. January 13.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

1891.

22,229. W. McDonnell. Improvements in the process of manufacturing margarine. December 19.

22,631. J. Torbitt. A method of treating the fruit of the potato plant (*Solanum tuberosum*) for its utilisation for alimentary purposes. December 28.

1892.

96. J. Fordred. An improved malted food. January 2.

279. A. D. McKay. A new chemical food. Complete Specification. January 6.

B.—Sanitary Chemistry.

1891.

22,442. J. Hanson. Improvements in the treatment of sewage and other foul liquid or semi-liquid matters for the clarification, disinfection, and deodorisation thereof. December 23.

22,531. W. Horsfall. Improvements in furnaces for destroying the refuse and dealing with the sewage, sludge, and other offensive material of towns. Complete Specification. December 24.

22,545. C. E. Bell. Improvements in the treatment of iron ores to render them suitable for use in the purification of impure waters and other liquids and gases. December 24.

22,546. W. Lawrence. Improvements in the clarification, purification, and softening of water, contaminated water or sewage in the preparation of reagents, and in apparatus for use therein. December 24.

22,747. J. T. Wood. A new or improved method or process for purifying sewage or foul water. Complete Specification. December 30.

C.—Disinfectants.

22,258. C. C. Leathers. A new or improved apparatus for disinfecting or odorising purposes. December 19.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1890.

21,019. E. Sonstadt. Making an extract of coffee and confection of the same, and in preserving liquid coffee extracts. December 31.

21,106. E. Sonstadt. Making an extract of tea and a confection of the same, and preserving liquid tea extracts. December 31.

1891.

2816. O. Murray.—From Calberla, Fitz and Consorten. Process and apparatus for sterilising liquids. January 13.

2944. J. Oakhill and R. H. Leaker. Process for preserving milk. January 13.

19,887. H. S. Elworthy. Preserving meat, fruits, and such like perishable articles in store or in transit. January 6.

21,372. J. Carnrick. Manufacturing kumyss compounds or kumyss tablets. January 13.

B.—Sanitary Chemistry.

1891.

2816. A. McDougall and J. J. Meldrum. Disinfection and deodorisation of sewage, and apparatus for preparing and applying the disinfectant. December 23.

5908. E. E. Dulier. Method of destroying smoke, and apparatus for that purpose. January 6.

14,735. E. Devonshire. Apparatus for purifying or treating water. December 31.

17,623. W. H. Bowers. *See Class I.*

20,726. J. Norris. Disposal of sewage and apparatus connected therewith. January 6.

C.—Disinfectants.

1891.

9083. C. Scott. Method of vaporising eucalypt and other disinfectants, and apparatus therefor. January 6.

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

1892.

433. H. Richardson and H. Glenny. Improvements in the manufacture of paper and in apparatus used for that purpose. January 8.

477. G. Hagenmann. Improvements in the manufacture or production of cellular substance suitable for paper-making and fibre suitable for spinning. January 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

3878. R. N. Redmayne. Manufacture of paper pulp for paper-making and other purposes. January 6.

5240. J. Valetton. New or improved anti-nicotine cigarette paper. January 13.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES,
AND EXTRACTS.

APPLICATIONS.

1891.

22,253. L. J. P. Pontallic. Improved apparatus for obtaining products of distillation, or separating volatile liquids. Complete Specification. December 19.

22,787. C. Fahlberg. Improvement in the production of pure saccharine. December 30.

1892.

361. C. D. Abel.—From C. F. Boehringer and Sohne, Germany. Improved manufacture of vanillin. January 7.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

21,019. E. Sonstadt. *See Class XVIII.—A.*

21,106. E. Sonstadt. *See Class XVIII.—A.*

XXI.—PHOTOGRAPHIC PROCESSES AND
MATERIALS.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

7635. E. Hackh. Magnesium lights for photographic and signalling purposes. December 23.

16,125. A. Hill. Enlarging photographic gelatin films by the aid of chemical means and without the aid of enlarging apparatus. December 23.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

1891.

21,879. A. Ruston and E. Beadle. Improvement in railway fog signal detonators. Complete Specification. December 15.

22,401. J. Tinsley. Improvements in explosives. December 22.

1892.

41. J. Wilson. Improvements in cartridges applicable for blasting purposes. January 1.

COMPLETE SPECIFICATION ACCEPTED.

1891.

3881. G. A. Rosenkolter. Manufacture of lucifer matches. December 31.

THE JOURNAL

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White, H. Osborne, 35, North Bank, Regent's Park, N.W., white lead manufacturer.

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Barnes, Jonathan, 10 Buckton Vale; 1, Trafalgar Street, Great Clowes Street, Manchester.

Batty, R. B., 10 Lincoln Villa; Wharncliffe, Erdington, Birmingham.

Bell, Sir Lowthian, Bart., address for subscriptions c/o Bell Bros., Middlesbrough.

Blythe, Herbert, 10 Church; 33, Leyland Road, Southport.

Bond, L. W., 10 Ensley; Box 506, Seattle, Wash., U.S.A.

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Bruce, Jas., 10 Mountpottinger; The Irish Distillery, Connswater, Belfast.

Burrell, B. A., 5, Mount Preston (not Pleasant), Leeds.

Chase, R. L., Journals to 155, East Main Street, North Adams, Mass., U.S.A.

Crowther, Horace W., Journals to 21, Beeches Road, West Bromwich.

Dagger, J. H. J., Journals to Hallwater, Endon, Stoke-on-Trent.

Dupce, H. D., all communications to Walpole, Mass., U.S.A.

Earnshaw, Edwin, 10 24; 72, Mark Lane, E.C.

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Franee, G. T., Journals to Friar's Goose Works, Gateshead-on-Tyne.

Froehling, Dr. H., 10 Richmond, Va.; Warners, Onondaga Co., N.Y., U.S.A.

Gamble, Jas. N., Journals to "The Laboratory," Procter and Gamble Co., Ivorydale, Ohio, U.S.A.

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Masson, G. H. 1/o Trinidad; 16, Roseneath Place, Edinburgh.

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Warne, Thos., 1/o Walsall; 6, Wakefield Road, Thwaitegate, Leeds.

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Williams, Seward W., East Orange, N.J. (not Mass.), U.S.A.

Wood, Wm., 1/o 124; 128, Chaussée de Turnhout, Antwerp.

ADDITION TO LIST OF MEMBERS.

Jackson, V., Park Hill, 10, Chorley Old Road, Bolton.

Deaths.

Dittmar, Prof., F.R.S., Anderson's College, Glasgow. February 9.

Fearfield, J. P., Stapleford, Notts.

London Section.

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D. Howard.	T. E. Thorpe.

Hon. Local Secretary: John Heron,
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SESSION 1891-92.

1892:—

March 7:—

Mr. Oscar Guttman, Assoc. M.I.C.E. "On the Dangers in the Manufacture of Explosives."

Drs. Evans and Wirtz, and Messrs. Cross and Bevan. "On the Acid Action of Drawing Paper."

April 14:—

Dr. C. R. Alder Wright, F.R.S. "On Specific Gravities for Practical Purposes."

Mr. Albert Baur, Ph.D. "On Artificial Musk."

Mr. F. H. Leeds, F.I.C., F.C.S. "Note on Rosin Oil."

Election of Officers and Five Members to the Local Committee.

Nominations must be signed by Ten Members and sent to the Secretary on or before March 22nd. Members can only sign one nomination. (See Bye-laws.)

May 2nd:—

Professor Wm. Ramsay, F.R.S., and Mr. J. C. Chorley. "The Distillation of Wood."

Dr. S. Rideal. "Notes on the Composition of some Indian Gums of known Origin."

June 6th:—

Mr. J. A. Nettleton. "Vinegar."

Dr. S. Rideal. "The Petroleum Jellies of Commerce."

Meeting held Monday, 4th January, 1892.

MR. THOS. TYRER, IN THE CHAIR.

THE CHAIRMAN, before calling on Mr. Redwood for his paper, referred to the loss the Society and the Section had sustained by the decease of the London Secretary, Mr. T. W. B. Mumford. On his motion a vote of condolence and sympathy with Mrs. Mumford and the family was passed unanimously.

The Chairman announced that in virtue of its powers under the Sectional Byelaws, the Committee had nominated Mr. John Heron, F.I.C., F.C.S., and past President of the Institute of Brewing, to be Secretary.

THE GALICIAN PETROLEUM AND OZOKERITE INDUSTRIES.

BY ROBERTSON REDWOOD, F.R.S.E., F.I.C., F.C.S.,
ASSOC. INST. C.E.

I.—Petroleum.

THE increasing consumption of petroleum in the form of lamp oil and lubricating oil, and especially the growing demand for the material in the manufacture of gas for illuminating purposes, either as a substitute for canal in enriching coal-gas or for carburetting water-gas, are rapidly tending to confer general industrial importance upon sources of supply that might otherwise have remained of merely local consequence. It is on this broad ground that the subject of the Galician petroleum industry has been thought to be not unworthy of the attention of the members of the Society of Chemical Industry.

The petroleum industry of Galicia, in common with the corresponding industries of the United States, Russia, and other countries, may properly be described as of great antiquity. From the earliest times of which any historical records have been preserved the crude oil has been collected in a primitive fashion and has been largely employed in the manufacture of cart-grease, and as a remedial agent for outward application in cases of cutaneous disease of men and animals. The oil was also, many years ago, sent into Bohemia, where it was mixed with small coal to form briquettes. In the first instance it was collected from springs and streams of water, but the old timbered oil-wells so frequently met with in Galicia and Roumania indicate

very clearly that it has long been the practice in those countries to dig wells or shafts for the collection of the oil. The petroleum of Galicia is specially referred to in local records from the commencement of the seventeenth century, but evidently was not at that early date regarded as having any commercial importance, for as Mr. Nelson Boyd, M.I.C.E., has pointed out, it was not mentioned in the Austrian mining laws framed in 1786, and applicable to Poland. It was not, in fact, until 1810 that petroleum appears to have been first officially noticed in a Government decree relating to the registration of mining rights. There are no statistics from which any accurate impressions of the extent of the industry at this early period can be gathered, but it may safely be assumed that the requirements of a sparse population, far removed from the civilising influence of the capitals of Europe, cannot have been considerable. It was not in fact until the manufacture from the raw material of an oil for use in lamps was commenced that the industry assumed industrial importance, and the pit-wells were found inadequate to meet the rapidly increasing demands.

In the United States the petroleum industry in its present form is generally considered to date from the drilling of what is known as the Drake well in 1859, but long before this time systematic attempts were made in Galicia to found a business in the refining of the oil. As far back as 1810, or between that date and 1818, Hecker and Mitis, who owned wells in the Dohobycz district, are reported to have distilled the oil, and the Alstettering in Prague is stated to have been lighted with the product. The refinery from which the city received its annual supplies of 300 cwt. was situated at Kabcza, and the oil appeared to have been sold at 35 florins per cwt. This business, however, came to an end in 1818, and no further attempt to supply an oil suitable for use in lamps appears to have been made until 1852. In that year, a manufacturer of cart-grease, of the name of Schreiner, collected some of the liquid which condensed on the cover of the vessel in which he was accustomed to heat the crude petroleum. This strong-smelling oil he took to an apothecary named Mikolash, whose assistants, Lukasiewicz and Zeh, treated it with sulphuric acid and caustic soda. This refined oil was found to burn so well that renewed attention was at once directed to the subject. In the following year Galician petroleum was substituted for candles in the lighting of the station of the Emperor Ferdinand's North Railroad, and in 1854 the oil became an article of commerce in Vienna.

In 1859 one of two brine-wells in the Sloboda-Rungurska district of Galicia, excavated as far back as 1771, and stated to have continuously yielded a small quantity of petroleum, was deepened to 25 metres, with the result of increasing the yield. This historic well, which bears the name of Stanislaw, appears to have been further deepened by digging, in 1865, to 50 metres, the original diameter of 1.50 metres being preserved to the bottom. It is stated by Babu* to have yielded then five barrels a day, and this production was not sensibly altered by an attempt in 1875 to increase it by drilling from the bottom of the shaft to a further depth of 100 metres, making 150 metres in all. In 1884 the depth of the well was further increased by drilling to 213 metres, and the yield of oil was thereby augmented to 10 barrels a day.

It was, however, in what is known as the Bobrka district that the earliest systematic development of the industry occurred, and when the writer visited the Galician oil-fields in 1887 he was pleased to see that a stone obelisk had very properly been erected in this district by Klobassa and Tszczieski, the owners of neighbouring petroleum properties, to record the fact. The monument bears an inscription of which the following is a translation:—"To preserve the memory of the founding of the petroleum mine in Bobrka in the year 1854 by Ignacy Lukasiewicz. 4th Nov. 1872."

Bobrka is a village on the left bank of the Jasolka, between Krosno and Dukla, and it was here that after many comparatively unsuccessful attempts to collect the petroleum by the digging of long trenches about a metre deep, and shallow wells, Lukasiewicz, with the co-operation of M. Klobassa, completed in 1861 the first important well, which, at a depth of 14 metres, yielded 6,000 kilogrammes of oil

per hour. The work of development was thenceforward proceeded with, and the production quickly assumed locally important dimensions.

The active development of the Sloboda-Rungurska section of the Kolomea oil-field was commenced in 1881, and in 1883 this district was reported to be yielding 550 barrels per diem of crude petroleum within an area of 1,500 metres in length and from 350 to 500 metres in breadth. The Sloboda-Rungurska field was for a time by far the most productive of the Galician oil-territories, the production at one period having increased to over 1,600 barrels per day. In consequence of the compact character of the petroliferous area, and the apparent regularity of the distribution of the oil over this area, the drilling of wells within the demarcated oil zone in this district has been attended with comparatively uniform success.

Meanwhile the development of the portion of the oil-belt in the neighbourhood of Ustrzyki has been steadily progressing, and there is now no part of the Galician oil-fields where the industry is more firmly established or where the prospects are more favourable.

Concurrently with the recent progress made in the Ustrzyki section of the belt renewed attention has been given to the western end, and at Wietzno some remarkably productive wells have been drilled. The Wietzno field joins the Bobrka district, where the petroleum industry of Galicia may, as already pointed out, be said to have had its birth. The neighbourhood of Krosno constitutes another portion of the western end of the oil-belt in which the efforts of the producer have quite recently met with conspicuous success, several very productive wells having been drilled here.

The province of Galicia was originally a portion of the kingdom of Poland. It was allotted to Austria at the time of the partition in 1776, and is now embraced in the Empire of Austria-Hungary. A glance at the map of Europe will show that Galicia lies on the northern slopes of the Carpathian mountains, which extend in a general north-westerly and south-easterly direction.

In this connexion it may be well to point out that the principal petroleum deposits occurring in various parts of the world are closely associated with the chief mountain ranges. In illustration of this statement attention may be directed to the accompanying map of Europe (Map No. 1), on which some of the chief petroliferous districts, deposits not yet of industrial importance, and localities where indications of petroleum have been met with, are marked.

Commencing, at the extreme eastern confines of Europe, with the very important oil-fields in the neighbourhood of Baku, evidences of the existence of the oil are found at many points along the Caucasus mountain range between Baku and the Black Sea coast, notably in the neighbourhood of Tiflis, and between Poti and Batoum. On the Taman peninsula, inland of Novorossisk, lie the oil-fields of Illsky and Kondako, and farther westward are the well-known petroleum deposits of Kertch, in the Crimea.

Still travelling westward, the Carpathian ranges are reached, and here, in addition to the Galician oil-territory, which as already stated lies on the northern slopes of those mountains, there are the important Roumanian oil-fields occupying the south-eastern and southern slopes of the Southern Carpathians, or Transylvanian Alps, and deposits which as yet are of comparatively small commercial importance in the Bukowina, Transylvania, and Hungary.

An extension of the same general south-easterly and north-westerly line will pass through the neighbourhood of Hanover, where petroleum is now being obtained.

Parallel to this long line of petroleum-producing localities, but considerably to the south of it, there is a series of localities where petroleum indications are said to occur on the coast of Dalmatia and Albania, near the Dinaric Alps and Pindus mountains, and to the north-westward of these indications is situated the somewhat important oil-field of Alsace, bordered by the Vosges mountains.

Still further south is another north-westerly and south-easterly line of oil-bearing rocks in Italy following the general direction of the Apennines, and to the south-eastward is the island of Zante, where the historic petroleum spring of Herodotus may still be seen.

It may be suggested that the oil deposits of Sicily lie on a further parallel line, and it will be observed that such a

* Ann. des Mines, Ser. XIV., 102-1206.

line prolonged to the north-westward would not pass far northward of the Pyrenees, where petroleum has also been met with.

In Spain petroleum has been found not only in the north, but also, it is said, in the south near Seville, not far distant from the Sierra Nevada mountains, and if a line parallel to those already referred to be drawn through the latter in a south-easterly direction it will intersect the Algerian oil deposits in the neighbourhood of Oran, with the Atlas mountains not far inland.

Reverting once more to the Galician oil-fields, attention may be drawn to the importance of their geographical position, for they lie, as will be seen, almost exactly in the centre of Europe. The "oil-belt," as far as it has yet been defined, has a length of some 220 miles with a breadth of from 40 to 60 miles, and it extends, as already indicated, in a general north-westerly and south-easterly direction.

The precise positions of the various petroleum-producing properties, as well as of localities where promising oil-indications occur, are very clearly shown in the series of three maps (Maps Nos. 2, 3, and 4) which have been drawn for this paper. The situations of the respective areas of these maps are indicated on the map of the kingdom of Austria-Hungary (Map No. 5). To all these maps further reference will be made under the heads of production and refining. The country, as will be seen from the series of three maps, is to a large extent of a mountainous character, but it is for the most part well provided with good roads and most of the developed properties are within a short distance of the railway.

The Carpathians form a long curved range of mountains separating Hungary and Transylvania on the north, east, and south-east from Silesia, Galicia, Bukowina, Moldavia, and Wallachia. The inner curve of this range consists largely of precipitous masses of rock, while the outer slope descends gradually to the Tertiary plains of Galicia and Roumania by a descending series of parallel folds. At the foot of the slope is a deposit of rock salt extending through Galicia and Bukowina into Moldavia. On the northern declivity in Galicia the Cretaceous formation is covered with a deposit of Eocene rocks and the whole surface has been thrown into a series of ridges, the denuded crests of which exhibit the successive layers. Heurtean* points out that the rarity of fossils in these beds renders their classification very difficult; it is, however, agreed that they are of the latest period of the Cretaceous age or of the Eocene age. To these rocks as a whole the name of Carpathian sandstone has been given. A portion of this sandstone is bordered by a deposit of the Miocene age. C. M. Paul, who has carefully studied the geology of the Carpathians,

asserts that in the neighbourhood of Cracow the Cretaceous formation met with is only in a rudimentary stage, while the Tertiary formation is fully developed. He describes the four following distinct groups in descending order:—

1. *Magura Sandstone*.—Quartzose noncalcareous sandstone, alternated with grey or whitish laminated clays, which separate the beds of friable and shaly white micaceous sandstone containing vegetable remains. In this formation white or blue hydraulic marl is also met with, and at the base is also found a characteristic quartzose conglomerate. Fish remains also occur. This belongs to the close of the Eocene period.

2. *Smilno Schiefer*.—Black laminated and contorted shales, characterised by layers of flint and sphaeroidite.

3. *Belowesa Schiefer*.—Hieroglyphic sandstone and red shales in thin layers, very micaceous. To this horizon belongs also the brown sandstone in thick layers, permeated by veins of spathic limestone and sandstone in thin laminae, with fucoids.

4. *Ropianska-Schiefer*.—Shaly beds, micaceous and quartzose, usually bluish-grey, containing layers of sandstone very difficult to distinguish from those of the upper deposits. At Ropianska these beds lie on a greyish sandstone of medium grain completely saturated with petroleum.

The slopes of the Carpathians thus consist of Cretaceous and Tertiary limestones, sandstones, and shales overlying a mass of metamorphic rocks. The shales are for the most part rich in vegetable and animal remains, this being particularly noticeable in East Galicia and the Bukowina, where thick beds of black bituminous shale are met with. The petroleum occurs in both coarse and fine sandstone, chiefly of the Eocene and Miocene ages, but it doubtless was formed in the shale. The oil-bearing formation lies, as already stated, in parallel folds, and the petroleum is found in great abundance under or near to the crests of the anticlinals. Rock-salt, gypsum, native sulphur and various sulphides, blende, pyrites and galena are met with in association with the petroleum. Sulphuretted hydrogen is also a frequent concomitant.

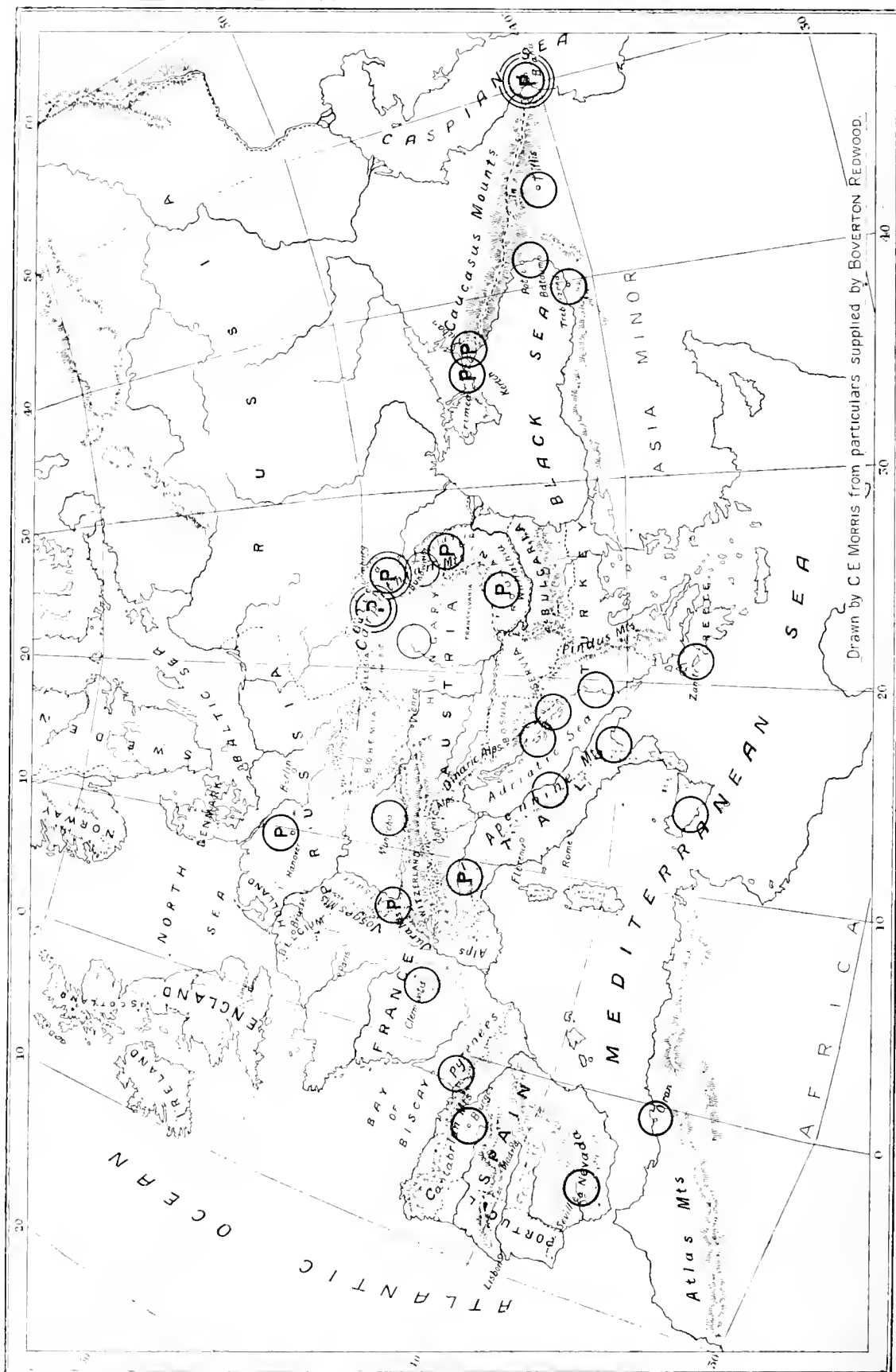
Of the petroliferous formation in the Ustrzyki district, Paul remarks that the alternating layers of shales, clays, and sandstones of which it is composed belong to the early Eocene age, therefore to the same geological horizon as the oil-bearing rocks at Bobrka, Płowiec, Uherce, and Schodnica. The overlying beds are of later Eocene age, and the underlying have not yet been opened up.

In the following table by Rateau† some of the petroleum-producing localities in Hungary and Galicia are classified geologically:—

Formation.	Division.	Local Names.	Deposits.	
			Hungary.	Galicia and Bukowina.
Neogene.....	Salzhongruppe	... ..	Reetz, Kovac, Garbomac, Dragomer, Sossmezo.	Boryslaw, Staranin, Dwiniacz.
Eocene	Upper	Szipot beds, Kliwa sandstone, Magura sandstone.	Upper Hungary and Transylvania.	Wherever the menilite shale assumes a sandy character.
	Middle	Menilite shale	Smilno, Szimna, Marmaros, Iod, Dragomer.	Libusa, Bobrka, Barvynick, Polany, Baryslaw, Wyskow, Moldawitz.
	Lower	Libusa sandstone	Marmaros, Zibo, Udvarhely, Sossmezo.	Libusa, Harklowa, Bobrka, Sanok, Polany.
Neocomian	Calcareous sandstone with nummulites	Upper beds with Hieroglyphs and fucoids.	Konyha, Sacstal.	Maukova, Ustrzyki, Pohar, Polany, Sloboda-Rungurska.
		Lower beds with Hieroglyphs and fucoids.	Prozolina, Sossmezo.	Schodnica, Maltawitz, Mraznica, Barvynick.
	Upper	Ropianska beds	Mikowa, Luch.	Ropianska, Sary, Ropa.
	Middle	Wernsdorf beds	Komarnik	Kowali, Brzisko, Kleczany.
	Lower	Teschen shales	Arva, Liptau.	Biala, Kimpolung.

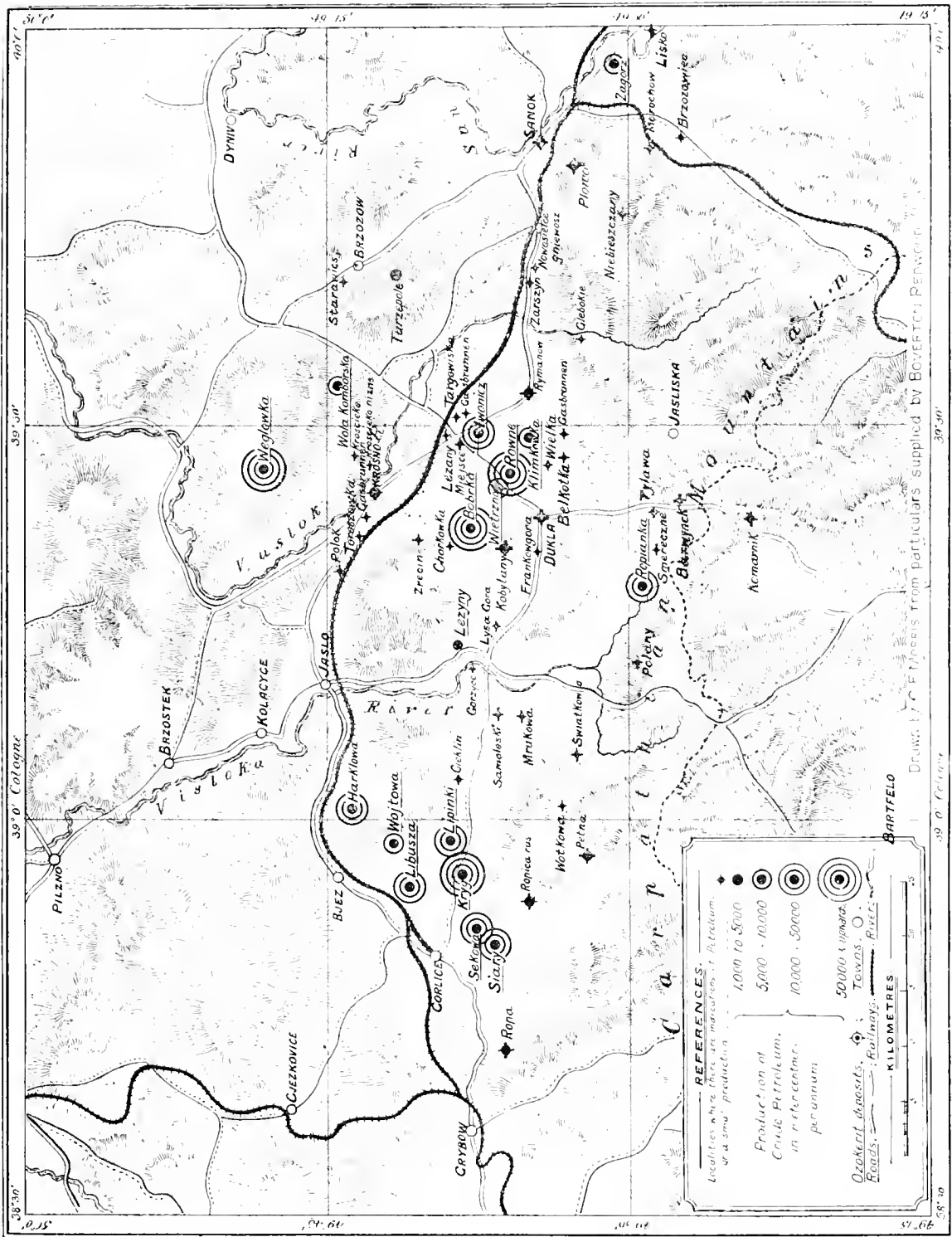
* Ann. des Mines, 6e. Serie XIX., 197—264.

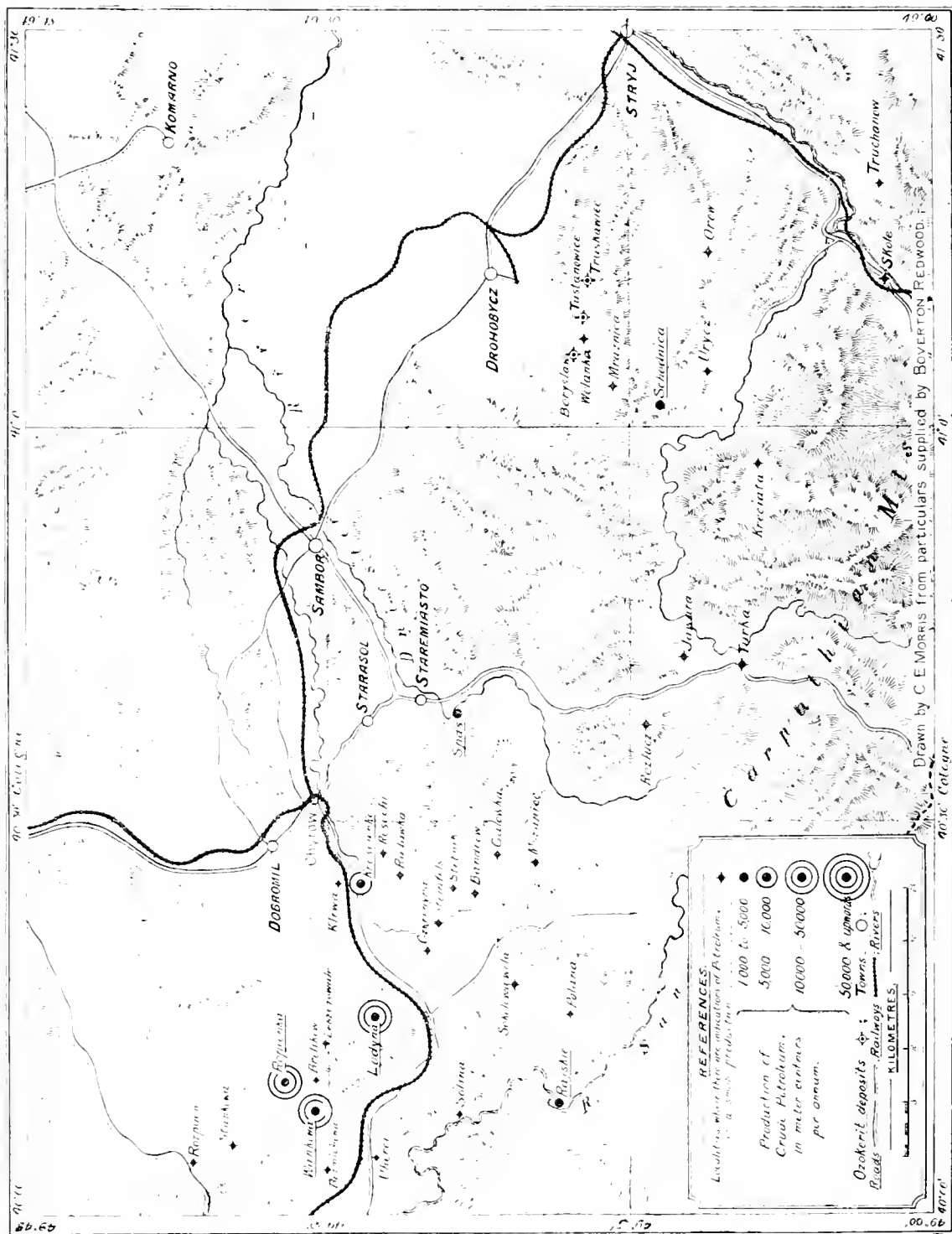
† Ann. des Mines, 8e. Serie XI., 147—170.



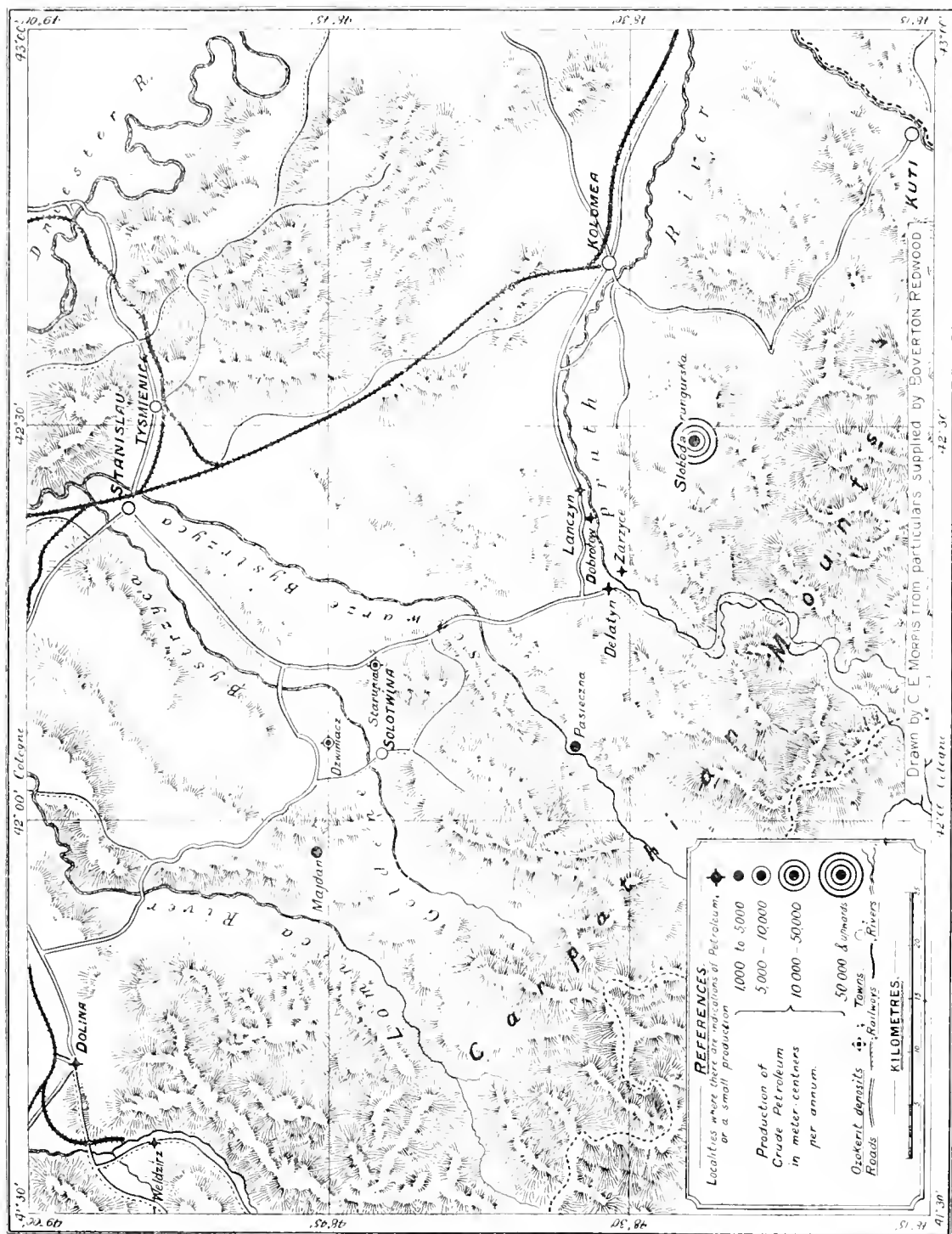
MAP No. 1.—OCCURRENCE OF PETROLEUM IN EUROPE.

The more important deposits are marked P in a circle. The Galician fields are distinguished by two concentric circles, and the Baku fields by three concentric circles.

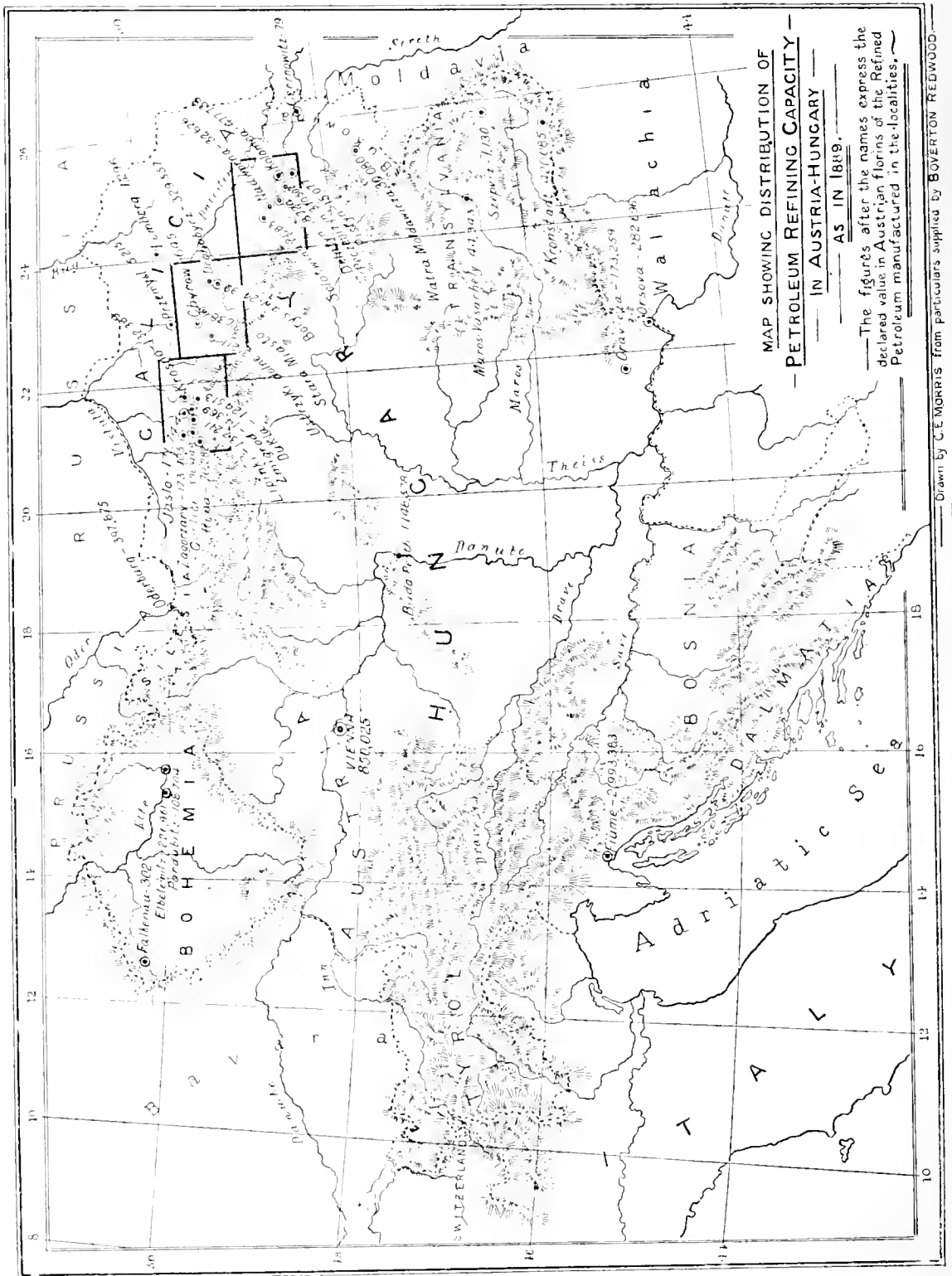




MAP No. 3.—INTERMEDIATE PORTION OF GALICIAN OIL-BELT.



MAP No. 4.—EASTERN END OF GALICIAN OIL-BELT.



Mr. William Topley, F.R.S., who is well known to have devoted special attention to the geology of petroleum, has, with a kindness for which the writer cannot sufficiently thank him, furnished for this paper the following particulars of the geological occurrence of petroleum in Galicia.

The Carpathians are composed of thick masses of rock, mainly sandstones, which have been thrown into a great series of folds, trending a little south of east in West Galicia, but turning more to the south further east, and in East Galicia trending about south-east.

These sandstones, collectively termed the Carpathian sandstones, are now known to belong to the Neocomian, Cretaceous, and Lower Eocene formations; or, by comparison with well-known strata in the south-east of England, they range in age from the Lower Greensand to the London Clay.

The Eocene strata, the upper beds of which are now called Oligocene by Paul, form the rolling ground on the northern flanks of the Carpathians, whilst the flatter land to the north is formed of Miocene beds. This is a rough and general statement of the range of the beds, but the whole district is traversed by a number of folds and anticlinals, so that the Neocomian beds are brought up amongst the newer

strata; and by the extreme foldings, faults, and overthrusts to which the beds have been subjected, the older rocks seem often to overlies the newer ones.

The general succession of the strata is as follows, petroleum occurring in the divisions marked * :—

*Salt Marl beds (ozokerite)	Miocene.
Magura and Kliwa sandstones ..	Oligocene of
*Menilite beds	{ some Authors. } Eocene.
Carpathian Sandstone series {	
*Upper	Cretaceous.
Middle	
*Lower (Ropienka beds)	Neocomian.

The menilite beds take their name from the occurrence therein of menilite (a semi-opal).

Different authors employ somewhat different names in describing the beds. Some of these names may be of beds only locally developed. It is therefore sometimes difficult to correlate the various descriptions, or to get all the beds mentioned into any general classification. The following are sections given by Walter and Dunikowski, from whose work† the accompanying illustrative diagrams (Figs. 1 and 2) are also taken :—

Fig. 1.

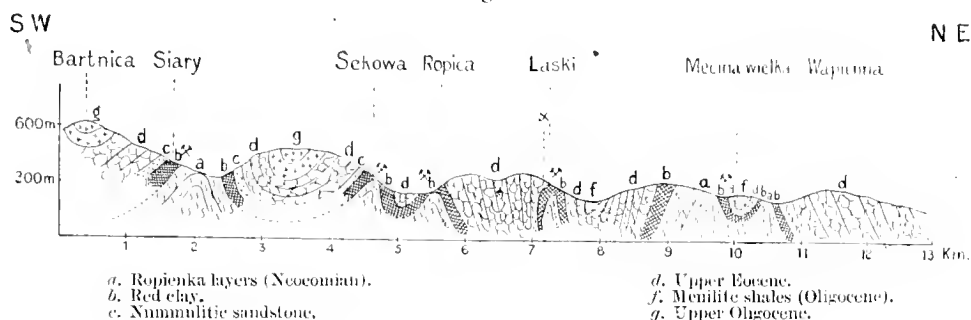
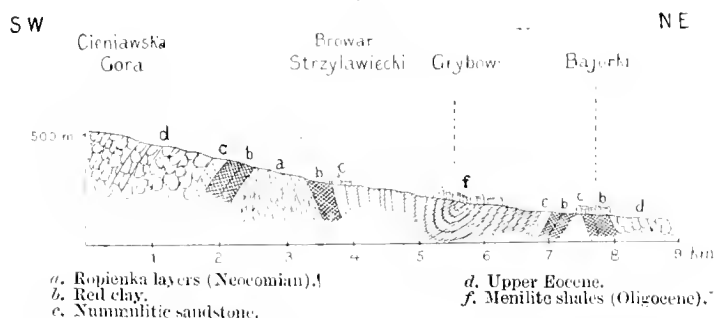


Fig. 2.



- | | |
|--|------------|
| 11. River sand, humus, &c | Alluvium. |
| 10. Glazy blechne, younger | Diluvium. |
| 9. Older clay, older | |
| 8. Coal-bearing beds | Oligocene. |
| 7. Thick-grained sandstone on the hills, younger | |
| 6. Menilite shales, older | |

- | | | |
|--|---------------------------|-------------|
| 5. Upper Eocene sandstones | Upper | Eocene. |
| 4. Nummulitic sandstones | Lower | |
| 3. Red clays and glassy sandstones | | Cretaceous. |
| 2. Upper Ropienka beds | Upper and Middle (?) | |
| 1. Lower Ropienka beds | (?) The Lower = Neocomian | |

The diagrams exhibit very clearly the manner in which the older beds are, as already pointed out, caused to overlies the newer. They also show that petroleum occurs along the summits of the anticlinal lines, though sometimes wells are preferably drilled where the beds have a regular dip in one direction.

According to Walter, the petroleum-bearing rocks of Lomna and Galowka belong to the lowest strata of the Eocene formation, and therefore resemble those of Bobrka. The strata at Galowka are :—

- 1st. Soft sandstones carrying water; the so-called Kliwa sandstones.
- 2nd. Black bituminous shales, with fish remains.
- 3rd. Horstone and glassy sandstones.
- 4th. A set of blue and red marls, without sandstones, impervious to water.

- 5th. Well-developed sandstones, with thin beds of blue marl. This sandstone is the horizon at which petroleum occurs most abundantly.

A fine series of specimens illustrative of the petroleum and ozokerite deposits of Galicia was exhibited by Professor L. Sajnoch, of Craew, at the International Geological Congress in London (1888). The following examples are extracted from the catalogue of the exhibition :—

Miocene.—Boryskaw, Starunia, Dwiniaez.

Eocene.—Klenczany, Libusza, Lipinki, Wojtowa, Bobrka, Głębokie, Płowce, Zagorz, Łodynia, Pasieczna, Słoboda-Rungurska, Tekucza.

† Das Petroleumgebiet der Galizischen West Karpathen. Wien 1883.

Neocomian (Carpathische Kreide).—Sekowa, Męcina, Siary, Ropianka, Mraznica.

The crude petroleum found in Galicia varies in density and other physical characters within wide limits. The great variation is partly due to the circumstance that oils obtained from relatively deep drilled wells are brought into comparison with petroleum collected in shallow pits. The latter may be described as surface oil, and in many cases it has been so exposed that it has lost its more volatile constituents by evaporation. In some places, *e.g.*, at Siary, Klewa, Rospućie, Starzawa (or Rudawka), Rosochy, and Ropa, a light brown or reddish-brown oil, known as red oil, occurs, which may be burned in ordinary lamps in its crude state,* but the greater part of the Galician crude petroleum is dark brown in colour by transmitted light, and exhibits a marked fluorescence. The oil is usually free from sulphur, and its odour is devoid of disagreeable characteristics. The oil from the drilled wells is very fluid, but the surface oil from the shallow pits is occasionally somewhat viscous.

According to Strippelmann,† the extreme limits of specific gravity recorded are 0.778—0.930 for West Galician oil, and 0.750—0.950 for East Galician. The writer has had occasion to examine from time to time a considerable number of samples of crude petroleum from Galicia, and in the following table, based upon the results obtained, the usual minimum and maximum densities of the produce of the drilled wells are stated:—

TABLE SHOWING DENSITY OF GALICIAN CRUDE PETROLEUM FROM DRILLED WELLS.

	Specific Gravity at 60° F.	
	Lowest.	Highest.
Eastern end of belt: Sloboda-Rungurska	0.830	0.868
Intermediate portion of belt: Ustrzyki district	0.835	0.844
Western end of belt: Wietno district	0.843	0.859

In illustration of a statement already made, it may be pointed out that the oil which was being obtained from the excavated shafts on the Bobrka estate, immediately adjoining the Wietno property, at the time of the writer's visit, had a specific gravity ranging ordinarily from 0.869 to 0.874, and running as high, in exceptional cases, as 0.885.

The extent of variation in the density of the produce of a number of drilled wells in the same locality is shown by the following particulars of properly authenticated samples examined by the writer:—

* This description of oil is also found at Gura Humura in the Bukowina.
† Die Petroleum-Industrie Oesterreich-Deutschlands. Leipzig, 1879.

FIFTEEN WELLS IN THE DISTRICT OF SLOBODA-RUNGURSKA.

No.	Date of Completion.	Depth in Metres.	Reported Production in 24 Hours in October 1886.	Specific Gravity of the Oil (at 60° F.).
1†	1865—1884	213	Barrels. 70	0.842
2	1877	194	5	0.868
3	1831	189	10	0.833
4	1883	164	20	0.850
5	1884	225	15	0.838
6	1885	275	20	0.845
7	1885	282	35	0.844
8	1885	274	15	0.833
9	1886	202	40	0.863
10	1886	280	25	0.837
11	1886	305	60	0.839
12	1886	280	15	0.837
13	1886	282	40	0.864
14	1886	250	50	0.830
15	1886	311	60	0.839

† Stanislaw. The deepening of this well to 213 metres was not effected until 1884.

FIVE WELLS IN THE USTRZYKI DISTRICT.

No.	Depth in Metres.	Average Daily Production.	Specific Gravity of the Oil (at 60° F.)
		Barrels.	
1	183	1.21	0.835
2	173	5.13	0.844
3	183	8.2	0.841
4	232	5.1	0.836
5	220	10.53	0.841

In making comparisons between the oils obtained from wells at different depths, it should be borne in mind that it is a common practice in Galicia to employ casing perforated at the oil horizons, and that it follows therefore that the produce of a well may consist of oils from two or more petroliferous strata in proportions which are subject to variation.

In the following table some of the results obtained in the writer's laboratory in the examination of several typical samples of Galician crude petroleum are given:—

No.	Locality.	Specific Gravity of Crude Oil.	Specific Gravity of Distillate.					Commercial Products.		
			A.	B.	C.	D.	E.	F.	G.	H.
1	Sloboda-Rungurska.....	0.845	0.724	0.763	0.792	0.821	0.841	12.0	35.9	41.6
2	Sloboda-Rungurska.....	0.860	0.743	0.771	0.789	0.825	0.835	8.8	37.4	49.0
3	Ustrzyki district.....	0.846	0.761	0.782	0.803	0.823	0.842	9.6	38.4	44.3
4	Ustrzyki district.....	0.912	0.786	0.829	0.867	..	..	2.6	17.4	58.6
5	Harklowa.....	0.901	0.760	0.806	0.846	0.878	..	7.5	32.5	51.8
6	Lenczyn.....	0.875	0.720	0.756	0.791	0.828	0.856	8.4	36.5	50.3

A. First tenth by volume.
B. Second " "
C. Third " "
D. Fourth " "

E. Fifth tenth by volume.
F. Percentage by weight of petroleum spirit.
G. " " kerosene.
H. " " intermediate and heavy oils.

Locality.	Formation.	Colour.	Specific Gravity.	Light Oil, 150° C.	Petroleum Distillate, 150° to 300°.	Lubricating Oil above 300°.	Coke and Loss.
Ropa	Cretaceous	Reddish-brown	0·853	Percentage. 11·49	Percentage. 39·80	Percentage. 46·50	Percentage. 2·30
Wojtown	Eocene, 114 m.	Greenish-black	0·820	12·40	43·60	41·50	2·50
Libusza	Cretaceous, 140 m.	Greenish-black	0·812	13·30	32·80	49·40	4·00
Starunia	Salt-layer, 36 m.	Greenish-black	0·815	10·30	34·90	50·90	3·30
Pagorzyn	Eocene, 188 m.	Blackish-brown	0·847	20·00	31·20	43·30	5·50
Lipinki	Eocene, 111 m.	Brownish-black	0·819	9·80	45·50	40·60	4·20
Siary	Eocene, 132 m.	Greenish-black	0·850	20·90	30·30	44·00	4·80
Siary	Eocene, 123 m.	Brownish-black	0·853	11·30	31·90	52·30	4·50
Mencina	Eocene, 230 m.	Greenish-black	0·853	19·00	33·10	42·90	4·40
Klenczany	Eocene, 57 m.	Dark green	0·870	3·40	38·60	54·50	3·50
Kryg	Eocene, 170 m.	Brownish-black	0·876	8·00	32·60	53·20	6·20
Harklowa	Eocene, 113 m.	Brownish-black	0·898	6·70	28·20	58·20	6·00
Harklowa	Eocene, 111 m.	Brownish black	0·892	5·70	56·70	55·70	7·50

It would not improbably be of practical importance, and would certainly be of great interest, if the oils found in the various geological horizons could be differentiated chemically; but it appears doubtful whether this can be done with any degree of precision on the basis of the existent data. At the same time Schaeffer* expresses the opinion that the geologically older petroleum of the Ropianka beds is more limpid and contains a larger proportion of the lighter hydrocarbons than the oils of the Eocene and Oligocene formations, which are comparatively heavy, darker in colour, and are rich in paraffin. While the petroleum of Sloboda-Rungurska contains at most 6 per cent. of paraffin, that of Boryslaw contains 8 or 10 per cent., and that of Starunia as much as 20 to 25 per cent.

Galician petroleum was examined by Lachowicz (Ann. der Chem. 220, 188—206; this Journal, 473). From an oil of boiling point 30° to 125° C. there were separated by distillation and treatment with strong nitric and sulphuric acids, normal and isopentane, normal and isohexane, and normal heptane; also from the higher boiling portions nonane (boiling point 148° C.), and decane (boiling point 152 to 153° C.). An oil boiling between 200° and 300° likewise shows all the properties of the paraffins, a whole series of which form the principal constituents of the petroleum. The first six fractions obtained in the distillation on the large scale of the crude petroleum are not acted upon by bromine, but the seventh and higher fractions absorb bromine vapour with evolution of heat. It is, therefore, most probable that the olefines do not exist in the petroleum, but are formed during the distillation. As it is possible that a formation of aromatic hydrocarbons might similarly take place, only the lightest portions of the distillate were examined with a view of ascertaining the presence of this class of hydrocarbons. By fractionation and nitration meta-dinitrobenzene, dinitrotoluene (melting point 71°), and dinitroxylole (melting point 176°) were severally isolated and analysed, and from a higher boiling portion trinitromesitylene (melting point 231° to 232°). From observations of the high specific gravity and the percentage composition of a portion boiling between 97° and 100° it is, in the opinion of Lachowicz, almost certain that it consists of heptane with some hexahydrotoluene. The presence of hexahydroisoxylene was not proved.

Pawlewski (Ber. 18, 1915; this Journal 4, 671) has isolated paraxylene from the petroleum found at Kleczany. He found that the crude oil contained about 2 per cent. of aromatic hydrocarbons, chiefly benzene and paraxylene. The presence of the latter was detected by brominating the fraction distilling between 125° and 145° C. Crystals of paraxylene bromide, $C_6H_4(C_2H_2Br)_2 = 1:4$, were obtained, melting at 145°.

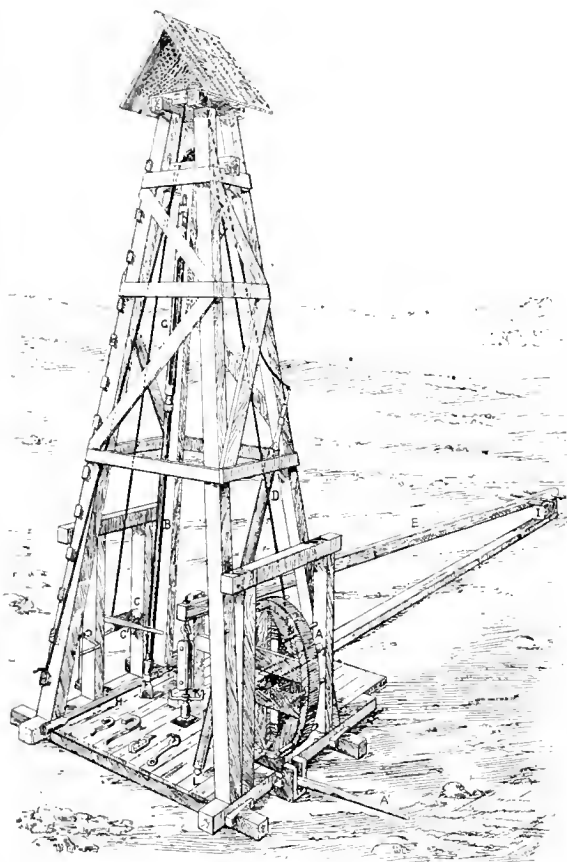
Nawratil points out that crude oils from the same locality often present considerable differences. Thus of two samples from Kleczany, one from a depth of 189 metres was light coloured and transparent, of low specific gravity (0·779), and yielded light distillates containing much paraffin, while the other, from a depth of 57 metres, was dark coloured and opaque, of high specific gravity (0·870), and yielded heavy distillates containing very little paraffin. Only one of a considerable number of samples examined, viz., that from Pagorzyn, gave off on distillation distinct traces of sulphuretted hydrogen.

As already stated, petroleum was first obtained in Galicia from the pit-wells or carefully timbered shafts excavated by hand. The influx of water and the presence of inflammable gas prevented the sinking of such wells to any considerable depth, and the yield of oil was small. In fact, the more productive petroliferous strata could not thus be reached. The first important step in the development of the industry was taken when hand-drilling was introduced. The plant employed for this purpose is shown in the illustration (Fig. 3), which is taken from a model kindly made for me in Galicia by Mr. Elgin Scott. It consists, as will be seen, of a derrick provided with a powerful windlass A, by means of which a gang of men can draw up the weighty drilling tools B, a smaller windlass or winch C, for use with the sand-pump D, and a long massive beam E (pivoted not far from one end), from which the tools are suspended in the well. The bit or drill F is either chisel-shaped, or more often is of such a form that it may be described as a combination of the chisel and the gouge. It is attached to an apparatus known as the free-fall jars G. This consists of a rod working freely within a casing or tube. The rod is provided with a pin or stud running in a longitudinal slot in the tube, and this slot is prolonged at a right angle at its upper end, forming a catch for the pin. It is obvious that by slightly turning the rod when it is fully telescoped into the tube it may thus be held or released. The tools are attached to the beam through the medium of iron rods H, screwed together, which are added successively as the depth of the well increases. Each windlass is provided with a brake, A', C'. It is usual to commence drilling from the bottom of a square shaft excavated as deep as possible, and the operation consists in drawing down the longer portion of the beam until the end strikes against a wooden block, I. At this instant the driller gives a slight turn to the tools, by means of the lever K, the pin of the jars is released from the catch, and the bit falls a distance of three or four feet, delivering a blow upon the rock at the bottom of the well. The longer end of the beam is then allowed to rise, and the jars thus being telescoped or closed, the driller gives the tools a turn in the reverse direction, and thus again brings the pin into the catch. The beam is usually about 30 ft. in length and pivoted about 5 ft. from one end. A gang of six

* Technologie der Fette und Öle der Fossilien. Leipzig, 1884.

men is required for the work in addition to the driller. Drilling by this method is necessarily very slow, the usual number of strokes which the writer has seen delivered per minute being six or seven. Moreover, the maximum weight of the tools capable of being used with a hand rig is not sufficiently great for expeditious work or deep drilling, and in fact, very hard strata can scarcely be penetrated with such a system. When a bit requires dressing (or sharpening), or the hole is full of detritus, the drilling tools are drawn up into the derrick by means of a wire rope coiled on the larger windlass, the rods being disconnected one by one. The well is then cleared out with the sand-pump D, which is a cylinder provided at the lower end with a valve opening inwards. The sand-pump is lowered into the well by the use of the smaller windlass, and when it reaches the bottom the valve is pushed open by the projecting stem L, and the mud flows in. As the cylinder is raised, the valve, of course, closes.

Fig. 3.



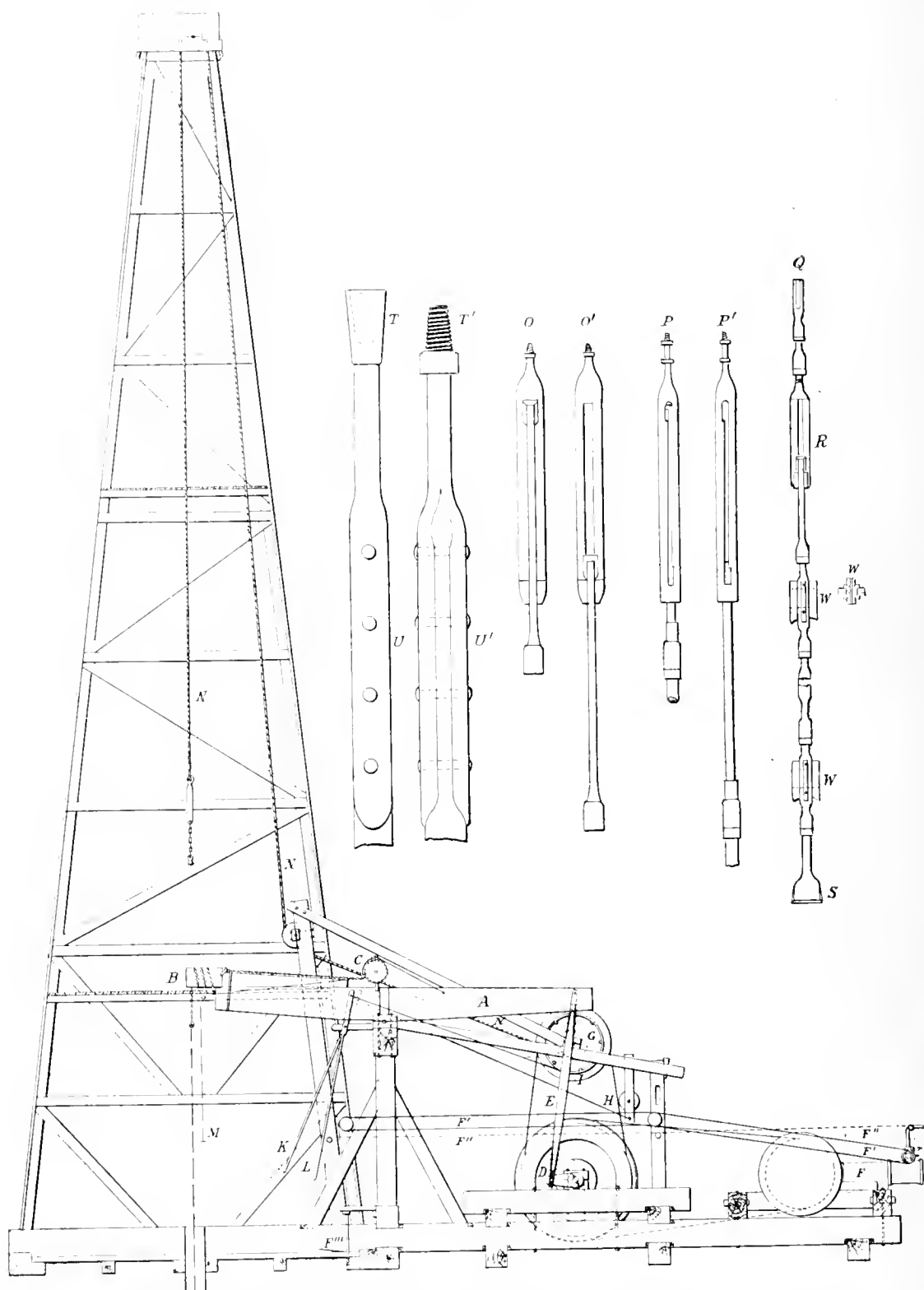
About the year 1867 attempts were first made in Galicia to substitute steam power for manual labour in drilling. The same general arrangement of rig, with free-fall jars, was at first adopted, and is, indeed, still in use to some extent. In one installation which the writer saw in operation in the Sloboda-Rungurska district the piston of the steam cylinder was directly connected with the end of the beam, the tools being suspended from the opposite end, but usually the oscillation of the beam is effected by means of an ordinary steam engine with driving-wheel, the reciprocating motion being given by a crank and connecting rod. The introduction of steam power enabled the driller to use far heavier tools, the weight of the falling portion ranging from 800 to 1,000 kilogrammes, and rendered the work more expeditious, the writer having seen as many as 40 blows of the bit delivered each minute. The free-fall jars employed are shown in Fig. 4 (P P'). While, however, the substitution

of steam power for manual labour in drilling with free-fall jars was the second important step of material consequence in the progress of the industry, a far more important advance was made when the Canadian system was introduced in 1882. Even that system, however, was found to require modification in certain details in order to adapt to the special requirements of the case, the character and disposition of the strata rendering drilling far more difficult as a rule in Galicia than it is in Canada. The derrick and transmission, as well as the principal tools, employed in the Galician modification of the Canadian system are shown in the illustrations (Fig. 1) taken from drawings with which Mr. R. Nelson Boyd has been so good as to furnish me. The derrick is 17·7 metres high, 5 metres square at the bottom, and 1 metre at the top. It is boarded on the outside. The working beam A, is of timber about a foot square. The end of this beam which is over the well is eased with a spirally-grooved cylinder of cast iron, B, carrying the chain supporting the drilling tools. The chain is coiled several times round the cylinder, and then passes to the "slipper out," C, a small winch with ratchet, fixed on the beam. The working beam is caused to oscillate, so that each end has a vertical movement of about a foot, by means of the crank D, and the connecting-rod E. The motive power is a horizontal high-pressure engine F, of about 15 horse-power, specially designed for the work. Steam is supplied from a boiler of the locomotive type. It will be observed that the driller in the derrick can stop, start, or reverse the engine, having control of the throttle-valve in the steam-pipe, through the medium of the "telegraph" or endless cord F', and of the reversing link, by means of the cord F'' attached to the foot lever F'''. The engine also, by means of a belt, drives the windlass G, for drawing up the tools. This belt runs loose when drilling is in progress, and is tightened by the application of a roller, H. A smaller windlass or winch for use with the sand-pump is sometimes employed, and is similarly driven. The larger windlass is provided with a brake, I, which is applied when the tools are being lowered into the well. The slipper-out, the roller for tightening the belt, and the brake are also all under the control of the driller in the derrick, the roller and brake being respectively applied by means of the levers K and L shown in the illustration, and the ratchet of the slipper-out being released by pulling the chain M. A Manilla hemp cable, N, is usually employed in raising the tools, but in many cases recently a wire rope has been adopted, and is found to be far more durable.

The jars O O', as will be seen, differ essentially from the free-fall jars, P P'. There is no arrangement for locking them when telescoped, O and P, and indeed the functions of the two arrangements are quite dissimilar. In drilling with the Canadian jars the whole string of tools and rods, Q, descends, the blow being then struck and the jars R partially closing; as the rods rise the jars at once fully open before the bit S is lifted, and the impact of the two links of the jars on this upward stroke is sometimes of service in dislodging the bit if it has become wedged in the rock. As the drilling progresses, the driller slightly turns the tools, so that the chisel-shaped bit S is caused to make a round hole. The tools are attached to the beam, or rather to the short chain already described, by means of rods, as in the case of hand-drilling and drilling by steam with free-fall jars, but the Canadian rods are of wood (ash). They are 2 in. in diameter, 16 ft. in length, and are connected by conical screw joints T T' with iron straps, U U'. The guide W, shown in the illustration, is an important adjunct to the ordinary Canadian tools which has been adopted in Galicia with a view of preserving the verticality of the well during drilling. It consists of four wings radiating from a common centre, and is inserted in the string of tools above the bit.

As the drilling progresses the well is eased, or lined with iron tubing. A portion of this casing serves to exclude water from the well, but below the water-bearing rocks the casing is necessary to hold up the rock and prevent caving. The difficulties met with in drilling in Galicia are chiefly due to the dislocated character of the strata, and the alternations of hard and soft beds. In some places the strata are disposed nearly vertically, and it will readily be understood that in drilling through soft and friable rock

Fig. 1.

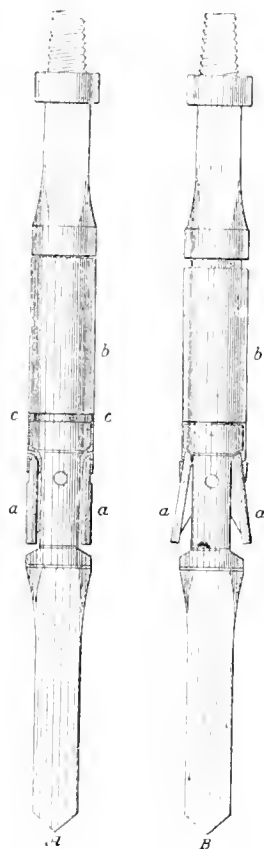


into hard rock at such an angle, the tools are very liable to become deflected, and caving is also very likely to take place. The guides are of great value in keeping the hole

straight, and caving has to be prevented by following the bit closely with the casing. Where the drilling is, in consequence of caving, exceptionally difficult under-reaming

has to be resorted to. This consists in the use of an expanding reamer (Fig. 5) by means of which the well

Fig. 5



may be drilled of the full external diameter of the casing. It is obvious that this could not be accomplished with an ordinary bit, which has to be inserted and worked through the casing, and therefore drills a hole smaller than the inside diameter of the casing. The Canadian drillers, who have had sufficient experience in Galicia, have shown themselves very skilful in the use of the under-reamer, and many wells, which would in all probability have been abandoned, have been successfully completed with the aid of this useful instrument. The rate at which the blows of the chisel are delivered with Canadian tools varies with the character of the ground. Sometimes as many as 70 strokes per minute may be given, but the number usually ranges between 40 and 60.

The under-reamer, which is inserted immediately above the bit, is provided with a pair of pivoted wings or dogs, *a a* (Fig. 5), which are forced outwards into the position shown in B by the pressure of a powerful helical spring enclosed in the tubular rod, exerted through the medium of the sliding collar *b*. When the instrument is to be inserted in the casing this sliding collar is raised as shown in A, and retained in that position by small wedges *c c*. The wings or dogs lie flat against the rod as shown in A. A few strokes of the tools dislodges these wedges, and the dogs at once assume the position shown in B, and "ream" the well to a diameter admitting of the descent of the casing.

The Canadian system of drilling has almost entirely superseded the free-fall system in Galicia. It is undeniably more rapid, and as it is accompanied with far less concussion, the risk of caving is minimised.

With the introduction of appliances for the expeditious drilling of wells by steam power, the original practice of commencing with an excavated shaft has been abandoned,

though in some cases old shafts are made use of where they happen to be advantageously situated. It is usual to case the upper part of the well with what is known as riveted casing. This consists of tubing, made of sheet iron, with riveted seams, and is not water-tight. To shut off the water, artesian casing, consisting of wrought-iron lap-welded tubing, with screwed joints, is employed. The casing is added in successive lengths during the drilling of the well, until it cannot be forced down any lower. The diameter of the well is then reduced, and a smaller casing used. In this way a completed well may have several "strings" of casing in it, each reaching to the surface. It is, however, a common practice to remove some of the artesian casing, taking care to leave that which shuts off the water, but the riveted casing is not withdrawn. In many instances it is found advantageous to use perforated casing below the horizon of the water-bearing rocks, as this, while preventing caving, allows oil to percolate into the well. The small riveted casing with which many wells are completed is not intended to be withdrawn, and therefore extends only up as far as the bottom of the artesian casing. The following particulars of the casing of a well inspected by the writer will perhaps make the foregoing description clearer:—

A.	33 ft. of 13 in. riveted.
B.	65½ ft. of 11 in. artesian.
C.	12½ ft. of 8½ in. artesian.
D.	213 ft. of 6½ in. artesian.
E.	433 ft. of 4½ in. artesian.
F.	236 ft. of 4 in. artesian perforated.
G.	75½ ft. of 3½ in. riveted perforated.

The water was shut off with the 8½-in. casing, and the 6½-in. was withdrawn on the completion of the well. Of the foregoing "strings" of casing, A, B, C, D, and E extended to the top of the well, while F lined the well from the bottom of E for 236 ft., and G completed the lining from the bottom of F for the remaining 75½ ft.

In strata so much inclined, it would doubtless be extremely difficult to drill with a cable in lieu of poles, as is the practice in the United States, but such a serious loss of time is necessarily involved in disconnecting and re-connecting the poles when any great depth is reached, that if an oil-bearing formation lying considerably lower should be found in Galicia, there will be a strong inducement to substitute the cable for the poles.

The following is the approximate cost in Central Galicia of an outfit for drilling by the Canadian system:—

	£
Derrick and transmission	90
Engine and boiler, 15 horse-power.....	250
Drilling and other tools, and pump	410
Poles and belting	200 to 250
Casing	300 to 500
	<hr/> 1,500

The drilling is frequently done by contract at 8s. a foot, the contractor finding labour inside the derrick (a wrench man, a scaffold man, and a third man for odd jobs), while the well-owner provides a smith, a machinist, and a helper, in addition to fuel for the boiler and oil for lubrication and lighting. Labour is cheap and the natives have exhibited considerable aptitude in acquiring the art of drilling, but owing to the number of church holidays it is desirable to adopt labour-saving mechanical appliances as far as possible. In most parts of the oil-fields fuel and water are abundant.

The diamond-boring system has been tried in Galicia, but does not appear to have been successful. The writer saw an uncompleted well in the Sloboda-Rungurska district which had been in process of drilling for over a year and had only reached a depth of 220 metres. In a paper read before the Civil and Mechanical Engineers' Society in 1889, Mr. Nelson Boyd gave some interesting details of the drilling of a well at Polana by the Aqueous Diamond-Boring Company. The power was supplied by a 12 horse-power engine, and the crown was driven at the rate of 120 revolutions per

minute. The quantity of water forced into the hole under a pressure of $1\frac{1}{2}$ atmosphere was 1.52 cubic metre per hour. This was, however, in excess of the necessary quantity, and about one-third of a cubic metre per hour was lost. About 75 per cent. of the water requisite may be saved, so that the actual consumption would be about half a cubic metre per hour. At a depth of 200 metres the drawing of the rods, the removal of the core, and the lowering of the crown again, occupied two hours, and this had to be done for every 10 feet of boring. In shale, as much as 2.7 metres were bored in an hour, and in sandstone 0.828 metre. Mr. Nelson Boyd considers that the results obtained in this well were of a favourable character, but he points out that the inclination of the strata constitutes a great impediment to the use of the diamond drill in Galicia, as the upper part of the stratum perforated is liable to slide on a joint and jam the core.

The rate of drilling in the Ustrzyki district commonly ranges from 12 to 18 up to as much as 50 or 60 ft. in 12 hours, according to the hardness of the strata. Not infrequently considerable delay is caused by the breakage of the tools, and some of the resulting "fishing" operations demand much skill and patience, but it is very seldom that a well has to be abandoned in consequence of such an accident. The depth of the wells in the Ustrzyki district is commonly from 220 to 250 metres, the first indications of oil being met with at a depth of 30 metres, the first oil horizon being perforated at 120 metres (the well then yielding from $\frac{1}{4}$ to 1 barrel a day), and the second oil horizon at 160 to 220 metres. It is believed that a third and probably more productive oil horizon may exist at a greater depth in this district, but the wells are not drilled below the second, when they usually yield about 20 barrels of oil per diem but sometimes much more.

In the Sloboda-Rungurska field the depth of the wells usually ranges from 215 to 330 metres, but in some instances exceeds 400 metres. The following particulars of the strata met with in the drilling of a well to a depth of 245 metres in this district are given by Babu:—

	Metres.
Green and red shales alternating.....	85.00
Unimportant beds of shale and sandstone, alternating	35.00
Hard shale.....	13.75
Hard sandstone (1st petroleum horizon).....	15.00
Shale.....	2.50
Hard sandstone.....	10.25
Alternate layers, 1 to 10 metres in thickness, of sandstone and marl.....	51.87
Sandstone (2nd and more important petroleum horizon).....	41.38

The writer was informed that the average time occupied in the drilling of a well in this district is three months, but he saw a well there, stated to be flowing at the rate of 70 to 80 barrels per day, which was drilled to a depth of 220 metres, with a diameter of 6 inches at the bottom, in 18 days. About 25 per cent. of the wells drilled in this district have been unproductive and the yield of the remainder appears to have varied considerably. Many of the wells flow at first and afterwards need pumping. One produced for a time as much as 300 barrels per diem, and afterwards for a year an average of 200 barrels a day. The smallest yield for which it is considered profitable to pump in this district is two barrels a day.

In the Wietzno field the writer saw a well out of which oil was flowing simultaneously from two horizons, through the 5-in. and 6-in. casings, respectively. The estimated yield of this well was 200 barrels a day. The depth of the wells in this field is about 250 metres. In the historic Bobrka field there were at the time of the writer's visit some 30 wells being pumped, some of which had yielded small quantities of oil for 17 or 18 years, but the ordinary life of a drilled well in Galicia is perhaps one-third of this period. The usual experience has been that provided a distance of 20 metres intervenes, one well does not drain another. The deepest drilled well in the Bobrka field at this time had a depth of 409 metres and a diameter of 6 in. at the bottom, while the deepest excavated shaft on the property had been carried down to 154 metres, with a uniform diameter of one metre.

The pumps used in raising oil from those wells which do not flow are of small diameter (1 to $1\frac{1}{2}$ in.), and are furnished with double or triple buckets with ball valves. The working barrel is placed at the bottom of the well, and $\frac{1}{2}$ -in. gas piping is frequently used as a sucker rod. To economise steam power a number of pumps are worked from one engine through the medium of rods, the power being thus sometimes transmitted a considerable distance.

The oil is conveyed to the refineries partly by barrels by road, and partly in tank-waggons by rail. In some cases short pipe-lines have been laid down from the wells to the railway to facilitate transportation. The railway rates for transport are moderate and the companies possess tank-waggons.

The drilling leases in Galicia are commonly for a period of 25 years, the lessee making a cash payment for the lease of an amount depending upon the character of the territory, and obtaining the usual rights of ingress and egress, the agricultural rights remaining with the lessor. The royalty payable by the lessee ranges from $12\frac{1}{2}$ per cent. to as much as $37\frac{1}{2}$ per cent. of the oil raised, and the lessee also pays a small rent for the land actually occupied by him. The system of land registration admits of drilling rights over oil-lands being intabulated in the land books, and thus affords to the petroleum producer perfect security at a trifling cost.

In the following table the production (in metre centners)* of the petroleum properties in the localities specified for 1889—90 (12 months) is given, and on referring to the series of three maps (Maps Nos. 2, 3, and 4) in which these localities are marked, a good idea of the extent of the oil-belt, as far as it has been demarcated, will be obtained. It will be observed that notwithstanding the large amount of work which has been done, an immense area of presumably oil-bearing territory remains undeveloped.

PRODUCTION AND DECLARED VALUE OF PETROLEUM IN THE LOCALITIES SPECIFIED IN GALICIA, 1889—90.

Locality.	Owner.	Production in Metre Centners.	Value in Florins.
Siary	Szczepanowski & Co.....	5,700	22,000
"	Rogoyski	13,600	52,000
"	Kostrzal.....	9,600	35,000
"	Dembowski	3,000	11,000
		31,900	
Sekowa ...	Dembowski.....	4,000	15,200
"	Szczepanowski.....	2,600	9,900
"	Rogoyski	10,000	38,000
"	Kapuscuski.....	5,000	19,000
		21,600	
Wankowa.	Wiktor	11,500	40,000
Schodnica.	Prince Lubomirski	3,000	12,600
Ropienka .	Elliot and Parkinson ...	31,500	125,600
Rajskie ...	"	800	2,400
Iodyna ...	"	10,500	34,600
Spas	"	4,000	12,000
Lezyny ...	"	4,500	14,000
Harkłowa.	"	12,400	29,000
Wojłowa..	Bielewicz.....	5,100	20,400
Libusza...	Skrzynski.....	8,100	24,300
"	Company Jaslo	2,400	7,200
		10,500	

* 1 metre centner = 100 kilogrammes.

Locality.	Owner.	Production in Metre Centners.	Value in Florins.
Kryz	Bergheim & McGarvey...	47,800	173,000
"	Skrzynski & Co.....	10,800	32,000
"	Wilusz.....	1,500	4,500
"	Stocker	3,400	13,600
"	Company Jaslo	4,800	14,000
		68,300	
Lipinki...	Stawiarski	4,700	17,000
"	Oil Co.....	6,800	25,000
"	Stawiarski	7,000	27,000
"	"	1,800	7,200
		20,300	
Klimkowa.	Bergheim & McGarvey...	9,000	30,000
Zargorz...	Baron Rhade	5,700	14,000
Turzepole.	Tessedeł	2,700	9,000
Ropianka - Dukla.	"	10,300	39,000
Hobirka...	Klobassa	99,000	374,000
Wola Kom- borska.	McGarvey	1,300	5,000
Weglowka.	"	94,000	327,000
Iwoniez...	Prince Louboumirski...	4,000	13,000
"	Count Kurlecki	8,200	29,000
		12,200	
Krosienko	Baron Hodenberg.....	6,500	19,000
Rowne....	Trzeciński & Co.....	101,000	390,000
"	McGarvey	70,000	242,000
		171,000	
Wietzno...	Suszycki.....	10,000	29,000
Majdau...	Szczepanowski.....	3,260	10,440
"	Bubella & Co.....	1,180	3,800
		4,440	
Pasieczna.	Osterr-Creditanstalt	450	2,100
"	Ibodoly.....	600	3,000
"	Szikuli	148	2,265
"	Sundry small firms.....	1,120	6,750
		2,918	
Sloboda- Rungurska.	Bubella & Co.....	7,400	28,120
"	Rosenkranz & Margules ..	2,100	7,500
"	Baron and Rosenkranz...	620	2,170
"	Szczepanowski & Co.....	22,620	75,180
"	" & Lewakowski	11,400	32,180
"	Dr. Fedorowicz	209	770
"	Wolfarth	11,000	40,000
"	G. MacIntosh.....	10,450	35,000
"	E. J. Torosiewicz	10,500	40,000
"	Wincenz & Co.....	545	1,950
"	Dr. Trachtenberg.....	1,500	5,250
"	Salpeter & Alter.....	1,000	3,000
"	Kolomear Company	1,430	5,150
"	Kahane & Co.....	1,500	4,500

Locality.	Owner.	Production in Metre Centners.	Value in Florins.
Sloboda- Rungurska.	Cyrus & Perkins	4,300	15,000
"	I. Torosiewicz	9,000	30,600
"	Kinnel and Christen.....	2,100	8,400
"	Dr. Lewakowski	11,730	42,240
"	Alfons de Richard	3,550	12,900
"	Lipinki Oil Co.....	3,700	14,100
"	Sundry small firms	3,000	9,750
		120,084	
		785,012	2,810,175

= in barrels, 523,500 about.

= in sterling at Fl. 12'00, 234,181/2 about.

NOTE.—The production in the neighbourhood of Krosno commenced too recently to find a place in the foregoing table.

In the following tabular statement the quantities of crude petroleum produced in and imported into the kingdom of Austria-Hungary during the years 1883—90 are given. The figures demonstrate that the local production must be very largely increased before it overtakes a consumption which is still growing:—

	Production of Austria-Hungary.	Imported into Austria-Hungary.	Consumption.
	Barrels.	Barrels.	Barrels.
1883	106,500	735,000	904,500
1884	233,000	899,735	1,132,735
1885	333,000	937,345	1,270,345
1886	433,000	858,976	1,291,976
1887	532,000	388,110	920,110
1888	665,000	801,715	1,466,715
1889	746,000	930,191	1,676,191
1890	816,000	867,831	1,683,831

The figures given in the foregoing tables are taken from official sources, but in the opinion of those best qualified to judge, the quantities are largely understated.

The present average price of the crude oil is 3 fl. 45 kr. per 100 kilos, equal to about 8s. per barrel.

At the Peezenyzen refinery in the Kolomea district, which the writer visited in 1887, the crude petroleum is distilled in horizontal cylindrical stills, the lower plates of which are of steel and the upper of iron. These stills take a charge of 200 barrels and 12 charges a month are worked off. In this operation only the benzine and kerosene are distilled off, and a portion of the residuum thus obtained is used as fuel for the stills, being burned partly with a steam-jet spray-producer, and partly in admixture with sawdust. The kerosene distillate is treated with 3 to 4 per cent. of sulphuric acid in lead-lined agitators holding 500 barrels. The crude oil, which is obtained from the neighbouring Sloboda-Rungurska field, is stated to yield from 4 to 8 per cent. of benzine (according to the length of time that it has been above ground), 58 per cent. of "standard oil" (sp. gr. 0·813 to 0·816, and flashing point 22° C.), 4 per cent. of "inflammable oil," and 2½ to 2¾ per cent. of solid paraffin. The paraffin oil, which is distilled from the residuum of the kerosene stills in small (40 barrel) stills with steel bottoms, is "chilled" by mixing it with crushed ice, and the paraffin is obtained by subjecting the semi-solid mass to pressure in Canadian presses, which are wooden lever presses of simple construction. Lubricating oils were not manufactured at this refinery, which is the largest in Galicia, at the time of the writer's visit. At a small refinery in Ustrzyki, which

he inspected, the crude oil is distilled in wrought-iron pot-shaped stills, 6 ft. in diameter and 5 ft. in height, the condensers being worms of 3-in. iron pipe. At this refinery various classes of crude oil were then being distilled, and the percentage of products obtained was as follows:—

	Wietzno Crude.	Ropienka Crude.	Polana Crude.
	Per Cent.	Per Cent.	Per Cent.
Benzine	15	10	5
"Saloon oil"....	30	35	40
2nd grade oil....	8 to 10	10	15

The residuum is further distilled in the same stills, and yields about 20 per cent. of heavy oil, which is redistilled. The final residue usually amounts to about 10 per cent., and the loss to about the same percentage. It appears to be customary to mix the second grade of kerosene with benzine, and a burning oil is thus obtained which is inflammable at common temperatures, but is nevertheless used locally as a lamp oil to a considerable extent. Galicia would appear to offer a very promising field for the employment of a dissociation process of distillation, whereby the yield of kerosene might be largely increased.

The petroleum industry in Austria-Hungary is a protected one, an import duty of 10 florins (gold) per 100 kilos, on refined oil (kerosene) and 2.40 florins (gold) on crude petroleum being levied. An exception is made in the case

of Roumanian crude petroleum, which is admitted on payment of 68 kr. per 100 kilos. Of this crude petroleum 164,333 metre-centners (109,555 barrels) were imported in 1889, and 155,901 metre-centners (103,934 barrels) in 1890.

Notwithstanding the encouragement thus given to the native industry, the consumption is, as already shown, very largely in excess of the aggregate quantity of petroleum produced in the Monarchy. The deficiency is supplied by the Russian petroleum imported into and refined at Fiume. This petroleum, though nominally crude oil, is understood to contain very far more than the natural percentage of kerosene, and considerable dissatisfaction has been manifested by the Galician refiners at what is regarded as an evasion of the fiscal regulations. The important position which the Fiume refinery occupies in relation to the industry as a whole is made evident by the following table giving the declared value in Austrian florins of the refined petroleum manufactured at the various refineries in Austria-Hungary for the years 1886—89. The table is based upon particulars supplied by the Finance Minister, and may therefore be accepted as an official statement, but it is generally believed that the declared values are very largely understated. It is thus difficult to estimate even approximately the consumption of petroleum in Austria-Hungary; some authorities being of opinion that the figures given might in many cases, at any rate, be doubled. The accompanying map (No. 5) which has been drawn for this paper, exhibits more clearly the distribution of the petroleum-refining capacity of the Monarchy, and the output of the various refineries.

TABLE showing the DECLARED VALUE, in AUSTRIAN FLORINS, of the REFINED PETROLEUM Manufactured at the Various REFINERIES in AUSTRIA-HUNGARY, for the Years 1886—89.

Based on particulars supplied by the Finance Minister.

Locality.		Description of Crude Petroleum Refined.	Value (in Austrian Florins) on which Petroleum Tax was Levied.			
			1889.	1888.	1887.	1886.
Lower Austria	Wien - Floridsdorfer Mineralöl Fabrik, Donaufeld bei Wien.	Galician	498,955	658,592	528,088	415,520
	Gustav Wagemann, Wien. N., Laaer- strasse.	"	351,070	358,959	340,363	291,767
	E. Pilhal's Nachfolger, Simmering	"	..	308	169	..
	Mayer & Moller, Breitenlee bei Wien.....	"	..	43	317	10
	Flesch, Volker, and Co., Donaufeld bei Wien.	"	..	..	..	1,028
Total			850,025	1,017,902	868,937	708,325
Silesia	Graf Larisch von Munnich, Oderberg (Balmhof).	Galician	137,875	334,103	33,384	.. ..
Galicia.....	Szecepanowsky & Co., ab 1 Juli 1889, Actien Gesellschaft Peczenezyn.	"	370,502	463,256	480,257	464,018
	Bergheim & MacGarvey, Marampolo, Gorlice.	"	326,213	251,366	21,935	.. ..
	Gartenberg & Co., Kolomea.....	"	284,622	295,228	368,049	271,282
	Gartenberg & Co., Droholyecz	"	254,089	239,825	186,671	155,614
	Adam, R. v. Skrzynski, Libusza, Zagorzany	"	173,705	194,766	175,913	126,780
	Gartenberg & Schreier, Nieglowice, Jaslo	"	171,774	.. ..	.. ..	.. ..
	Hedwig Straszewska, Lipiuki	"	137,211	129,481	125,620	127,131
	Pblich & Stawiariski, Chorkowka, Krosno..	"	132,389	120,765	97,237	112,096
	Vinzenz & Co., Sopow, Kolomea.....	"	110,721	134,816	102,794	61,298
	Fuhrer Chanina, Herzog Mechel & Co., Dukla.	"	103,767	11,853	26,474	5,237
	Nikolaus Feodorowicz, Ropa	"	70,282	42,480	42,709	36,296
	Jacob Alexandrowicz und Sussle Landau, Gorhee.	"	56,311	53,065	45,582	45,547
	Kallmann Nebenzahl, Strozowka, Gorlice	"	39,846	43,502	41,698	29,312
	Efrann Wertheimer, Gorlice.....	"	36,741	38,397	45,583	55,408
	Samuel Ehrenberg, Sekowa, Gorlice	"	35,312	36,013	38,250	25,897

TABLE showing the DECLARED VALUE, in AUSTRIAN FLORINS, of the REFINED PETROLEUM Manufactured at the Various REFINERIES in AUSTRIA-HUNGARY, for the Years 1886—89—continued.

Locality.	Description of Crude Petroleum Refined.	Value (in Austrian Florins) on which Petroleum Tax was Levied.			
		1886.	1887.	1888.	1889.
<i>Galicia—cont.</i>					
Leiser Gröffel, Pasieczna, Nadworna	Galician	31,035	19,761	15,417	15,402
Hersch Bloch, Werbiarz, Kolomea	"	39,477	28,059	36,879	47,392
Isaak Gleicher, Gorlice	"	27,893	22,757	28,233	27,410
Josef R. v. Wiktor and Co., Ustizyki dolne ..	"	27,008	30,003	38,978	12,295
Leiser Hoffmann, Hubieze, Drohobycz ...	"	23,389	20,289	22,914	22,678
Pibich & Stawianski, Kolomea	"	20,983	132,490	222,580	189,574
Isaak Reich, Cergowa, Dukla	"	20,716	20,603	15,232	5,033
Furstin Maria, Lubomirska, Schodnica, Boryslaw ..	"	19,707	18,047	16,992	21,717
Leib Lantmann, Zarzeczce, Delatin	"	18,724	11,366	12,749	7,908
Moses Wertheimer, Sokol, Gorlice	"	18,512	11,559	13,326	11,265
Louis Dankmaier, Kleezany, Marcinkowice ..	"	18,101	16,535	19,637	12,582
Fensterstein & Co., Drohobycz	"	18,067	24,101	17,912	6,202
Jacob Nebenzahl, Siary, Gorlice	"	17,867	32,628	20,100	24,861
J. Friedmann, Kolomea	"	15,655	..	..	..
Weiser & Co., Werbiarz, Kolomea	"	15,280	19,784	29,615	49,792
W. Fischler, Mikietyncz, Pistyn	"	15,077	8,965	11,577	15,963
Karl Jedrzejowski, Goreyce, Zmizrod	"	11,369	..	..	..
Sarah Bodner, Ropica polska, Gorlice	"	13,397	11,832	14,541	13,984
Salomon Backenroth, Derezyce, Drohobycz ..	"	12,506	14,010	16,165	12,631
Zacharias Handel, Drohobycz	"	11,274	9,090	9,511	13,840
Chackel Gleicher, Ropica polska, Gorlice ..	"	10,893	9,290	10,301	6,763
Salomon Kreppel, Lisznia, Drohobycz	"	10,235	11,728	7,646	2,654
Ferdinand Br. Brunicki, Kleezany, Marcinkowice ..	"	8,086	9,013	8,366	10,321
Aron Deutelbaum, Ropica polska, Gorlice ..	"	7,593	14,578	9,821	9,169
Mechel Honizfeld, Przemysl	"	5,215	7,346	7,264	7,895
Sternbach & Chojes, Berehy dolne, Ustizyki ..	"	4,113	20,196	13,605	15,985
Moses Glanzmann, Strzelbice, Stara Miasto ..	"	3,038	3,863	3,167	915
Benjamin Mermelstein, Boryslaw	"	2,978	2,592	2,016	14,680
Eisig Schifter, Starunia, Solotwina	"	2,083	2,031	1,291	1,129
Hersch Glaser, Pniow, Nadworna	"	1,591	3,071	2,477	1,772
Schapsel Rechter, Mraznica, Boryslaw	"	1,514	1,445	1,514	1,125
Franz Wohlfahrt, Lemberg	"	1,296	12,788	12,340	2,727
Ozias Rymald, Chyrow	"	615	356	725	455
Gebrüder Gredel, Huta Komorowska, Kolbuszow ..	"	..	3,497	3,472	4,720
Aron Kanner, Uherce, Lisko	"	..	3,274	18,401	11,085
Ozias Brettschneider & Elias Kriss, Hadykowce, Husiatin ..	"	..	872	4,370	9,871
Franz Wohlfahrt, Kurzany	"	..	459	..	2,454
Alter Salpeter, Rungury, Peczenizyn .....	"	..	..	8,538	18,968
Frankel Chuma, Drohobycz .....	"	..	..	538	2,473
Josef Blech, Przemysl .....	"	..	..	264	1,615
Schurcier & Co., Drohobycz .....	"	..	..	3	10,988
Josef Altmann, Drohobycz .....	"	..	..	..	638
Moses Drymer, Starunia, Solotwina .....	"	..	..	..	508
Moses Popper, Dynow .....	"	..	..	..	375
Moses Fischmann, Drohobycz .....	"	..	..	..	510
Total		2,752,799	2,612,964	2,487,412	2,164,877

TABLE showing the DECLARED VALUE, in AUSTRIAN FLORINS, of the REFINED PETROLEUM Manufactured at the Various REFINERIES in AUSTRIA-HUNGARY, for the Years 1886-89—*continued*.

Locality.	Description of Crude Petroleum Refined.	Value (in Austrian Florins) on which Petroleum Tax was Levied.			
		1889.	1888.	1887.	1886.
Bukowina	Ernst Serzler und Naftali Zwiebel, Mitoka-Dravomirna und Watra Moldwicz (zusammen). Leisor Jankel & Israel Blum, Leukoutz, Czernowitz.	30,080	28,149	75,375	56,291
		79	763	2,404	2,155
	Total	30,159	28,912	77,779	58,446
Bohemia	Sprecher & Co., Zabor, Elbeteinitz	226,461	192,814	49,973	..
	David Fanto & Co., Pardubitz	108,704	..	..	..
	Dr. Friedrich Pilz, Theusau, Falkenau...	302	278	255	560
	Dr. Max Bohm & Co., Privos, Mahr-Ostrau.*	..	..	..	..
	Total	335,467	193,092	50,228	560
Hungary	Petrol-Raffinerie-Actien-Gesellschaft, Fiume.	2,903,383	2,973,317	2,725,780	2,861,755
	Ungar. Petrol-Industrie-Actien-Gesellschaft, Budapest.	883,605	932,787	823,908	793,725
	Siebenburger Petrol-Raffinerie-Actien-Gesellschaft, Kronstadt.	300,216	201,467	67,543	..
	Wilhelm Spitzer, Orsova	282,696	275,023	179,475	82,212
	Adolf Berg & Co., Budapest	264,883	222,686	134,240	100,899
	Oesterr.-ungar. Staatseisenbahn-Gesellschaft, Oravitz.	173,259	159,108	136,236	97,433
	C. J. Joannides, Kronstadt	52,908	46,481	47,078	52,095
	Adolf Baruch, Maros-Vasarhely	44,343	49,200	37,069	32,207
	Dr. Ferdinand Otrobán, Kronstadt	35,340	22,762	26,746	25,318
	Salamon Grünfeld, Kronstadt	31,612	29,481	21,525	20,552
	Adolf Lack, Csik-Gyimes, Bez. Szepviz ..	1,140	3,356	7,764	2,036
	Julius Gmeiner, Kronstadt .....	..	..	49,194	75,661
	Porr and Leitinger, Tömös, Kronstadt ...	..	..	44,595	63,798
	Georg Popp, Kronstadt .....	..	..	42,260	69,945
	Müller & Co., Szacsal, Marmaros-Sziget ..	..	..	388	242
	Total	5,063,474	4,915,673	4,346,101	4,277,878
	somit Niederösterreich	859,025	1,017,902	868,937	708,325
	Silesia	397,875	334,103	33,384	..
	Galicia	2,752,739	2,612,964	2,487,412	2,164,877
	Bukowina	30,159	28,912	77,779	58,446
	Bohemia	335,467	193,092	50,228	560
	Cisleithanien	4,366,325	4,186,973	3,517,740	2,932,208
	Transleithanien	5,063,474	4,915,673	4,346,101	4,277,878
	Austro-Hungarian Monarchy	9,429,799	9,102,646	7,863,841	7,210,086
		£785,816	£758,554	£655,320	£600,840

* First worked in 1890.

These statistics show, therefore, for the year 1889 as compared with 1888, an increase of 327,153 fl. = 27,262*l.* 18*s.* 4*d.* sterling, and as compared with 1887, 1,565,955 fl. = 132,996*l.* 10*s.* sterling, while as compared with 1886 the increase amounts to 2,219,713 fl. = 184,976*l.* 1*s.* 8*d.* sterling.

II.—Ozokerite.

The principal seat of the ozokerite mining industry is at Boryslaw, where the extraction of the mineral has afforded occupation to a large number of men and women during the past 30 years.

Boryslaw is a town of 20,000 inhabitants lying in a valley surrounded by hills at the foot and on the northern slope of the Carpathians, 12 kilometres south-west of Drohobicz.

It is 360 metres above sea-level, and is traversed by a small river. One kilometre to the east of it is Wolanka.

Ozokerite is mined to a small extent in Dwiniacz and Starunia, which lie to the south of Stanislaw. It also occurs at Truskaviec and Tustanowiec, near Boryslaw, at Slanik in Moldavia, and in many other places on both sides of the Carpathians. The mineral is also found in quantity in the islands of Teheleken and Swjatoi in the Caspian Sea, and has been met with on the Transcaspian mainland as

well as in the Kouban. Recently it has been obtained in commercial quantities from the Wasatch mountains, 113 miles east of Salt Lake City, Utah.

The following are localities where ozokerite is reported to occur:—

England—Newcastle.

Galicia, Roumania (near Plojesti and Slauik), Hungary, and elsewhere.

Wettin-on-Saal, East Frisia.

Derbent (near), Baku, Islands of Tchelen and Swjatoi, Ekaterinodar, Station of Kalochinsky, Transcaucasia.

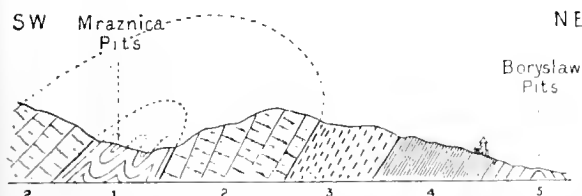
Egypt.

Utah, Texas, Arizona, Oregon, Canada, Manitoulin Island.

It is difficult to say whether ozokerite is peculiar to any particular geological formation. Regarding it as a description of petroleum with a high melting point, Râteau points out that it would not be reasonable to expect that it would be confined to any one formation, and, in fact, it is found in many, though chiefly in the Tertiary and Cretaceous. The Boryslaw, Dwinaez, and Starunia deposits are in Miocene, but ozokerite has been met with in the shales of Teschen, as well as in Neocomian and other formations elsewhere. The Kouban deposits are on the borders of the Lower Tertiary and Upper Cretaceous. In Tchelen it is found accompanying petroleum in pockets in beds of sand above the clay-shales and muschelkalk of the Aralo-Carpathian formation. In Southern Utah and Arizona it occurs in Tertiary rock, probably Miocene. Rock salt and gypsum are commonly found in association with the ozokerite in Galicia. Occasionally these minerals occur in an almost pure state, but they are more frequently mixed with clay. At Boryslaw salt and gypsum are often found in the ozokerite. At Truskawice, near Boryslaw, there is a deposit of native sulphur and sulphides, intermingled with gypsum, ozokerite, and petroleum. The formation here is a greyish-blue clay-shale, with sand and marl. The association of petroleum and rock-salt is not peculiar to Austria-Hungary, and may be said to be a frequent characteristic of oil-producing districts. In some of the Carpathian salt-beds no liquid or solid petroleum is met with, but large quantities of gaseous hydrocarbons are evolved. Carbonic acid and sulphurous acid, as well as sulphuretted hydrogen, are also given off, and frequently under great pressure.

The soil of the valley in which Boryslaw lies is a bed of diluvial deposit some metres in thickness. In sinking a shaft, first yellow clay, then rounded flints and gravel, and then plastic clay are met with. Below this, sandstone and blue shale, much disturbed, alternate, and it is in these beds, which have a thickness of some 200 metres, that the ozokerite is found. The ozokerite-bearing formation, which is considered to be of Miocene age, lies on a basis of petroliferous menilite shale, the strata of which, as they approach the surface, are disposed almost vertically, but inclined towards the south. This structure, which bears evidence of the complete disruption which the rocks have undergone, is shown in the accompanying section by Paul (Fig. 6). The strata are composed of layers of coarse-grained

Fig. 6.



sandstone, green marl, fine-grained sandstone with veins of calcite, dark shale alternating with grey sandy shale, imperceptibly merging into the main beds of the non-petroliferous sandstone and shale. Below these are the Carpathian sandstones of the lower Eocene (nummulite sandstone) and Upper Cretaceous formations. It should be pointed out that the basin of menilite shale and the beds of shale and sandstone are disturbed by a fault, the Miocene rocks having thus become mixed with the Carpathian sandstone, and it seems reasonable to conclude

that the petroleum and ozokerite may have found their way into the Miocene formation through this fault, for without this means of escape the hydrocarbons would have been imprisoned by the beds of shale lying between the Carpathian sandstone and the menilite shale. A consideration of this view led M. Râteau to express the belief that by drilling to a depth of 400 or 500 metres large quantities of petroleum might be obtained in this neighbourhood from the lower Carpathian sandstone layers. The geological conditions prevailing at Dwinaez and Starunia are similar, but the ozokerite is more largely mixed with petroleum. The soil is grey and red diluvial clay, below which is a bed of gravel, lying on the Miocene formation in which the ozokerite and petroleum occur in association with native sulphur, iron pyrites and zinc blende. Still lower a highly porous calcareous rock is met with, containing cavities filled with petroleum and sulphuretted water, and below this again is a marl with gypsum and the salt-clay formation destitute of petroleum.

The ozokerite occurs in the form of veins of a thickness ranging from a few millimetres to some feet, and is accompanied with more or less petroleum and gaseous hydrocarbons. It fills the many fissures with which the disturbed shales and Miocene sandstone abound, and frequently forms thus a kind of network. The Boryslaw deposit extends over a pear-shaped area, the axis of which lies E. 30° S. The town of Boryslaw lies on the broader portion of this area and Wolanka at the point of it. The upper layers of the richest portion of the deposit occupy an area of about 21 hectares, with a length of 1,000 metres and a maximum breadth of 350 metres, but outside this there is an outer zone of less productive territory which increases the total superficies to about 60 hectares, with dimensions of 1,500 metres by 560 metres. The deposit narrows considerably as the depth increases, and at a distance of 100 metres from the surface of the ground has a breadth of only 200 metres. This is held to indicate that the deposit has found its way upwards from some very lying formation (probably through the fault already referred to) and has gradually extended itself laterally through the interstices in the disturbed rocks as it neared the surface. The ozokerite-bearing formation contains also much petroleum, and is bordered on the south-east and west by petroliferous territory.

It has been pointed out by Babu that the study of the geological occurrence of ozokerite may be of considerable assistance in forming conclusions in regard to the geology of petroleum, for the deposits of ozokerite may be followed up as readily as a vein of metal. On the other hand, ozokerite does not indicate its presence by rising to the surface of the ground as petroleum so often does.

The name of ozokerite is derived from *ὄζω* = to smell, and *κνίψ* = wax. It is usually spelt without the final "e" by German authors, and that form has been adopted by Messrs. J. C. and J. Field, who are so prominently identified with the industry. It will probably be in accordance with usual practice to retain the final "e" in the case of the mineral and drop it in spelling the name of the distilled product. The mineral, which is commonly known in Germany as *erdwachs*, also bears, according to Schaedler, the following designations:—*Bergwachs*, *fossiles paraffin*, *fossiles wachs*, *kenderbal*, *lehmnapththa*, *mineralwachs*, *steintalg* (mineral tallow), *cire de terre*, *neft-gil* (Persian), *nefta ghil* (Turkish).

Ozokerite varies from a very soft material, which may be regarded as a petroleum very rich in paraffin, to a black substance as hard as gypsum. The density of ozokerite ranges from 0.850 to 0.950, and its melting point from 58° to 100° C. It is soluble in benzol, oil of turpentine, and petroleum. It is a good insulator, and has been recommended for use as such in admixture with 50 per cent. of india-rubber. Ordinary commercial Galician ozokerite, such as is employed in the manufacture of *ceresin*, has the following properties:—It is soft and plastic, and has a very fibrous fracture. The colour varies from light yellow to dark brown, and it frequently has a greenish hue owing to dichroism. It becomes negatively electrical by friction and exhales an aromatic odour. It becomes more plastic on heating, and usually melts at about 62° C.

According to Laeh (Chem. Zeit. **13**, 831; this Journal, **8**, 696), Caucasian ozokerite is inferior to Galician. Its melting point is 68°C , and on treatment with 20 per cent. of fuming sulphuric acid it yields 58 per cent. of second quality ceresin of melting point 68.5°C .

A material described as ozokerite is found in Colorado. It is a dull black substance, hard and pulverisable, with a melting point of 76°C . It does not yield ceresin, but on being subjected to distillation it furnishes the following results:—

	Percentage (by difference).
Paraffin and oil.....	90.00
Loss in gas.....	2.12
Loss in water.....	2.60
Residue.....	5.28

It commences to distil at 360°C , when nearly 3 per cent. of oil setting at 30°C comes over. At a much higher temperature it distils steadily and furnishes a product suitable for use as a source of paraffin.

The following are particulars of samples of ozokerite from various sources:—

BAKU.—Specific gravity 0.903, melting point 79°C .

	Per Cent.
Paraffin mass.....	81.8
Gas.....	13.8
Coke.....	4.4
	100.00

—Petersen.

PERSIA.—Dark green, rather hard. Specific gravity 0.925.

	Per Cent.
Light oil, b.p. 0.740 to 0.780	2.35
Light oil, b.p. 0.800 to 0.820	3.50
Oil, b.p. 0.880	16.63
Paraffin.....	53.55
Coke.....	16.73
Loss.....	7.24
	100.00

ENGLAND (LIPETH, NEAR NEWCASTLE).—Soft and sticky, brownish. Specific gravity 0.890, melting point, 60° to 70°C .

	Per Cent.
Light oil, boiling point 80° to 120°C	3.00
Light oil, boiling point 150° to 200°C	7.50
Lubricating oil, boiling point 200° to 250°C	7.80
Paraffin.....	64.35
Coke.....	11.15
Gas, loss.....	5.60
	100.00

—Wagner.

BORYSLAW.—Specific gravity 0.930. 1. Dark yellow.
2. Dark brownish-black.

	1.	2.
	Per Cent.	Per Cent.
Benzine, b.p. 0.710 to 0.750	4.32	3.50
Kerosene, b.p. 0.780 to 0.820	25.45	27.83
Lubricating oil, b.p. 0.895	7.64	6.95
Paraffin, &c.....	56.54	52.27
Coke.....	2.85	4.63
Loss.....	3.00	4.82
	100.00	100.00

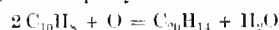
Olive green, rather hard. Specific gravity 0.9236, melting point 60.5°C .

	Per Cent.
Light oil, boiling point up to 150°C	6.25
Heavy oil, with paraffin, 150° to 300°C	35.10
Paraffin, &c., over 500°C	49.73
Residue in retort, and loss.....	8.92
	100.00

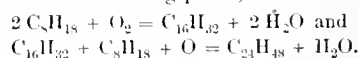
—Josef Merz.

Ozokerite consists of a mixture of hydrocarbons in various proportions. It contains 85.7 per cent. carbon and 14.3 per cent. hydrogen.

According to R. Hegor (Seifensied. Zeit. **321**; this Journal, **2**, 473), the composition of ozokerite may be best represented by the formula $\text{C}_{20}\text{H}_{32}$. It appears to have been formed by the oxidation and decomposition of the hydrocarbons of naphtha, since the action of oxygen on these compounds simply eliminates hydrogen. Thus, for example, naphthalene gives dinaphthyl and water—



By further oxidation there are obtained compounds of the formula C_nH_{2n} , which react with the hydrocarbons of the marsh-gas series, with formation of very complex carbon compounds of various melting points, as for example:—



Zaloziecki (Zeits. f. angew. Chem. **1888**, 261—263; this Journal, **7**, 428) has separated crystalline paraffin from refined ozokerite (ceresin) by the use of warm methyl alcohol as a solvent. After pressure and repeated crystallisations from methyl alcohol, a product was obtained which upon fusion and subsequent cooling formed a translucent and distinctly crystalline material closely resembling paraffin in its properties. The substance separated by the first solution in the alcohol was soft and pasty, and had a melting point of 32° – 33° , while the melting point of the ceresin was 65° . The natural inference is that in addition to crystalline paraffin ozokerite contains certain colloidal substances (amorphous paraffin), the presence of which hinders the crystallisation of the paraffin. These substances are removed by the methyl alcohol in consequence of their greater solubility, and doubtless become either converted or decomposed in the process of distillation ordinarily adopted in the manufacture of crystalline paraffin from ozokerite.

F. Redl (Chem. Zeit. **11**, 415—416; this Journal, **6**, 504) purifies ozokerite by heating it to 120° to remove water and light oils and then allowing it to cool to 75° , when it is treated with 50 per cent. of naphtha of sp. gr. 0.700 – 0.720 . The mixture is gently agitated, and 10 per cent. of fuming sulphuric acid added. After further agitation, subsidence is allowed to take place during 20 minutes, and the ozokerite at a temperature of 70° is treated with caustic soda solution, after which the naphtha is removed by distillation. The decolourisation of the ozokerite is completed by means of charcoal.

Zaloziecki (Dingl. Polyt. J. **265**, 178—184) refers to the well known fact that the yield of ceresin is largely affected by the purification of the ozokerite with sulphuric acid, from 15 to 30 per cent. being lost during this operation. He finds that the loss is, if anything, smaller at a temperature of 200° than at 160° , which he accounts for by assuming that at the higher temperature the sulphuric compounds are decomposed with the regeneration of sulphurous anhydride and hydrocarbons.

In mining the ozokerite it is usual to sink a circular well 3 metres in diameter through the upper beds of clay until the water level in the gravel is reached. This well may have a depth of 14 to 16 metres. In the centre of it a shaft 1.3 metre square is built up of balks of timber jointed together, the intervening space being filled with clay. The digging and timbering of a shaft 1.3 metre square is then continued until further progress is arrested by inflammable gas or water. When this occurs, one of the veins of ozokerite intersected by the shaft is opened up and followed by means of a timbered gallery. Immense pressure is exerted by the semi-fluid ozokerite, and it is usual to employ timbers not far short of a foot square placed not more than one metre apart. The writer has seen timbers of this size which had been broken like matchwood by the pressure to which they had been subjected in the galleries. Sometimes the ozokerite suddenly bursts into the workings and overwhelms the miners, and there are cases on record of men having been unexpectedly raised from the bottom of the shaft to the surface of the ground by an influx of the semi-fluid mineral. One shaft was pointed out to the writer as bearing the name of the Asparagus shaft, from the

circumstance that on a thin layer of sandstone which was met with at a depth of 160 metres being perforated by the miner's pick, the underlying soft ozokerite was slowly forced up through the opening in a form which resembled the vegetable specified, the "growth" being for a long time renewed as often as it was removed.

The horizontal galleries cannot without serious danger be driven to any considerable distance, not in fact beyond about 5 metres, but driving much further, even if free from risk, would not be possible in most cases owing to the contiguity of the properties. As it is, frequent quarrels ensue in respect to the underground rights. The disused galleries are usually allowed to fall in, but are sometimes filled up. The water and oil which occur with the ozokerite are drawn off from the bottom of the shaft. The sinking of the circular well costs about 4 fl. the metre, but in the dislocated beds below, where the ozokerite is met with, the cost of sinking is from 5 to 10 fl. the metre run, without reckoning the cost of pumping out the water. The driving of the galleries is paid for at the rate of 7.50 fl. to 9 fl. per metre run. The shafts and galleries are, however, more commonly excavated by contract, the price per metre for the former down to a depth of 130 metres being from 20 to 25 fl., and for the latter 5 to 8 fl., both without timbering. This brings the cost of a shaft of 100 metres, inclusive of timbering, to 2,000—4,000 fl., or for a shaft of 200 to 225 metres, 10,000—12,500 fl.

Over the mouth of the shaft is fixed a windlass carrying a wire rope, to each extremity of which is attached a bucket used in drawing up the ozokerite and in lowering and raising the miners. The descent is made by placing one foot in the bucket and holding on to the rope, the other foot being used in fending the bucket off the sides of the shaft. Owing to the subsidence and lateral movement of the earth due to the extraction of the ozokerite the shafts do not long remain vertical, so that the descent is not a pleasant experience. The miner wears a safety belt to which a rope is attached, which passes over a smaller windlass. Much inflammable gas is met with in the workings, and safety-lamps are necessarily used. Ventilation is unsatisfactorily effected by means of a revolving fan turned by a woman. Within easy reach of the miner in the gallery is a cord communicating with a bell at the mouth of the shaft, by means of which he can summon assistance; but notwithstanding the provision of the bell and the safety-belt, deaths from suffocation are not uncommon. The inhalation of the gas appears to produce a kind of intoxication, which some of the miners find enjoyable. The underground miners receive 0.75 to 1.25 fl. per day, while the labourers employed above ground get about 0.60 fl. The majority of the people employed are of a low class, and they usually work on the basis of a daily contract. Heurteau states that in 1871 of the 10,000 workmen engaged in the industry, 2,000 were underground miners, and among these there were usually from 200 to 300 accidents per annum, nearly all fatal. In some years there are said to have been as many as 1,000 deaths due to such accidents. According to Rateau, the "admitted" annual death-rate due to accidents ranges from 7 to 15 per 1,000 (compared with 1.88 per 1,000 in "ordinary mining"), but he adds that the rate is understated. It will doubtless be evident to most visitors to Boryslaw, that notwithstanding the salutary effect of a code of regulations which are supposed to be enforced by officials specially charged with the duty, much of the underground work is carried on under unnecessarily dangerous conditions. The staff of officials consists of an inspector, a cashier, a geometriean, three overlookers, and six or eight police agents. To defray the expenses of this superintendence a charge of two florins per shaft is levied on the proprietors. The very primitive character of the arrangements adopted is well shown in the illustration (Fig. 7), which is taken from an interesting model made in Galicia, and kindly presented to the writer, together with a number of specimens of the crude ozokerite and various commercial products, by Mr. Wentworth Sturgeon.

The unscientific method in which so important an industry continues to be conducted may excite surprise, but it should be borne in mind that the right of raising petroleum and

ozokerite belongs to the surface owners of the land, the result being that there are in Boryslaw a number of small landed proprietors, who, with the assistance of their wives and children, raise as best they can the petroleum and ozokerite lying beneath their plot of ground. It is not surprising that work of an admittedly difficult and dangerous character conducted thus with insufficient capital, inadequate appliances, imperfect organisation, and lack of skill should have been attended with much unnecessary loss of life, especially when the reckless character of the population is taken into account. Attempts have been made to place the industry upon a proper basis, and a French company was some years ago formed with the object of extracting the ozokerite by the adoption of a systematised scheme of mining, but the shafts sunk by this company were unfortunately not favourably situated for the successful carrying out of the project. It would undoubtedly be very beneficial if some fusion of interests could be effected, so that the industry might be placed on a more satisfactory footing.

Distributed over an area of 90 to 100 hectares are many thousand shafts, ranging in depth from 20 to 200 metres, but the writer was informed that not more than 400 of these were being worked when he visited Boryslaw. The shafts are in many cases not more than from 3 to 8 metres apart, and the available surface ground round each shaft usually ranges from 9 to 60 square metres. When it is considered that there are hundreds of separate proprietors it will be understood that there is frequently considerable confusion, and that there is great difficulty in getting rid of the earth excavated and raised with the ozokerite. It has been the practice to shoot the material between the houses or on any vacant piece of ground and naturally as near to the wells as possible. The result is that the whole place is deeply covered with an oily mud, through which it is difficult to make one's way. Recently arrangements have been made for the systematic removal of the débris.

As already stated, a French company has carried out the system of mining for ozokerite by means of a well-constructed shaft and carefully-timbered galleries, such as are adopted in coal-mining. The diameter of the main shaft through which the ozokerite is raised is 2 metres, and there is a smaller shaft, 1.50 metre in diameter, through which the water is pumped. The mine being situated near Wolanka and to a large extent outside the zone of the most productive territory, the system can scarcely be said to have been fairly tested. In this outer zone there is not only less ozokerite, but there appears also to be much more water to be contended with. The main shaft is fitted with cages running in guides and operated by a steam engine. Ventilation is effected by means of centrifugal exhausters, also driven by steam power.

The ozokerite occurs sometimes in sheets as thin as paper, but more often in veins from 2 or 3 in. to a foot in thickness disposed in the most irregular manner. The mineral is broken out by hand with the pick and wedge, and this may be regarded as easy work owing to the disturbed character of the strata in which it occurs.

For the working of each shaft two miners, two labourers, and one woman are needed. The annual cost of this labour is 1,000 to 1,500 fl., and other charges, with interest on capital, bring up the total working expenses, according to Babn, to 3,500 to 4,000 fl. per shaft. Taking the produce of each shaft at 15 to 18 tons on the average the cost of the ozokerite to the proprietor would be from 16 to 18 fl. per 100 kilos. Presumably this is the cost of mining the mineral within the inner zone.

An attempt has been made to estimate the quantity of ozokerite in the Boryslaw deposits. The basis of the calculation is that the outer zone demarcates a territory containing 2 per cent. of the mineral, while the proportion in the inner zone is more than 5 per cent. Taking the dimensions of the zones already given and further assuming the extraction of the deposits to a maximum depth of 200 metres, the total quantity of ozokerite obtainable would be more than two million tons.

Two products are obtained from the mines, viz., nearly pure ozokerite in fragments, and earth containing much

Fig. 7.

A. Shed in which the above-ground work is carried on. In practice the sides are boarded up, and a ventilator for the escape of the gas from the mine is provided in the roof, as shown.

a. Windlass for lowering and raising miners, and raising ozokerite.

b. Windlass carrying rope attached to miners' safety-helt.

c. Rotary blower for ventilation.

d. Signal bell.

e. Bucket in which the ozokerite is raised.

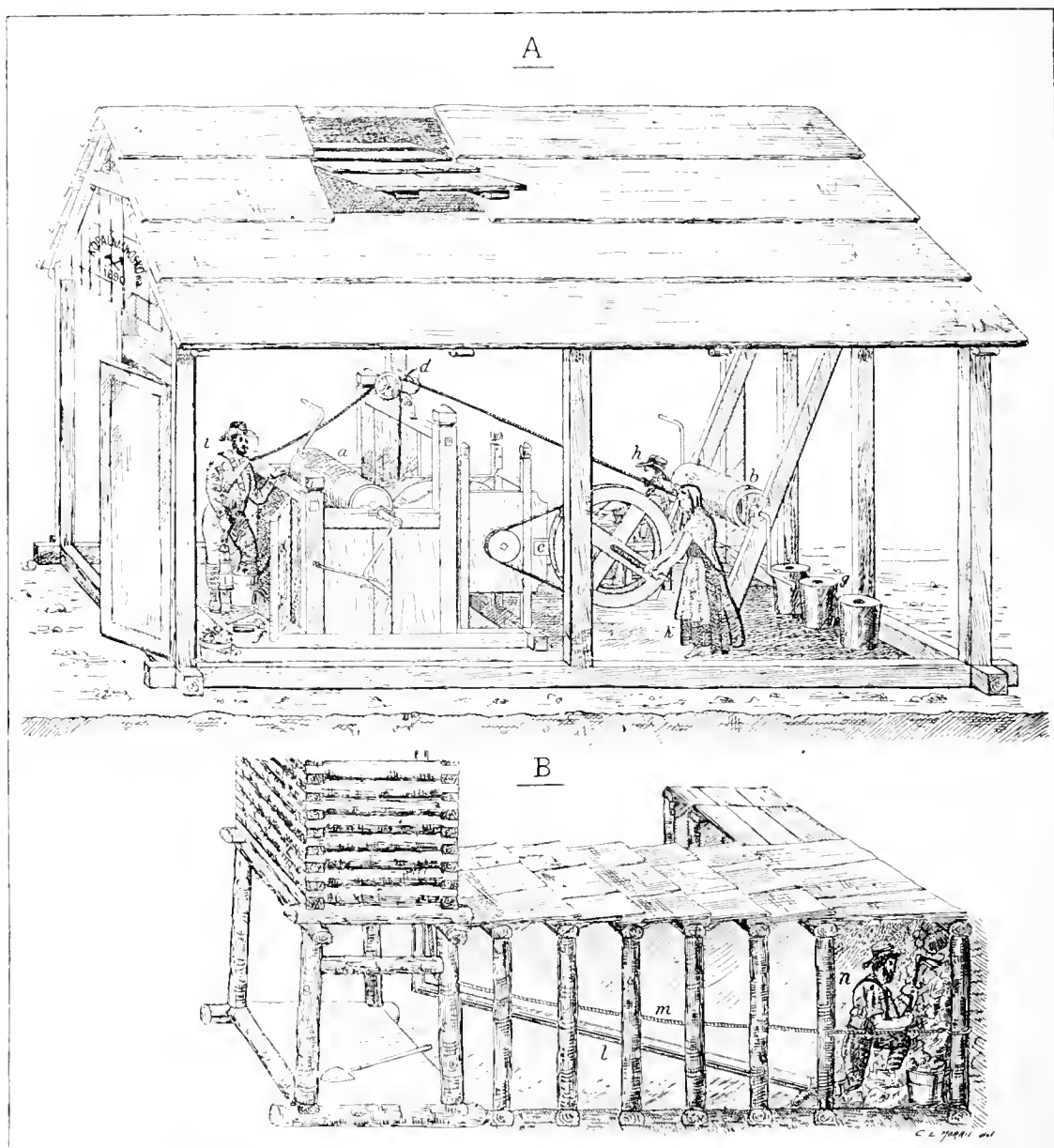
f. Hammer, chisel, and pick used in the work of mining.

g. Blocks of cast ozokerite.

h. Proprietor of the mine keeping an account of the ozokerite raised.

i. Miner, wearing safety-belt, and carrying safety-lamp, preparing to descend.

k. Woman working blowing machine.



B. View of portion of shaft and gallery, showing mode of limbering.

l. Tube conveying air from blowing machine.

m. Signal cord.

n. Miner at work.

ozokerite. The former is melted as it is, while the latter is subjected to the following operations in consecutive order;—

1. Hand picking or sorting.
2. Washing with cold water.
3. Washing with hot water.
5. Treatment with benzine and steam.

By hand picking all the larger fragments of ozokerite are sorted from the earthy matter. The work is performed at the pit's mouth by women, who are provided with a small mattock by means of which the separation of the matrix is facilitated. After this the earth, which still contains from 8 to 10 per cent. of ozokerite, is thrown into tubs of water and stirred with shovels. Under these circumstances the liberated ozokerite rises to the surface and is skimmed off with a sieve. The earth, still containing from 4 to 5 per cent. of ozokerite, is then subjected to the action of boiling water and the finer particles of the wax, aggregated by fusion, rise to the surface in the form of a black oily semi, which is removed from time to time. The fourth process, originally suggested by Van Haeht, consists in exposing the earth which, after treatment with boiling water, still contains from 1 to $1\frac{1}{2}$ per cent. of ozokerite, to the solvent action of benzine. By this means nearly the whole of the remaining wax is dissolved, and by steam distillation the benzine is recovered. The ozokerite thus obtained commands a higher price than which is obtained by either of the three preceding processes.

The separated ozokerite is melted and cast into loaves or blocks of the form of a truncated cone, and weighing about 50 or 60 kilos. One of these blocks is on the table. The expenses of picking, washing, and melting amount to from 40 to 50 krentzers per quintal.

There are two or three recognised commercial qualities of the melted and cast ozokerite. The first quality is transparent in thin sheets and its colour ranges from yellow to greenish brown. Adulteration by means of crude petroleum, heavy oils, the residues from refineries, asphaltum, and even earthy matter, are not unknown, and occasionally by a process of double casting the exterior of the block is made to differ in quality from the interior.

In the form of the blocks described the ozokerite is delivered to the Austro-Hungarian refineries, and exported to Russia, Germany, and England. The principal refineries are in Drohobicz, Lemberg, Vienna, Stockerau (near Vienna), Aussig, Teplitz, Elbeteinitz, London, Halle, Frankfort, and Hamburg.

In the following table the quantity and price of the ozokerite raised in Austria-Hungary are given for the years 1877—90. The figures are official, but, as in the case of petroleum, the production is probably very largely understated. The greater part of this ozokerite is the produce of the mines of Boryslaw, but a portion was obtained from the deposits at Truskawice, Starunia, and Dwiniacz.

The raw material, which has been separated from earthy matter by fusion, is treated with Nordhansen oil of vitriol, whereby a portion of the material becomes converted into a soluble sulpho-compound, and afterwards with charcoal.* The purified ozokerite, which then bears the name of ceresin, is separated as far as possible from the charcoal by pressure, and an additional quantity is obtained by exhausting the charcoal with benzine, which is afterwards distilled off. There is thus usually obtained from the crude ozokerite from 60 to 70 per cent., or even more, of ceresin, which in some cases is afterwards coloured to imitate beeswax, and is largely used on the Continent, especially in Russia, as an adulterant of, or even as a substitute for that material, especially in the manufacture of church candles. Refined ozokerite or ceresin usually ranges in melting point from 61° to 78° C., but notwithstanding its high melting point, when made into candles, it exhibits a tendency to gutter; it also burns with a smoky flame. For the production of the material of which candles are made, the ozokerite is subjected by Messrs. J. C. and J. Field, Limited, to a process of distillation, patented in 1870 by Field and Siemens. Under this process the ozokerite is

AUSTRIA-HUNGARY.

Ozokerite.

Year.	Production in Metre Centners of 100 Kilos.	Average Price per 100 Kilos. in Florins.
		Fl. K.
1877	89,610	25.73
1878	103,420	29.80
1879	90,666	25.89
1880	105,270	34.94
1881	106,491	25.84
1882	99,300	25.50
1883	106,209	28.78
1884	119,669	31.31
1885	130,258	29.72
1886	139,254	25.42
1887	80,500	23.67
1888	87,800	21.66
1889	75,000	23.76
1890	64,439	28.50

melted, pumped into stills, and distilled in a current of superheated steam.† The distillate is eaked, pressed with naphtha, cleared down with Fuller's earth, and filtered. Under favourable circumstances, with good material, about 60 per cent. of white wax, of a melting point of 140° F., may thus be obtained. Candles made of this wax are especially adapted for use in high temperatures, as they are less liable to gutter and bend than ordinary paraffin candles. In addition to light oils, the crude ozokerite yields under certain circumstances a semi-solid product resembling vaseline, but less homogeneous. This product, known as yellow ozokerine, is used in ointments and pomades. By the action of Nordhansen sulphuric acid it is rendered white, and in that form is employed by French perfumers as a substitute for lard in the process of "enfleurage," the almost entire insolubility of the hydrocarbon in alcohol, and its non-liability to become rancid, giving it a great advantage over the animal fat.

The residue in the stills consists of a hard, black, waxy substance, for which at first no use could be found, but in 1875 Messrs. Field and Talling took out a patent for producing electrical insulating material by combining this black ozokerite with india-rubber by welding through rollers at a moderate temperature, and subsequently vulcanising the compound. This material, with certain modifications, has been introduced as "okonite," and is now largely used by the Okonite Company for the insulation of electrical cables. Okonite is not only a good insulator, but is remarkably flexible and tough. By a similar process a form of the material known as heelball is manufactured. This is employed to impart a black polished surface to the heels and soles of boots; it is also very largely used by the Austrian Government for the leather work of cavalry and artillery. The consumption of the black ozokerite in consequence of these industrial applications of what was at first a valueless by-product has now become so great that the present demand largely exceeds the supply.

For the very complete and highly interesting series of illustrative specimens, as well as for much valuable information relative to the ozokerite industry, the writer is greatly indebted to Mr. Leopold Field, who is well known to have devoted special attention to the technology of the subject. The specimens include natural ozokerite from a large seam

* The carbonaceous residue produced in the manufacture of potassium ferrocyanide being employed.

† If the ozokerite is subjected to destructive distillation, it is very largely converted into gas, oil, and coke, but in the presence of superheated steam this decomposition does not take place to any important extent.

at a depth of about 350 feet (such ozokerite yields by the system of distillation adopted by Messrs. Field about 60 per cent. of white ozokerite (melting point 140° F.) 30 per cent. of black ozokerite and 3 per cent. of ozokerine, the remaining 7 per cent. being represented by gas, light oil, and coke) crude ozokerite ("primitiva") as imported, showing the characteristic fracture and dichroism of the material; distilled ozokerite, 140° F. melting point, ozokerite candles and nightlights; black ozokerite, "okonite" and heelballs; "ozokerine," yellow and white; eeresin.

For the specimens of electric cables insulated with okonite, the thanks of the writer are due to the Okonite Company.

In conclusion, the writer cannot too strongly express his indebtedness to Mr. George Adams, whose long experience and intimate knowledge of the industry have been generously placed at his disposal, and have been of the greatest value to him in the preparation of this paper. The writer's cordial thanks are also due to Imperial and Royal Commissioner Henryk Walter, of Cracow, who has kindly furnished him with much valuable statistical information.

DISCUSSION.

Mr. W. TORLEY, F.R.S., ventured to assert that no one would in future attempt to discuss or write about the petroleum and ozokerite industry of Galicia without referring to this paper. He thought Mr. Redwood had dealt with the subject in a very masterly manner. What he had to say would be mainly geological. Mr. Redwood had been good enough to refer to him, and to say that he had given him (Mr. Redwood) some information, so that for him to make general remarks upon the geological part of the paper would be mere repetition. He could quite agree with what Mr. Redwood had said as to the general coincidence between the occurrences of petroleum and the course of mountain ranges in Europe. A geological map would show that the mountain ranges coincided with the geological structure. Perhaps he had not fully understood Mr. Redwood in some of his remarks with reference to the supposed connections of distant localities. He would hardly, for instance, be inclined to connect the petroleum of Algeria with that of the South of Spain. He was rather inclined to think that in Algeria, when the course of petroleum was more fully known, it would be found to lie in an east and west direction, extending for some distance along the hills. He did not see any geological reason for connecting the petroleum of Hanover with that of the Carpathians. He would rather connect the Carpathian ranges with that very interesting case in Bavaria, south of Munich; this was plainly suggested by a geological map. As regards the varying chemical compositions found in different geological formations, it was very easy to compare the composition of petroleum of different formations from different places, but what they wanted was a minute comparison from different formations in the same district, and he thought that could be done in Galicia. As regards the varying density of different petroleum deposits, very often it appeared that petroleum at greater depths had a lesser specific gravity. As Mr. Redwood had pointed out, one would expect this, because the petroleum near the surface would lose some of its volatile matter, but an inspection of the tables exhibited scarcely seemed fully to bear that out.

Mr. NELSON BOYD said that Mr. Redwood had shown them the methods which were originally used with hand labour, and then proceeded to show them the drilling apparatus which was used now, namely, the Canadian, but which he (Mr. Boyd) would prefer to call the American system. The best method for classifying the systems of drilling was based upon the tools that were used in the borehole itself. In the American system, whether worked by rods or rope, the tools used were the same. In Canada they used 2-in. rods, whereas in Pennsylvania they used the rope system, which was very useful for deep wells. The systems were really exactly the same. With reference to the Canadian system not being suitable for deep boring, he had had a hole drilled no less than 613 metres deep, and he thought that that was a feat which had not often been

accomplished with rods. When wells were sunk to 1,400 or 1,500 ft., a rope was usually adopted, and there the rope system had the advantage, as it was more expeditious. In fact, where one got beyond 300 or 400 yards, it took very nearly half an hour to draw up the rods. The free-fall system had been universally used in Europe for boring for water, and it had also been adapted for other borings. This system had been described as very good, but then it involved the necessity of iron rods. The result was an enormous weight and a very slow bringing up of rods, with consequent increase in the expenditure. He thought that the American system was infinitely superior to it. The system used on the Continent was a modification of the one before them, but instead of hand labour they used an engine. There was also the so-called diamond drill, which ought to be called the crown drill, because it was not absolutely necessary to have diamonds at the bottom of the crown. He had himself seen an apparatus for boring with a preparation of emery which was sufficiently strong to go through soft ground. In beds of clay in which petroleum is found, the diamond drill was absolutely useless; it clogged in the clay, the crown had to be given up and the chisel used; and then a pulp of fine sand and clay was formed, which remained in the hole; and not only that, but the rotary action of the chisel formed cavities all round. He supported Mr. Redwood in the opinion that the Canadian system was infinitely the best of the three. It should be remembered that the Northern Carpathians were very much steeper on the northern side than on the southern side, and therefore people working on the southern side would strike the oil line at a less depth.

Mr. GEORGE MORDAUNT might say, with regard to this petroleum, that it was well known in England, and as far back as the years 1865 and 1866 about 1,000 tons had been imported to London, and was refined by the Hydrocarbon Oil Company at Southall. At that time the price of refined petroleum was 2s. 9d. per gallon, whilst at the present moment it was $4\frac{1}{2}$ d. Between 1864 and 1892 enormous quantities of American, Canadian, and Russian oils had been imported. The import into London in 1864 was 45,211 barrels; last year it was 1,244,115 barrels. That would give some idea of the marvellous development of this trade. The members of the oil trade were extremely pleased to see these new developments leading to increased production all over the world, because they felt convinced that, by the aid of chemists and engineers, petroleum would sooner or later be adopted for fuel, and also as a motor for steamships.

Mr. W. J. A. BUTTERFIELD wished to ask Mr. Redwood two or three questions on the applications of petroleum. Mr. Redwood had mentioned the extensive use now made of oil for making gas, and for carburetting water-gas. Oil for this purpose should be free from water, and he was not very clear whether the petroleum from Galicia was free from water. He did not understand also whether the petroleum was free from sulphur, or whether this was only the case with the ozokerite. He would also like to know whether, on distillation, the oil gave off any ammonia or not. He thought it would be interesting to ascertain if the oil-fields of America were co-extensive with mountain ranges, as were the oil-fields of Europe.

Mr. W. PAYNTER said he had been investigating the existence of oil in North Africa during the last two years, and was of opinion that that oil-field would prove an important one in the near future. In the borings he had made on the southern slopes of a range of the Atlas mountains, and from other surface indications, the oil showed very plainly over a distance of 20 miles. The oil-fields in the district of Ann Zelt, in the Atlas mountains, corresponded exactly to the description of those in the Galician mountains which Mr. Redwood had given them. His personal experience completely bore out what Mr. Redwood had said, and he would venture to say that if they studied the origin of petroleum it would be found to exist in Europe and Africa principally near limestone of the tertiary period. The specific gravity of the Galician oils from 900 down to 764 were exactly what he had found at various depths. At a depth of 14 or 15 yards he found it

to be 860. He had found that Am Zeff oil contained from 6 to 7 per cent. of solid hydrocarbons. Mr. Redwood had found 5 per cent., but he had since come across some samples of oil which contained nearly 8 per cent. It seemed to him that in North Africa they had another extensive petroleum field, and the company in which he was interested was the pioneer company in developing this field. "Am Zeff" is Arabic for "pitch wells."

MR. REDWOOD, in reply, said that with reference to Mr. Topley's remarks, he did not desire to carry the argument of the north-west, south-east line too far. He did not wish to pose as an exponent of the view that on the continent of Europe these deposits must occur on such a line. He had thought it expedient to point out that the petroleum fields to which he had occasion to refer occupied the relative positions described. He did not desire to advance any opinion on a geological question in opposition to the views of Mr. Topley, and he quite agreed with him that new deposits might be discovered, which would necessarily modify the generalisation attempted. But, nevertheless, there was in his mind an idea that some sort of general disposition on parallel lines running, broadly, north-west, south-east, characterised the petroleum fields of Europe. He was fully in accord with Mr. Topley in thinking that a chemical comparison of petroleum from the various geological horizons in Galicia might prove to be exceedingly interesting and valuable. He might say, however, that he had worked out that idea a little farther in his paper, than he had, from lack of time, been able to indicate that evening; but while he felt that a careful study of the relative physical and chemical characteristics of various samples of petroleum obtained from the different geological horizons in Galicia might lead to important results, it did not appear to him that any very definite deductions could be drawn from the existing data. He would like to make one remark in reference to Mr. Topley's comments on the results obtained in the examination of samples from a number of wells in the Sloboda district. In consequence of the fact that in Galicia it was not an uncommon thing to perforate the casing, not only at the lowest oil horizon, but at every important oil horizon, a product was frequently obtained in variable proportions from different horizons. With respect to Mr. Boyd's observations he might remark that he had found it convenient to apply the terms American and Canadian respectively, to the systems of drilling with a cable and with rods. He quite agreed with Mr. Boyd that the tools were of the same description, but he believed that the names in question were appropriate, since the rope system was generally used in the United States, and the rod system in Canada. He did not think that the remarks made by other speakers called for any reply, except those which had fallen from Mr. Butterfield, who asked some questions in reference to the employment of Galician petroleum as a source of gas for carburetting purposes. Mr. Butterfield had pointed out in the first place that the oil for this purpose should be free from water; and he had inquired if Galician petroleum was free from sulphur. As a matter of fact, crude petroleum which had a specific gravity considerably different from that of water could not long retain much water in suspension, and the quantity which would remain in solution might be disregarded in the use of the oil for gas-making purposes. The crude oils which had given trouble in gas making, owing to the presence of water, had been of a high specific gravity. From such oils water separated but very slowly, by subsidence at common temperatures. As regarded freedom from sulphur he might say that the petroleum found in Galicia was usually practically free from sulphur. He might add that the presence of sulphur in petroleum employed in gas making was a matter of much less consequence than its presence in crude oil intended as a source of kerosene, for it was comparatively easy to remove sulphur from gas.

Meeting held Monday, February 1st, 1892.

MR. THOS. TYLER IN THE CHAIR.

THE STABILITY OF CERTAIN ORGANIC NITROGEN COMPOUNDS OCCURRING IN COAL-TAR PITCH.

BY WATSON SMITH.

(*Lecturer in Chemical Technology in University College, London.*)

THIS note is merely designed to call attention to a fact that appears to have been overlooked, as well as to point to a very simple lecture experiment for the purpose of illustrating that such organic substances as pitch, which contain small quantities of nitrogen in combination, if ignited so as to become reduced to a porous coke, evolve a considerable proportion of that nitrogen as ammonia. The exhalation of ammonia from the porous coke is most marked when the ignited residue has cooled down to such an extent that the retort or other vessel is so warm that it can just be borne upon the hand for a short time. No odour of ammonia is perceived whilst the retort or other vessel is still very hot. This evolution of ammonia is secured even long after attaining a period in the distillation, when absolutely no more solid or liquid distillation products come off in the case of pitch, clearly proving that the nitrogen carbon compounds of the pitch are those which are the most stable. The fact also that the nitrogen is finally evolved as ammonia would appear to prove that some hydrogen is present and is retained in a stable form. To endeavour to show that it is not due to the influence of the moisture in air aspirated back into the retort after cooling of the latter, a set of drying-tubes were adjusted to the retort, so that the air passing back should be dry air. Ammonia was still evolved. Nevertheless, it is quite conceivable that before the adjustment of such drying apparatus, and after the removal of the lamp flame, back suction of moist air may have occurred, before the drying tubes could be fixed, as also whilst the source of heat was still present, and during lapses of the intensity of the flame.

An interesting and effective lecture experiment to illustrate this stability of nitrogen, is very simply performed, by introducing some bits of pitch into a small retort, placing a flame under the bulb of the retort and heating strongly until all that will distil over has passed off, and the residue has become red hot, and the glass of the bulb is somewhat warped and has become semi-molten. The lamp is then removed, and the retort let cool until the heat of the bulb can be just endured in the palm of the hand. On removing the stopper of the retort, the stem being still inclined downwards, a current of air passes up the stem, through the retort and through the stopper-hole, after the manner of the draught of a chimney. If the nose be now held in the ascending current of air from the stopper, a powerful, in fact, unendurably strong odour of ammonia is perceived, producing dense white fumes with the moistened stopper of a hydrochloric acid bottle. Meanwhile, as an instructive, simple, and I believe new lecture experiment I thought it not unworthy of record or of presentation to this Society.

DISCUSSION.

MR. WILLIAM CROWDER said that he did not quite see what the peculiar reaction was in the case of the pitch mentioned by Mr. Watson Smith. It was a very well known thing that in distilling nitrogenous substances a residue of charcoal was found, and that that charcoal always contained nitrogen. He himself had distilled large quantities of animal matter, and he had invariably obtained nitrogen in the charcoal. He had found exactly the same thing in the case of bone; and, in fact, it was well known that if any organic substance were distilled there was always a residue of nitrogen left in the substance. He therefore did not see what Mr. Watson Smith was driving at in singling out pitch as a substance having anything peculiar about it.

Dr. C. R. ALDER WRIGHT had noticed that sometimes nitrogen was evolved in another form, cyanogen, when the residue in the retort was coked; sometimes ammonia and cyanogen were obtained together. On redistillation of bone oil (Dippel's oil), a large quantity of ammonia was formed when the residue left in the retort approached carbonisation, and one would also frequently find a white sublimate in the neck of the retort. This consisted partly of ammonium cyanide, the cyanogen being easily recognised by dissolving in water and applying the Prussian blue test; the smell of ammonia was persistent all through the latter part of the distillation. Bodies analogous to those in bone oil would be probably contained in small quantity in ordinary coaltars, and the formation of ammonia would probably be noticeable there also to a lesser extent.

The CHAIRMAN asked what percentage of ammonia had been found in such coke material, and whether it was not possible that the nitrogen of the air might be concerned in the formation of the ammonia?

Mr. WATSON SMITH said, in reply, that the exhalation of ammonia from the coking and coked pitch did not appear to commence until after cooling had set in, and in fact to a temperature that could just be borne by the hand. Whilst other substances containing nitrogen, such as bone-black, &c., might similarly exhale ammonia, he had never observed the phenomenon so strongly marked as in the case of pitch, and he had first observed it in 1869 when continually experimenting with pitch on a large scale in a tar distillery. On reheating the coked residue after it had ceased to evolve a smell of ammonia and then letting the residue again cool down, a fresh exhalation commenced. Some further experiments would be required to prove whether or not the nitrogen of the air was at all involved in the development. It seemed scarcely probable. He had indeed tried the experiment with coked sugar, but without evidence of a trace of ammonia. The probability suggested by one speaker that the compounds decomposed might be cyanides and sulphocyanides seemed likely, especially since the ammonia was accompanied occasionally by a smell of sulphuretted hydrogen, and occasionally by a faint one of hydrocyanic acid. The best way to obtain all the nitrogen of nitrogenous cokes of any kinds, as ammonia, was to pass steam through the red-hot material until all was consumed but ash, and in suitable apparatus for the condensation and recovery of such ammonia. This was no new thing, but was well-known to and for long practised by the firm of Brunner, Mond and Co., to the best of his knowledge, in the case of coal.

The CHAIRMAN said that the point whether the nitrogen of the atmosphere had anything to do with this evolution of ammonia ought to be settled; and the fact mentioned by Mr. Watson Smith that no ammonia was perceptible whilst the contents of the retort were very hot was certainly singular. It would not be at all a difficult thing to determine by experimenting with some neutral gas. Mr. Smith admitted that the investigation was incomplete, but was put forward as a suggestion to be worked out by those whose opportunities were larger than his own.

Liverpool Section.

UNIVERSITY COLLEGE, BROWNLOW STREET.

Chairman: H. Brunner.

Vice-Chairman: A. Norman Tate.

Committee:

E. Carey.	A. H. Knight.
V. C. Driffield.	D. McKechnie.
F. Gossage.	E. K. Muspratt.
W. D. Herman.	Henry Tate.
C. L. Higgins.	A. Watt.
F. Hunter.	

Hon. Treasurer: W. P. Thompson.

Hon. Local Secretary:

Dr. Chas. A. Kolm, University College, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

1892:—

Mar. 2nd.—Dr. G. Shack-Sommer. "Bill to amend the Law with respect to the Sale of Agricultural Fertilisers and Feeding Stuffs."

Apr. 6th. Chairman's Address. "Manuring for the Production of Fruit."

Meeting held Wednesday, January 13th, 1892.

MR. A. NORMAN TATE IN THE CHAIR.

MODERN LEGISLATION IN RESTRAINT OF THE EMISSION OF NOXIOUS GASES FROM MANUFACTURING OPERATIONS.

BY A. E. FLETCHER,

*H. M. Chief Inspector under the Alkali, &c. Works
Regulation Act.*

LAST year I read a paper on this subject before the Congress of Hygiene meeting in London. On that occasion I sketched the course which such legislation had taken, and spoke of the effects produced. This evening I have the advantage of addressing an audience well acquainted with the practical bearing of the subject, and propose therefore to take now a step in advance, and, referring briefly to what has been done in the past, to set forth, and possibly lead to a discussion on, the line of action that should be taken in future.

By way of preface I would remind the Society that the Alkali Works Regulation Act of 1863, was, as far as I have been able to discover, a new departure in the legislation not only of this but of any other country. Prohibition of noxious trades there have been, and local Acts to regulate the locality of factories where noxious trades were carried on; but there had been before 1863 no Act of the Legislature whereby an admission was implied that the emission of noxious gases was in certain cases unavoidable, and that such would be subject to definite regulations. The Act of 1863 recognised the existence of alkali works, and the fact that acid gases liable to injure surrounding vegetation were discharged from them. There was no attempt to put a stop to such works on account of the admitted injury they were liable to inflict on the neighbourhood, but steps were taken to limit that injury, and to oblige the manufacturers to adopt means for reducing the evil to the smallest possible amount.

I think I am right, therefore, in saying that in this Act a new principle was thus introduced, one differing widely from that of simple repression, hitherto applied whenever an admitted evil of the kind was dealt with. There was herein an acknowledgment that with the evil there was associated a greater good, and that to sweep away the one would be

to destroy the other; that it must suffice to restrain the evil, to insist on the adoption of the best practicable means for diminishing it to the furthest possible limit.

A second important principle in the Alkali Act of 1863 was that its administration should not be placed in the hands of the local authorities. The larger manufacturers, proprietors of chemical works, and others interested in the carrying on of processes which might cause the occasional discharge of noxious gases, are obviously not those who should be entrusted with the administration of a law to control those operations in which they are particularly concerned. It was felt to be necessary therefore that the inspectors to be appointed under the Alkali Act should be removed from all local influence, and that they should be appointed by the central authority.

For this and for other reasons it was probably thought that the local medical officers of public health would not be suitable agents for carrying out the new law. Their medical studies eminently fit them for their office as guardians of the public health, but they are not necessarily students of chemistry nor familiar with its application to the arts.

The appointment of inspectors who should have power of entry of the works registered under the Act was also new and seemed to be in opposition to our instinctive feeling of the inviolability of private property. This step was, however, necessary to the carrying out of this newer legislation.

If it were conceded that a work should not be stopped though it might have been ascertained that some noxious gas escaped from it, provided that such escape were kept within the narrowest possible limits, then there must be inspectors to ascertain the fact, and they must have opportunity of continually examining the process and the apparatus.

As the number of chemical works increased and they were grouped together in considerable numbers, as at Widnes and St. Helens, it was found impossible for a farmer in the surrounding district whose crops may have been injured by an acid gas to fix on the factory whence this had proceeded. The work of an inspector became therefore the more necessary to go before and prevent the injury, or, if necessary, single out the offender. It being then conceded that if certain chemical manufactures were carried on some noxious gas would inevitably from time to time escape, and inspectors being appointed to examine with a view to minimise the amount thus escaping, it became necessary to give a standard for their guidance, to fix a limit beyond which any emission of a noxious gas should be considered penal.

In the original Alkali Act of 1863 the only gas dealt with was hydrochloric acid. That gas, liberated by the action of sulphuric acid on common salt during the first stage of its conversion into alkali by the Leblanc process, was in the early days of the manufacture allowed to pass into the fire flues, thus finding a discharge through the chimney into the atmosphere. The first effort to mitigate the damage thus inflicted on surrounding vegetation was to heighten the chimney in the hope that, carried to a distance, the acid gas by extreme dilution would be powerless for evil. Thus rose the tall structures once seen at Newton, in Lancashire, and that still standing at St. Rollox, in Lancashire. It was when the failure of this palliative was realised that Mr. Gossage constructed his now famous towers for the condensation of hydrochloric acid gas. Brought here into contact with water distributed over large surfaces it was dissolved and retained as a liquid acid.

It was the operation of these condensing towers that gave a standard for the Alkali Act. Their action was so nearly perfect that it seemed safe to engage that 95 per cent. should be condensed. Thus it was made penal for an alkali manufacturer to allow more than 5 per cent. of his hydrochloric acid to escape into the air. As the number five has no particular relation to common salt or hydrochloric acid, or to the molecular weights of either, it must be admitted that it was taken as a conveniently familiar figure, and sufficiently near for a first attempt. As a fact the manufacturers from the first kept well within it, indeed the amount of acid escaping from the condensers themselves was very much below the proportion named. At the present time, adding to this the amount which escapes

through crevices in the furnaces, or in other ways finds its way into the chimneys, the whole does not exceed on the average 2 per cent.

The Alkali Act of 1863, containing the novel principles here indicated, was passed tentatively for five years only. During this first time of trial it worked satisfactorily, the amount of acid gas found to be escaping from some of the works was rapidly diminished, the presence of an inspector was not found to be excessively offensive, and it was said that in some districts a marked improvement could be observed in the neighbourhood of chemical works. In 1868 the Act was therefore renewed and made perpetual.

The standard of a condensation of not less than 95 per cent. was still the only one upheld by the Act. It is said that this had been readily agreed to by those who represented the manufacturers in the committee of the House of Commons, as it was believed that no means existed for determining the total amount of acid escaping from any work, so as to calculate the proportion it bore with the quantity generated. In order to estimate this it was not sufficient to compare the relative acidity of the air or gas entering the condenser with that leaving it, for should there be leakages in the furnaces some gas might find its way to the chimney without passing through the condenser. It was seen that the total amount passing up the chimney during any given time must be estimated, and a proportion determined between that and the total quantity being generated during the same interval. No means were, however, available for giving all the factors necessary for this calculation. A measured volume of the gases passing up a chimney or through a culvert might be withdrawn, and the amount of hydrochloric acid there contained determined, but there was no means of estimating the quantity of those gases which passed in a given time. In order to do this an anemometer was needed, by which one could measure the speed of air of any temperature, even if red hot, and when charged with corrosive acids, or if heavily laden with dust or soot. But no such instrument was provided or was known. It was only after much investigation and the independent work of one of the inspectors that this problem was solved, and an anemometer constructed which should measure the speed of a current of air even under the adverse conditions named.

Apparatus was also needed for ascertaining the amount of acid gas in a given volume of mixed air. Some means of withdrawing a measured portion of air from the chimney or smoke culvert were in the hands of chemists, and for ascertaining the quantity of acid gas contained in it, but it was the good fortune of one of the inspectors under the Act to devise an apparatus portable and specially convenient for the purpose in hand. It took the form of a collapsible cylinder constructed of ebonite and vulcanised rubber, in size capable of holding one-tenth of a cubic foot. The solvent for the acid or other body contained in the air aspirated was introduced into the collapsible aspirator, where on agitation it was brought well into contact with the contained gases.

Thus armed with anemometer and collapsing aspirator and a few bottles of standard solutions, it was in the power of an inspector rapidly to determine from his own observation what proportion of the hydrochloric acid produced in an alkali work was allowed to pass through the smoke flues and chimney into the air.

The result of this was a notable diminution of the amount of hydrochloric acid allowed to escape from the alkali works, a result achieved not by means of numerous prosecutions, but by pointing out whence and how the escape took place. The chief source of this was a faulty method of setting the decomposing pots, also leakages in the inner arch and bed of the muffle furnaces in which the saltcake was roasted. Before long all the Lancashire saltcake furnaces were modified, so as to obviate the faults thus pointed out; the decomposing pots were set so that the rim was not buried in the brickwork as formerly, but exposed to view, thus rendering it impossible for any gas to pass round it into the furnace flues beneath. As to the roasting furnaces, those of the older construction, found so often to leak and allow much of the hydrochloric acid to follow the draught of the chimney to be thus discharged into the air, were

replaced by furnaces wherein a slightly higher pressure was established in the fire flues surrounding the muffle of the furnace than in the muffle itself, thus neutralising the tendency for the acid gases to pass away with the smoke. These were called *plus-pressure* furnaces. As pioneers in their construction we are indebted to Messrs. Gamble and Son, of St. Helens, and Messrs. Gaskell, Deacon, and Co., of Widnes.

It may thus be said of the inspection established under the Alkali Act, that by introducing an exact system of estimating the character and the amount of the waste gases passing into the atmosphere, and by inducing the manufacturers to daily repeat these tests and keep a constant record of the results, a gradual reformation has been effected in the construction of apparatus and the conduct of works generally.

After the renewal of the Alkali Act in 1868 a further period of six years elapsed, when an amended Act was passed in 1874.

It had been found that it was possible to carry on the condensation of the hydrochloric acid generated in alkali works till far more than 95 per cent. of it was arrested, yet the amount which still escaped from large works was in some cases so great that unless much diluted with other gases it was still highly dangerous to vegetation.

It was considered, therefore, that a further standard of condensation should be adopted, also that other gases than hydrochloric acid should be placed under control. Accordingly in 1874 an amended Alkali Act was passed, wherein it was provided that no gas or smoke containing more than two-tenths of a grain hydrochloric acid should be allowed to escape into the atmosphere.

It was enacted also that the best practicable means must be adopted for preventing the escape of all other noxious gases, besides hydrochloric acid, which are generated in an alkali work. The term noxious gases is defined to include sulphuric acid; sulphurous acid, except that arising from the combustion of coals; nitric acid, or other oxides of nitrogen; sulphuretted hydrogen; and chlorine.

The adoption of the standard of two-tenths of a grain of hydrochloric acid in a cubic foot of air was not to supersede the former standard of 5 per cent., but run with it. The two together formed a complete check upon any excessive escape of this gas. The introduction also of the injunction to use the "best practicable means" for preventing the escape into the air of certain other noxious gases was a great step in advance. When a numerical standard is adopted it is necessary that it should be loose, lest in some cases it might be found to be oppressive; indeed, the same standard may be unduly loose under some conditions, yet unfairly severe in others. The obligation, however, on a manufacturer to adopt the "best practicable means" for the avoidance of that which may be a source of injury to his neighbours, is one which he can never in justice seek to evade, or of whose fairness he can rightly complain.

The work of inspection under the now amended Alkali Act continued, yet farmers and others in the neighbourhood of the accumulated chemical works still complained that the evils from which they had suffered were not removed. In explanation of this it should be noticed that the past 15 years had been a time of rapid increase in all chemical industries. In the year 1864 the amount of salt decomposed in the alkali works of the kingdom was 288,100 tons; this increased till it has reached the large total of 855,000 tons, showing an increase of 200 per cent. This rapid increase had neutralised the controlling effect exercised by the Alkali Act. Indeed when it is remembered that the consumption of coal had reached, both in St. Helens and in Widnes, the large amount of about one million tons annually, and that the sulphurous acid from this as well as that from numerous copper-smelting, glass-making, and other works passed unrestricted into the air, it will be felt that the repression exercised by the inspection under the Alkali Act in enforcing the condensation and arrest of hydrochloric acid was quite overshadowed by this widespread pollution of the atmosphere. The inspectors could only draw consolation from the fact that if their influence were to be withdrawn a very great addition to the damage in the surrounding country would soon become apparent.

Under these circumstances a Royal Commission was appointed to inquire into the past working of the Alkali Act, and to report with a view to further legislation.

In 1881, therefore, an amended Act was passed superseding the previous Acts. In this some other branches of chemical manufacture were brought under the inspection hitherto reserved for the alkali works. It was not made generally a noxious gases Act, but under it cognizance is taken of those processes of manufacture only which are there specified, namely, sulphuric acid works, chemical manure works, gas liquor works, nitric acid works, sulphate of ammonia works, and chlorine works, also salt works and cement. Concerning these, no numerical standard is given, but it is provided that the "best practicable means shall be adopted for preventing the discharge into the atmosphere of all noxious or offensive gases evolved in such works."

The increase made in the number of works now brought under inspection was great, as is shown by the recent annual reports under the Alkali Act. In the year 1890 the number of works in the United Kingdom and Ireland registered under the Alkali Act was 1,034, while of these 133 only were alkali works, the larger majority being those coming under the classes mentioned in the schedule to it.

Such is a sketch of the history of the legislation for controlling the discharge of noxious gases from certain processes of chemical manufacture, but from certain processes only. There are, however, other processes from which noxious gases may proceed, and in most cases the gases which are omitted are the same as those which escape from the scheduled processes, yet they do not come within the scope of the Alkali Act, and the inspector cannot interfere. This anomaly presents itself, for instance, markedly in the case of nitric acid. If a manufacturer of this acid allows any to escape owing to the leaky condition of his apparatus he lays himself open to the penalties fixed in the Alkali Act, but if he sells that acid to his next door neighbour who by careless use or otherwise evaporates the whole, driving it into the atmosphere, he is not amenable to the law under the provisions of the Alkali Act. Again, if this manufacturer, who in the ordinary use of the acid in oxidising metals, was accustomed to discharge into the air the whole of the nitrous fumes thus produced, which, as stated, would be no offence under the Alkali Act; if he, by a process now commonly adopted, commenced to collect this acid and by reconvert it into nitric acid condensed it so as to prevent its escape and the consequent contamination of the atmosphere, he at once comes under the provisions of the Alkali Act, and can be brought under a penalty if any considerable quantity of it escaped.

Many anomalies of this kind may be pointed out, they arise from the difficulty or impossibility of scheduling all the manufacturing operations which should come under the control of a noxious gases Act. A list, indeed, which is complete to-day, may be no longer so to-morrow, owing to the rapid and constant advance in chemical industry. This difficulty may, however, be met by enumerating the noxious gases themselves rather than the processes of manufacture which generate them. Nor is this difficult; their number is but small. Probably as short a list as the following will be found to include all those gases with which it would be necessary to deal in such legislation as we are contemplating, namely:—

The acid compounds of sulphur, nitrogen, chlorine or fluorine. Chlorine. Fumes containing lead, arsenic, antimony or zinc.

Indeed, some may think it unnecessary even to go so far as to specify any noxious gases at all; they would style the proposed enactment, "An Act for the control of noxious gases" or "a noxious gases Act." The definition of a noxious gas might be "a gas which is complained of" or which is notoriously a cause of complaint, or which in the opinion of the inspector appointed under the Act is liable to cause complaint.

The enactment would be that every manufacturer must use the best practicable means for preventing the discharge into the atmosphere of any such gas evolved in his work.

To guard against frivolous complaints being brought against a work it might be defined that any such complaint

must be brought by, say, 10 neighbouring householders, or a complaint held to be *bonâ fide* by the Local Government Board or other central authority. Such an enactment would certainly have the merit of simplicity; it would also be comprehensive, and I do not think it would be indefinite. It is certainly clear, I think, that in future the term "Alkali Act" should no longer be used. The term "*Acid Act*" would be more appropriate. Though the title "alkali" stands over the present Act, yet simple alkali works, such as these for the manufacture of caustic soda, or those where the ammonia-soda process is carried on, do not come under it; it is only those works where acids are made which come within its scope.

Should a fear be entertained that without a more precise description of the gases to be controlled and some definite standard by which to measure the amount of acid, &c., discharged into the air, manufacturers might be harassed by restless inspectors, I would reply that the past experience of the conduct of inspectors has not been such as to warrant such fear, and remind the objector that no prosecution under the Act could be maintained until the inspector were able to convince a judge and jury that the best practicable means had not been adopted for the suppression of the evil under complaint. To do this he would probably have to point out some means that were acknowledged to be practicable and were in common use for attaining the end in view. This, too, he must do in the face of skilled witnesses that might be brought to confront him in open court. It is certain that no inspector would subject himself to such an ordeal unless he had a very strong case to maintain.

With these remarks I leave the subject in your hands, anxious to hear the view of the Society, many of whose members have had long experience of the present Act, and who habitually see its working, viewing it from another standpoint than that of the present speaker.

DISCUSSION.

Mr. TATE remarked that looking at the effect of legislation during the time that the Alkali Act had been in force, he thought it must be admitted that it had in many ways conferred advantages upon manufacturers themselves, especially owing to the way in which the Act had been worked under the auspices of the first inspector, Dr. Angus Smith, to whom manufacturers owed a great debt of gratitude for taking action in the way he did. It showed the difference between inspection by men well acquainted with the operations they had to inspect, and unintelligent inspection carried on in the ordinary policeman-like manner. Dr. Angus Smith had set himself to work to make the Act not only serviceable to those who were injured by the emanation of noxious gases, but had thought also of the difficulties under which manufacturers laboured, and so manufacturers were not unduly harassed by him. He made himself thoroughly acquainted with what manufacturers could and could not do, and endeavoured to enforce what was feasible. As Dr. Smith worked, so had other inspectors. They had one and all done their best, rather to carry out the provisions of the Act by assisting manufacturers to do what was necessary, than harass them with legal proceedings. Consequently benefit had been conferred all round. The inspectors had thrown themselves thoroughly and intelligently into the work, as for instance, in inventing pieces of really serviceable apparatus for the measurement of escaping gases, and in that respect he believed no person had worked more energetically than Mr. Fletcher himself. His apparatus has been largely used, and so had other apparatus designed by other inspectors.

Altogether, he (Mr. Tate) considered the operation of the Act as decidedly beneficial, and this because it had been worked under such an excellent system of inspection.

Mr. CAREY said he had listened with great pleasure to Mr. Fletcher's very interesting paper and to the review he had given of the progress of legislation from its first inception in 1863 to 1881, and as he (Mr. Carey) was familiar with the subject during the whole of that time, Mr. Fletcher's account had been extremely interesting to

him personally. He could support the lecturer's remarks in almost every respect, especially in regard to the spirit in which the Acts had been worked by the inspectors. If it had not been for the judicious way in which Dr. Smith, Mr. Fletcher, and other inspectors had acted, they would not have seen anything like the improvement in dealing with noxious gases which had taken place. It was desirable that the inspection of noxious vapours should be in the hands of the central authority, and that the inspectors should be men of high education and character; it was owing to attention to these two points that the Acts had been so successfully carried out. The only point on which he had always felt inclined to say, "Well, don't go too far," was about the great benefit that was alleged to have accrued to manufacturers owing to these Acts. It was quite clear that the condensation of HCl. had been of benefit to the manufacturer up to a certain point. But if it was a benefit to condense, up to 95 per cent. for example, it did not follow that there would be a proportionate benefit by condensing 97 or 98 per cent. These last one or two degrees cost more money than they were worth from a manufacturing point of view.

He agreed with Mr. Fletcher that it was unsatisfactory to schedule the works, and that it would be better to schedule the gases. But the objection that he had heard taken to that course was that if the gases were scheduled the inspectors would be obliged to visit works in a disagreeable or inquisitorial manner. He understood that Mr. Fletcher's reply to that criticism was that he did not propose to inspect these works until some complaint had been laid by a number of responsible persons. But he (Mr. Carey) was not sure that that reply was quite complete.

Under the present system of scheduling the works there are great anomalies. In some works it is not practicable to condense sulphuric acid arising from the decomposition of sulphate of soda. These works are therefore not scheduled or inspected, but if the gases were scheduled all the works making these gases would at all events be inspected, and if the inspectors continue to act in the same spirit as they had acted in the past he did not think that those manufacturers would find that they had any cause to complain. He would be glad to see the alteration made.

Professor CAMPBELL BROWN hoped the alkali manufacturers would, like the fabled fox who had lost his tail, endeavour to persuade other manufacturers whose processes emitted noxious gases or fumes, to submit to inspection under a general Act applicable to all.

He was quite sure it would be only fair, and of great benefit to the public. The inspector was no longer dreaded, but often welcome. Mr. Fletcher had indicated a preference for an Act to schedule gases rather than works, but he could not help thinking that it was a mistake to persist too long in piecemeal legislation. Of course it was right to begin tentatively, but it was now time for Parliament to pass a general Act providing that any works which emitted noxious gases should be subject to inspection in the same way that certain works now are. Of course it would not do to define noxious gases as "something that anybody complained of." They knew that if one were to manufacture pure oxygen and turn it out into the air in great quantities to benefit one's neighbours, somebody or other would complain of it; but another definition might be adopted that a noxious gas was "a gas which did appreciable harm to health or property." That would be very simple and workable, because if it came to the knowledge of an inspector that anything injurious to health or property was emitted it would be his duty to investigate it. If any people complained it should be their duty to satisfy the inspector that there was injury. An Act of that kind would be far better now than an enlarged schedule of gases or of works brought under inspection. He hoped for an Act which would take cognisance of anything that did harm.

Dr. HURTER pointed out that if alkali manufacturers had not derived much benefit from inspections, they in the laboratories had. He, personally, was obliged to Mr. Fletcher for having introduced necessary apparatus and tools which proved satisfactory in a number of

analytical operations, and he would say that he had always looked forward with pleasure to the days on which Mr. Fletcher should happen to come to their works as inspector, and that pleasure was increased when Mr. Fletcher was accompanied by Dr. Smith. In that district there had never been any friction between inspectors and employees or manufacturers themselves, and so far the Acts had worked satisfactorily. In regard to future legislation Mr. Fletcher proposed to schedule the vapours instead of the works. Looking over the list of gases so scheduled, he (Dr. Hunter) was afraid that an enforcement of such limits as were now enforced in the alkali works would be a severe task to fulfil for certain other industries. To condense, for instance, the fumes to the extent to which they had to condense them in alkali works might in glass works be a different matter, and in copper works also. Mr. Fletcher would have to frame his Act with different numerical limits for different industries. To leave the definition of a noxious vapour to householders would be a very serious matter. Householders might very easily combine together to annoy a poor small manufacturer for instance.

Mr. DAGGER observed that there was one thing which the Act would not touch, a matter of serious moment, that was the smoke emitted in connexion with the potteries. It had been his lot to live for the past two or three years in the neighbourhood of pottery towns, and he did not know whether on foggy days there was much to choose between the atmosphere of Hanley or Longton and that of Widnes.

Mr. FLETCHER in reply remarked that inspectors might well wait until complaints had been made; these came usually soon enough. Where, however, it was notorious that an offensive gas or substance emanated from a works, it might be assumed that the matter should come under examination.

Discharge of dust from works had been spoken of, and a recent case had occurred where it was alleged that plants had been injured by the dust of carbonate of soda and heavy damages had been awarded. Mr. Fletcher agreed that the term noxious gases might be made to cover solid emanations of that kind. Cement works were already under the Act; they emitted a certain amount of alkaline earths in a state of extremely fine division. Many manufacturers recognised the advantage of being under the Act, finding that they are thereby assisted in their efforts to keep their works up to a high state of efficiency. They prefer the visit of the Government inspector to the interference of local officers under the Public Health Act. He had been told by a manufacturer that he would be willing to pay 100*l.* annually rather than that the office of Government inspectors under the Alkali Act should be abolished. The question of potteries had been mentioned; they of course would come under the control of a general noxious gases Act, as would also the glass and copper works, though no action could be taken in these cases until it was known how to deal with the gases which they threw out.

As to coal smoke, whenever inspection concerning this were undertaken it would be for some time a gigantic work, but the difficulty would diminish. An association had been started in Manchester with the object of accurately testing all smoke-preventing appliances; manufacturers would be wise in giving them liberal support, for they were doing for all what it was difficult and expensive for each to do separately for himself.

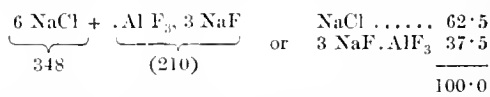
Meeting held February 3rd, 1892.

MR. A. NORMAN TATE IN THE CHAIR.

THE MANUFACTURE AND INDUSTRIAL VALUE OF ALUMINIUM.

BY J. H. J. DAGGER, F.I.C., F.C.S.

IN the paper I had the honour of reading before this Society in May last year I described the now well-known electrolytic method for the production of aluminium, the two processes which I noticed being that of Herault, as carried on at the works of the Aluminium Industry Co., Limited, Menhausen, and those of the Société Electro-Metallurgique, at Froges, near Grenoble, and the Hall process of the Pittsburgh Reduction Co., U.S.A. These methods are typical of the most recent advance in the metallurgy of aluminium, and it may be taken for granted that no departure will be made from the main outline of these processes in the present state of our knowledge of the conditions of the reduction of aluminium from its combinations for some time to come. In these processes and in the electrolytic process carried on at the works of the Cowles Co., in Lockport, U.S.A., the conditions are essentially the same, the electrolysis of alumina dissolved in a bath of fused haloids, salts of aluminium, and metals of the alkalis and alkaline earths, preferably the fluoride. In the process described by M. Minet in the *Compt. Rend.*, February 17th, June 9th 1889, and October 27th, 1890, the bath is composed of a mixture of chloride of sodium and the double fluoride of aluminium and sodium as expressed by the formula—



such a mixture melting at 675°. The composition of the bath is maintained constant during the operation by means of the following mixture:—

	Per Cent.
Hydrate of alumina (partly dried)	6 (Al ₂ O ₃ 2 H ₂ O) 416.4 = 48.2
Double fluoride of aluminium and sodium	Al ₂ F ₆ 6 NaF 210.4 = 24.3
Oxyfluoride of aluminium....	Al ₂ F ₆ 3 Al ₂ O ₃ 238.4 = 27.5
	<hr/> 100.0

This mode of alimentation enables the two-thirds of the fluorine given off at the positive pole to be replaced. The bath is kept at the same level by the introduction of a mixture of chloride of sodium and double fluoride of aluminium and sodium in the proportion before given.*

M. Minet claims that by his method he attains the production of 32 grms. of aluminium for one h.p. hour with E.M.F. of 4 volts, and the return of electric energy as 70 per cent. Unfortunately, however, I have been unable to obtain further information as to this process or to verify the results obtained. M. Minet's papers are, however, well worth reading, as he goes into the theory of the decomposition of fixed aluminium fluoride and tabulates the results he obtained under varying conditions of current and temperature. From my own experience and knowledge, however, the use of more easily decomposing mixtures than those of the fluorides, even the addition of chloride of calcium, as is sometimes advocated, is attended with practical difficulties and requiring much greater skill and intelligence than one could well expect from the workmen, and therefore at present the simpler methods of the three great companies will continue to supply the

* You will note that in this process it is the fluoride that is electrolysed, in the processes before described it is the alumina that undergoes decomposition, the loss in the bath itself being only very slight, provided care is taken not to let the pots get out of ore (alumina), this being shown by the increased resistance indicated by the voltmeter. Should, however, this be neglected, the current begins to act on the materials of the bath, the halogen of the salts used being given off instead of the CO produced under normal conditions.

greatest part of aluminium required, and any further development will lie rather in the cheapening of the methods of preparing alumina, and improvements in the construction of dynamos, and the application of steam, above all water power. For the metal itself there is unquestionably a very great future, and of that the specimens on the table before you tell you more eloquently and more clearly than I can hope to do. Let me again call your attention to the comparison of aluminium with our most familiar metals, and ask each one to note clearly the figures given, which show the result of tests of the average metals and do not include exceptional or highest figures that are only occasionally obtained in the testing room.

INFLUENCE OF TEMPERATURE ON TENSILE STRENGTH OF ALUMINIUM (LE CHATELIER.)

Temperature.	15°	100°	150°	200°	250°
Tensile strength in tons per sq. in...	11.68	9.5	8.1	6.3	4.8

Temperature.	300°	350°	400	460°
Tensile strength in tons per sq. in...	3.6	2.4	1.5	1.0

Here are the results of a number of tests made at Lockport on bars cast in green sand:—

Diameter.	Tensile Strength.		Elongation.
	Lb. per Sq. In.	Tons per Sq. In.	
0.327	17,444	7.78	14
0.324	18,483	8.25	23
0.320	19,577	8.73	20
0.311	20,030	8.95	20
0.318	20,144	8.99	19
0.320	19,577	8.73	18

From these figures you see that the metal in castings is about equal in strength to cast iron. When, however, the metal is rolled or drawn we get a tensile strength of 25,000 to 35,000 lb. per square inch (11—15 tons), approximating to gun bronze. The following figures are given by the Neuhausen Company showing detailed test of a metal before and after annealing:—

TENSILE STRENGTH OF ROLLED ALUMINIUM (NEUHAUSEN).

Reduction of Cross Section by Cold Rolling and Forging.	Unannealed.		Annealed.	
	Tons per Sq. Inch.	Elongation per Cent. per d.m.	Tons per Sq. Inch.	Elongation per Cent. per d.m.
20:1	Lb. 14.7 (32,928)	4.3	Lb. 6.25 (14,000)	20
80:1	16.87 (37,788)	4.2	5.06 (11,334)	19

These figures show fairly the mechanical value of aluminium, and I must again repeat what I have stated over and over again in my former papers that aluminium can never possibly take the place of steel and iron for structural purposes, such as bridges and heavy machinery; it is not a rigid metal, and its elasticity is low, though it is only one-third the weight of iron it has less than one-half the tensile strength of the best wrought iron, and one-third that of mild steel. But it is the lightest of all industrial metals, and this lightness is combined with a tensile strength not far below gun-metal when it is rolled or

drawn, and equal to cast iron in castings. It is an excellent conductor of electricity, its melting point, 700° C., is between that of zinc, 433° C., and copper, 1082, its high specific heat making it most valuable of all metals for fine castings and light machine work, and with this corrosion resistance only inferior to the noble metals. Aluminium, surely, with these properties, needs no special pleading.

Aluminium Corrosion Experiments.

In air at all ordinary temperatures polished aluminium undergoes less superficial change than any metal excepting gold and platinum, a film of oxide is formed of infinite thinness which appears to prevent all further oxidation, the molten metal in the crucible retains its lustre until the temperature passes a red heat, and only at whiteness does much loss from oxidation occur, the affinity for oxygen increasing rapidly after bright redness is passed. This freedom from marked oxidation in its molten state compares very favourably with the loss undergone during the casting and alloying of the readily oxidisable ordinary metals, there being no scale formed and so practically little finishing needed in case of aluminium castings. This you will see by some specimens of castings taken directly from the sand.

At ordinary temperature water has no action on aluminium, and as it is unaltered even by steam, would be useful for many purposes in the laboratory, and should replace entirely water bottles of copper and all fittings at present made of other and corrodible metals employed for water supply and service, combining the strength of copper with the appearance of silver and adding to these its peculiar value of lightness. Care must be taken, however, that it is not in contact with other metals, as in that case a galvanic couple might be formed and so oxidation and corrosion take place, though the extent of this is much less than the loss of copper or iron under similar conditions. For this reason, also, it is essential that the metal should be as free from foreign elements as possible, as I shall point out later on the presence of even small amounts of impurity influences the corrosion resistance of aluminium to an extraordinary extent. Water containing salt has a corrosive action on aluminium, but less than in case of iron or copper even when the metal is repeatedly wetted and allowed to dry in the air.

A plate of cast aluminium (99 per cent.)* 7 cm. long by 4 cm. wide and 0.15 cm. thick, was suspended in a saturated solution of sodium chloride and kept at a temperature of 60° C. during 48 hours. At the end of the time it was found to be spotted in places, small patches of alumina about the size of pin heads having formed on the metal. The plate being removed from the solution, washed in distilled water, gently brushed with a piece of soft rubber to detach these small flocks, was carefully dried and reweighed, showing a loss of 0.052 per cent.

A similar plate of metal† (Al 97.10 per cent., Fe 0.44 per cent., Si 2.46 per cent.) containing 3 per cent. impurity (iron and silicon) showed larger patches of alumina with small growths of flocculent hydrate covering tiny corrosive pits, the loss was 0.0078 per cent., the difference shows the manner in which the value of this and other metals may be affected by the presence of even very small quantities of other elements. An experiment carried out at Neuhausen to determine the relative value of aluminium and iron with reference to the action of sea-water gave favourable results. A sheet of this metal (24.578 grms.) of 1 d/m² exposed surface was laid in artificial sea-water (in 1,000 parts —

* Al	99.154
Fe	0.786
Si	0.060
	<u>100.000</u>

† Al	97.10
Fe	0.44
Si	2.46
	<u>100.00</u>

27 NaCl + 3.2 MgCl₂ + 2.2 MgSO₄ in contact with an iron plate during 200 hours. At the end of this period it had lost 9 mgrms. or 0.04 per cent., whilst the iron plate of the same surface lost 54 mgrms. Another sheet of same surface 1 d.m² (24.821 grms.) being in contact with air at a t° of 80°—90° in this artificial sea-water, not in contact with iron, during 18 hours only lost 3.5 mgrms. or 0.014 per cent.

Aluminium is of course readily acted upon by hydrochloric acid at all temperatures with the evolution of hydrogen. Small strips and granules of this metal will be found useful in the laboratory for reducing purposes, and has the advantage over zinc that it is not precipitated by sulphuretted hydrogen even if a large excess of this gas be used. Nitric acid has no action on this metal unless exposed above ordinary temperature or for many hours to the concentrated acid. A sheet of pure metal 1 d.m² surface (24—25 grms.) laid in cold concentrated nitric acid (36° B.) showed a loss of 0.6628 grm. on the seventh day and 1.0195 grms. in a fortnight. (Neubausen laboratory.)

The action of sulphuric acid is very slight at ordinary temperature though it dissolves the metal with evolution of SO₂ on heating.

To determine this point I exposed a plate of cast metal (99 per cent.) 7 cm. × 4 cm. × 0.15 cm. to the action of cold concentrated H₂SO₄ during a period of 131 days. At the end of this time the loss amounted to 4.970 per cent.; the surface of the metal showed a fine white matt. The action of dilute acid would, of course, be very much less, and with regard to its use in this connexion superior to copper, though not equal to lead. The presence of impurity in small quantity has a marked influence on its resistance to this acid. With a plate of 97—8 per cent., the crystalline etching much coarser, the metal was also covered with tiny pits, probably due to minute particles of silicon or ferrosilicon compounds, as a distinct trace of H₂S was evident, both by scent and action on lead paper; the loss was 4.49 per cent. And here I will just interpolate a note of a curious result I obtained on exposing a turned and polished bar of 10 per cent. aluminium bronze to the action of cold concentrated H₂SO₄. This bar was uniform in colour and lustre, but after two days' exposure I noted a dark coloured corrosion band running in a half spiral round the bar. On removing from the acid, there was a strong odour of H₂S, and lead paper was at once blackened if held close to this patch, the rest of bar being only slightly dulled and perhaps a little reddened in colour, and active corrosion seemed to be confined to this one spot. The exceedingly minute quantity of iron and silicon that had set up this reaction (probably galvanic) was indicated by the analysis and the fact that the result of the mechanical test of the bar was normal. The action of even strongest acetic acid on aluminium is slight, a plate of cast metal (99 per cent.) surface, as in my former experiments, was suspended in concentrated pure acid at ordinary temperature during 131 days, the loss was 0.24 per cent. only, and with a plate of (97—98 per cent.) metal during the same period was only 0.013 per cent. Possibly in this case the presence of silicon hindered corrosion.

An experiment with saturated solution of citric acid during 19 hours at 50°—60° C. showed a loss of 0.095 per cent. with (99 per cent. metal). The experiments tend to show the very slight action dilute organic acids would have upon aluminium, and are confirmed by some results obtained in the Neubausen laboratory, in which the metal was exposed to cold solutions of ordinary vinegar 4 per cent. (acetic acid), and citric acid (1 per cent. solution) containing salt for two days without evidence of loss, and a sheet of 1 dm² surface (weighing 24.72 grms.), after boiling for 14 hours in a solution of common salt with 4 per cent. acetic acid, lost only 47 mgrms., or about 0.29 per cent. Under the same conditions a piece of iron lost 900 mgrms. Alkalis and alkaline carbonates act readily on the metal; it dissolves easily in solution of caustic potash and soda with evolution of hydrogen forming aluminates; ammonia solution acts more slowly, but corrosion takes place after

a little time, a flocculent growth of alumina forming on the surface of the metal. Pure dry ammonia gas seems to have no action on it.

In solutions of the alkaline carbonates the metal becomes coated with a compact skin of alumina, but in this case the presence of impurities modifies this action to a considerable extent. A test plate of cast metal (99 per cent.) was suspended in a solution of 10 per cent. carbonate of sodium for 24 hours at 45°—50° C. On examining it I found it covered with a fine strongly adherent skin of alumina, which dried to a smooth enamel-like surface. On (97—98 per cent. metal) this deposit was thicker, coarser in texture, and corrosion of the metal was more clearly marked. On suspending similar plates in saturated solutions of Na₂S at same temperature the influence of even a small percentage of impurity in modifying corrosive action was still more strikingly shown. The (aluminium 99 per cent.) metal was much corroded (loss about 3.0 per cent.) and had black stains of FeS. The (97—98 per cent.) metal was corroded, deeply honeycombed, and covered with a thick black crust containing FeS, SiO₂, and alumina. The action of metallic solutions on the metal is, of course, correspondent to that of the combining acids. All chlorides, including aluminium chloride (which dissolves the metal liberating hydrogen), act readily on aluminium, the more negative metals being liberated; the presence of sodium chloride is said to facilitate the reaction. The chlorides of the alkalis and alkaline earths are, however, an exception, their action on aluminium being only slow unless in concentrated solution and at higher temperatures. Bromides and iodides have effects in proportion to their chemical activity. Nitrates and sulphates act only very slowly on aluminium. Organic salts have only very slight or no action on this metal, and in case of acid solutions may be disregarded unless in presence of common salt, which would increase the corroding power. The action of fused caustic soda or potash at a low red heat is exceedingly slight, care being taken that the aluminium is free from silicon. It is not affected by molten nitrate of potassium until redness is reached, when energetic oxidation ensues, forming aluminate. With the alkaline carbonates and sulphates the metal is oxidised, forming aluminates with evolution of CO and some separation of carbon. With silicates and borates the metalloids is liberated on aluminate being formed with the base. Molten fluorides dissolve the metal forming in case of cryolite a sub-fluoride. No flux is needed in melting aluminium, and this must be done in black crucibles or crucibles lined with alumina. Many failures to obtain good work with this metal has doubtless arisen from not bearing in mind the importance of this point, that to the founder and metal worker aluminium is a new metal and requires new methods adapted to the physical and chemical properties will differentiate it widely from the old metals. It is a metal which must be handled by skilled and intelligent workers, and will give to them the results of which we have the first promises in the specimen before you. I have gone into this question of corrosion at length because it, more than any other, will determine the limits of the use of aluminium, and the results given to you will have already suggested to your minds my possible uses for this metal. For instance, it will replace copper and brass for kitchen utensils, not only because it resists corrosion, but that in the event of any taking place the salts formed are non-poisonous. An aluminium saucepan would, while possessing the same strength, be three and a half times lighter. Vessels of aluminium would retain their heat for a longer time, an advantage in case of workmen's dinner cans for example. The slow cooling of aluminium is very marked in the case of metal in the crucible, 40—60 lb. heated to dark redness, may be left half to three-quarters of an hour without fear of its settling. Aluminium offers many advantages, and has a nicer look than tin ware, whilst stiffer, lighter, and harder. Dishes, plates, covers, and all articles now made of tinned iron might be replaced by this metal. It would also replace many vessels used in the laboratory at present made of copper or galvanized iron. Flasks and water bottles of all kinds, more especially for military service, would be advantageously made of aluminium, as they would not only be unbreakable but be lighter than the glass and

† The actual corrosion loss was 0.1375 per cent. in 94 hours at ordinary temperature.

enamelled iron at present in use. Its indifference to organic acids would suggest its use for brewers and vintners. You will notice among the specimens a cast beer tap lent by the Cowles Company.

Again, cups and flasks could, if preferred, be made of aluminium and silvered, though the metal itself has a good appearance and will not tarnish as silver does. For scientific instruments of all kinds, especially frames and tubes of surveying and astronomical apparatus, for chemical balances, and all metal work exposed to no strain above the limits of its tensile strength, aluminium, by virtue of its lightness, would be invaluable. Scales for measuring, and indicator scales of this metal would not warp or crack as do those of ivory or wood if exposed to a damp atmosphere. That aluminium can be worked with the same facility as any other metal will be evident to those who inspect the set of tubes lent by the Mannesman Tube Company. For gas and light fittings aluminium would be valuable, enabling the weight of chandeliers, candelabra, and lamps to be reduced one-third, whilst having the appearance of silver. I have not gone into the mechanical value of this metal at length, because my duty as a metallurgist is to place the metal before you with all its physical and chemical properties, and leave the application of it to the engineer and craftsman. I have not touched upon the value of this metal in alloys, because to do so would involve not one, but two or three papers; and further I have already dealt with their production and properties in my British Association paper of 1889, reprinted in your Journal, No. 9, Vol. VIII. 1889,

and in a paper dealing with their mechanical properties as a material for artillery, read before the Mechanical Section of the British Association, 1890. At some future time of greater freedom and lesser responsibility I hope to bring before your notice some additional notes on the chemistry and metallurgy of this most valuable metal. In conclusion I would express my thanks to the directors of the Cowles Company, to the Aluminium Industry Company, the Metal Reduction Company, and to the Mannesmann Tube Company, for their valuable and beautiful specimens, and also for much valuable information as to the working and properties of the metal.

The production of aluminium is given in the Chemical Trades Journal for January 23rd, quoted from the Bulletin de Musée Commercial.

	Lib. per day.
The Neuhausen Works.....	1,000
The Pittsburgh Reduction Co.....	600
The Metal Reduction Syndicate, Lim..	300
The Cowles Co.	600—700 in alloys
and the present production of the world 2,600 lb. per day.	

However, I know the figures for the Cowles Co. are altogether too low, unless they refer, as they do truly, to the English works alone, for that company's Lockport works have a constant output of 1 ton per day; this latter figure, too, would doubtless be much nearer for the Neuhausen Co.

The following figures as to the effect of temperature on the tensile strength of aluminium are given by André le Chatelier:—

Temperature.	15°	100°	150°	200°	250°	300°	350°	400°	450°
TS in tons per sq. in.	11.68	9.5	8.1	6.3	4.8	3.6	2.4	1.5	1.0

NEUHAUSEN EXPERIMENTS.—CORROSION RESISTANCE OF ALUMINIUM CAST AND ROLLED PLATES.

Weight of Metal.	Purity.	Surface exposed.	Solution.	Temperature.	Time.	Loss.	Notes.
Grms.	Per Cent.	1 d m ²		° C		Per Cent.	
24.575	99	"	Sea water	..	200 hours	0.040	.. ..
24.82	99	"	"	80—90	18 hours	0.014	.. ..
..	99	"	Nitric acid of 34° B. cold concentrated.	..	7 days	6628 grms.	Weight of metal not given (21—25 grms.?)
..	99	"	"	..	14 days	1.0195 grms.	.. ..
24.726	99	"	Common salt with 4 per cent. acetic acid.	Boiling	14 hours	0.29	.. ..
..	99	"	4 per cent. acetic acid	Cold	2 days	..	No action.
..	99	"	1 per cent. citric acid	..	"	..	No action.

MILTON EXPERIMENTS.—CORROSION RESISTANCE OF ALUMINIUM CAST PLATES.

..	99	59.3 c m ²	Saturated NaCl solution.	60	48 hours	0.052	Small pin-head patches of alumina in places.
..	97.5	"	"	60	"	0.0078	Large patches of alumina with flocculent hydrate covering tiny pits in metal.
..	99	"	Cold concentrated pure H ₂ SO ₄	Ordinary temperature	131 days	4.970	Fine crystalline matted surface.
..	97.5	"	"	"	"	4.49	Much pitted and crystalline with matt coarse and dark coloured. H ₂ S evolved by corrosion pits.
..	99	"	Pure acetic acid	"	"	0.24	.. ..
..	97.5	"	"	"	"	0.013	.. ..
..	99	"	Saturated citric acid	50—60	19 hours	0.095	.. ..
..	99	"	10 per cent. Na ₂ CO ₃	45—50	24 hours	..	Smooth adherent coating of alumina, slight corrosion.
..	97.5	"	"	45—50	"	..	Thick coarse deposit flocks of alumina suspended in solution and marked corrosion.
..	99	"	Saturated Na ₂ S solution.	45—50	"	3.0 approx.	Deep corrosion and black stains, but no deposit on plate.
..	97.5	"	"	45—50	"	..	Deeply honeycombed and thick black crust of FeS, SiO ₂ and alumina.

SPECIMENS TO ILLUSTRATE PAPER ON ALUMINIUM, ITS MANUFACTURE AND INDUSTRIAL VALUE.

Lent by the Aluminium Industry Co., Lim., Neuhausen, Switzerland (Leisler Bock and Co., Glasgow).

- 2 ingots pure aluminium (99 per cent.).
- 5 „ aluminium bronze.
- 1 „ ferro-aluminium (10 per cent. Al).
- 1 piece aluminium tube.
- 1 „ „ sheet.
- 1 fireman's helmet.
- 1 water bottle.
- 1 folding drinking cup.
- 1 fan.
- 1 photograph frame.
- 1 ash tray.
- 2 stamped plates.
- 4 spools aluminium wire.
- 3 medals of the Queen, the Prince of Wales, and the German Emperor.

Lent by the Mannsmann Tube Co., Lim., Landore, South Wales.

- 25 double pencil cases.
- 25 single „
- 6 Couplings „
- 1 tube 4 mm. ex diameter.
- 1 „ 5 mm. „
- 1 „ 26 mm. × 24 mm. × 3080 mm.
- 1 „ „ „ 1675 mm.
- 1 „ 15 mm. × 12 mm. × 255 mm.
- 1 „ 16 mm. × 12 mm. × 255 mm.
- 2 „ 14 mm. × 10 mm. × 255 mm.
- 2 „ 13 mm. × 10 mm. × 255 mm.

Lent by The Metal Reduction Syndicate, Lim., Patricroft.

- 2 painted plaques.
- 2 „ panels.
- 1 plain panel.
- 1 „ plaque.
- 3 sand castings.
- 4 tubes.
- Pieces of aluminium wire.
- „ „ bronze wire.

Lent by The Cowles Syndicate Co., Lim., Milton, Stoke-on-Trent.

- Beer tap of aluminium (cast in sand and finished).
- Two forged bolts and nuts of aluminium bronze.
- Teaspoons of pure aluminium.
- „ „ „ after 9 months use.
- 2 books lettered with aluminium leaf.
- Small cross cast in open sand showing sharp clear casting.

DISCUSSION.

MR. TATE, in opening the discussion, asked what was the cost of aluminium.

MR. THOMPSON wished to know whether Mr. Dagger knew anything of the statement circulated in the electrical papers that works had been started in New Jersey for making aluminium on the sodium process, with cryolite-producing sodium at 7 cents per lb. Regarding the electrical conductivity of aluminium, he had always understood that it was almost equal to that of copper. He was anxious to learn whether the tubes exhibited were pressed out or drawn from the solid. Concerning cost, he had received a quotation from a firm who asked 4s. a lb. for large quantities.

MR. CAREY was glad that the Chairman and others had drawn attention to the subject of cost; he hoped to hear something on this head. One question he wished to ask, that was, if, as Mr. Dagger had stated, saline and alkaline

solutions acted upon aluminium, how far would the slightly alkaline and saline liquids met with in ordinary cooking operations injure utensils made of aluminium.

DR. KOHN asked whether the oxyfluoride of aluminium employed in the Minet process, as described by Mr. Dagger, was a natural product or only a mixture of aluminium fluoride and alumina.

MR. DAGGER, replying to the question as to the chemical method of the production of aluminium, said probably the works in New Jersey were using the double fluoride, but he had no knowledge of such a company. In his last paper, however, he described the last and most approved chemical methods of production. The Cowles Syndicate Company produced one ton per day of aluminium, ranging from 97—99 per cent. purity. The tubes, he understood, were run out from the cold metal. Touching Dr. Kohn's question concerning the use of oxyfluoride in the Minet process, he remarked that the oxyfluoride was really an artificial product, not a definite compound, but simply alumina dissolved in cryolite. The price of the metal varied, ranging from 4s. to 3s. 4d. or 3s. 2d. per lb., depending upon the purity of the metal. There had been a reduction of 1s. per lb. since he read his last paper, when he quoted 5s. The figures, 32 grms. aluminium per 1 horse-power hour, with E.M.F. of 4 volts, which he gave, were taken from Mr. Minet's paper, which he had read over carefully. Mr. Minet wrote a great deal on the results not put into operation other than on an experimental scale. The other figures, 22 E.H.P. per lb. aluminium, were the amount common to the electrical methods now in operation.

The practical difficulties arising from chloride of calcium meant in using chloride there was a greater tendency for decomposition to take place, and chloride to give off chlorine, a great nuisance in the furnace room, whereas in cases of the fluorides which had a higher fusion point, no decomposition of the bath took place so long as ordinary care was taken, but if salt be added, then decomposition of the electrolyte was more likely to take place, and very much more careful management was required. The product given off in the ordinary process was CO, not CO₂. The loss of carbon was practically 1 lb. of carbon for every pound of aluminium. The cost of current amounted to something like 75 per cent. of the cost of production. Hall gives the following theoretical cost per pound:—Alumina, 3d.; carbon electrodes, 1d.; chemicals and pots, ½d.; 22 E.H.P. water power used, 2½d.; labour and superintendence, 1½d.; general expenses and repairs, 1½d. The difficulty of soldering aluminium still remained with them, and he had heard nothing since he gave the mixtures used for soldering purposes in his last paper, though he believed that results which were said to be successful had been obtained by using fused potash as a flux. As to the sources of aluminium, for the present, production was steady and there was more than sufficient, but should there be a large demand for the metal in the future, it would tend to stimulate chemists to produce aluminium by taking rich clays, treating them with acids, and getting out alumina that way.

MR. CAREY had spoken about its use for cooking vessels; he had given him figures as to the corrosion by salt. In his experiment he had used concentrated solutions, and they would see that the loss at 60° C. during 48 hours in 98 per cent. metal was found to be 0.0078 per cent., while in the case of a pure metal it was 0.052 per cent., while the experiments of the Neuhausen Company showed only 0.29 per cent. after boiling for 14 hours, and those conditions would not be reached in ordinary cooking.

Manchester Section.

Chairman: Ivan Levinstein.

Vice-Chairman: Edw. Schunck.

Committee:

J. Angell.
G. H. Bailey.
R. F. Carpenter.
G. E. Davis.
H. Grimshaw.
Harold B. Dixon.

J. Grossmann.
P. Hart.
A. Liebmann.
Sir H. E. Roscoe, M.P.
C. Truby.
D. Watson.

Hon. Local Secretary:

J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Friday, February 5th, 1892.

MR. IVAN LEVINSTEIN IN THE CHAIR.

NOTE ON THE AMOUNTS OF TANNIC ACID ABSORBED BY COTTON UNDER VARYING CONDITIONS.

BY EDMUND KNECHT PH.D., F.I.C., AND JAMES KERSHAW, MANCHESTER TECHNICAL SCHOOL.

THE natural affinity which gallotannic acid and the other tannins possess for the cotton fibre, coupled with their property of forming insoluble compounds with metallic oxides and the basic coal-tar colours, renders these materials of great importance in the dyeing and printing of cotton.

For the application of the tannins in cotton-dyeing, two methods are principally employed, viz., by *steeping* (chiefly used for loose cotton and yarn) and by *padding* (chiefly used for piece-goods). It was namely for the elucidation of certain points in connexion with the first of these methods that we undertook the present work.

It is well known that cotton steeped in a tannin solution absorbs some of the tannin, and practical experience has shown that the amount absorbed depends upon the temperature and degree of concentration of the bath and upon other conditions of working. It is also known that the tannic acid absorbed can be completely removed by long-continued washing with cold water, more rapidly by boiling water. The only exact work which has, to our knowledge, been published on this subject is that of Juste Koechlin.*

This authority finds that cotton mordanted in a solution containing 50 grms. per litre loses all its tannin in pure water, but loses nothing in a solution containing 5 grms. per litre. It only begins to lose tannin in a solution containing 2 grms. per litre. From acetic acid and alcoholic solutions the tannin is not taken up as well as from aqueous solution.

All Koechlin's estimations appear to have been done colorimetrically, viz., by the depth of shade produced by developing the tanned cotton in a solution of acetate of iron.

That it is impossible to completely exhaust a tannin bath, is well known, but hitherto it does not appear to have sufficiently interested anyone to know how much tannin is actually absorbed by the fibre under given conditions, to make it worth while carrying out exact quantitative determinations. Since the introduction of the Lowenthal process of estimating tannin, this is rendered possible and it has been our principal aim to determine by exact methods

the actual amount of gallotannic acid absorbed by cotton under varying conditions of temperature, time, concentration of water bath, &c.

The cotton used for the experiments was a bleached two-fold 20-s. yarn. Boiled in distilled water it gave up nothing that would decolorise permanganate.

The tannin employed was a pure pharmaceutical tannic acid containing, in terms of oxalic acid—

	Per Cent.
Tannic acid	128.28
Gallie acid	3.72

The strength of the permanganate solution was 1 grm. per litre, and this was standardised with ferrous ammonium sulphate.

In each case, the tannin absorbed has been estimated not directly, but by difference, an aliquot portion of the solution being withdrawn from the bath and titrated with permanganate. By thus ascertaining the total amount left in solution, we were able to determine by difference what had been withdrawn by the fibre. The results are expressed in terms of the tannic acid used. A quantitative determination showed that gallic acid has absolutely no affinity for cotton, so that under the heading, "Left in solution," the amounts stated express the tannic acid plus the whole of the gallic acid left from the 0.25 grm. tannin employed.

In the experiments, except where otherwise stated, we used 5 grms. of cotton, 5 per cent. of tannic acid, and 30 times the weight of water (of the weight of the cotton). The cotton was entered at 100° and was allowed to cool with occasional stirring during three hours.

I. Effect of Temperature.

1. The cotton was steeped cold for three hours.
2. The cotton was entered boiling and allowed to cool during three hours.
3. The cotton was steeped at 50° for three hours.
4. The cotton was steeped boiling for one hour.

Results.

—	Tannic Acid Taken.	Absorbed by Cotton.	Left in Solution.
	Grm.	Grm.	Grm.
1.	0.25	0.0393	0.2137
2.	0.25	0.0513	0.1987
3.	0.25	0.0082	0.2418
4.	0.25	0.0025	0.2475

From this it would appear that the method adopted in practice, viz., entering hot or boiling is the best condition of temperature.

II. Concentration.

Same conditions as above, but with varying amounts of water, viz. :—

1.	75 cc. water.
2.	150 cc. "
3.	300 cc. "
4.	450 cc. "

Results.

—	Tannic Acid Taken.	Absorbed by Cotton.	Left in Solution.
	Grm.	Grm.	Grm.
1.	0.25	0.0663	0.1837
2.	0.25	0.0513	0.1987
3.	0.2	0.0288	0.2212
4.	0.25	0.0238	0.2362

* Bull. Soc. ind. de Mulhouse T. I.I. p. 438.

III. *Additions to Bath.*

Same conditions as stated at first.

Results.

—	Tannic Acid Taken.	Absorbed by Cotton.	Left in Solution.	Addition.
1.	Grm. 0.25	Grm. 0.0498	Grm. 0.2002	Per Cent. 10 Na ₂ SO ₄
2.	0.25	0.0363	0.2137	50 „
3.	0.25	0.0250	0.2250	100 „
4.	0.25	0.0363	0.2137	5 H ₂ SO ₄
5.	0.25	0.0288	0.2212	10 „
6.	0.25	0.0213	0.2287	20 „

The effect of sodium carbonate was also tried, but it was found that on adding 5 per cent. Na₂CO₃ to the tannin solution, boiling and allowing to cool during three hours (without any cotton), the amount of permanganate required increased 17 per cent. on the original amount required for the pure tannic acid. An estimation by difference was therefore impossible.

IV. *Time.*

The original conditions were again adhered to, but the time was altered.

Results.

Tannic Acid Taken.	Absorbed by Cotton.	Left in Solution.	Time.
Grm. 0.25	Grm. 0.0128	Grm. 0.2372	30 min.
0.25	0.0168	0.2332	1 hr.
0.25	0.0190	0.2010	2 hrs.
0.25	0.0572	0.1928	4 hrs.
0.25	0.0609	0.1891	6 hrs.

The tannin is still being absorbed after six hours' immersion, and although the absorption is not in a direct ratio to the time of immersion, it is probable that the limit has not been reached in six hours.

V. *Consecutive Baths.*

1. 5 grms. cotton were entered boiling and allowed to cool during 1½ hours.

2. Same as No. 1. Wring out well, then enter a second 5 grms. at 100° and allow to cool again during 1½ hours.

3. Same as No. 2, with a third lot of cotton.

Results.

Tannin used.	Absorbed by 1st 5 Grms.	Absorbed by 2nd 5 Grms.	Absorbed by 3rd 5 Grms.	Left in Solution.
Grm. 0.25	Grm. 0.0355	Grm. ..	Grm. ..	Grm. 0.2145
0.25	0.0355	0.0195	..	0.1950
0.25	0.0355	0.0195	0.0103	0.1847

VI. *Washing Out.*

Enter boiling and allow to cool over night.

Absorbed by Cotton.	Left in Solution.
Grm. 0.0612	Grm. 0.1888

1. Steep in cold water (150 cc.) for one hour.
2. Steep in cold water (150 cc.) for three hours.
3. Steep in boiling water for one hour.
4. Enter into a solution of 10 per cent. tannic acid at boil and allow to cool during three hours.
5. As No. 4, using 2½ per cent. tannic acid,

Results.

—	Left in Fibre.	Tannin extracted.
	Grm.	Grm.
1.	0.0467	0.0147
2.	0.0393	0.0221
3.	None.	0.0612
4.	0.0195 + the 0.0612 absorbed	0.4802
5.	0.0007 lost.	0.1243

VII. *Bleached, Unbleached, and Mercerised Cotton.*

Same conditions as above.

Tannic Acid taken.	Absorbed.	Left in Solution.
Grm. 0.25	Grm. 0.0513	Grm. 0.1987 bleached.
0.25	0.0568	0.1932 unbleached.
0.25	0.1033	0.1467 mercerised.

The unbleached cotton was boiled previously for a short time with soap, to remove waxy and other impurities.

Precipitated Cellulose, obtained by dissolving filter-paper in Schweitzer's reagent, precipitating with hydrochloric acid, and washing thoroughly with water, is capable of absorbing under similar conditions a much larger proportion of tannin than cotton yarn. Using 5 grms. of such cellulose, 150 cc. water, entering at 100° C., and allowing to cool during three hours, we obtained the following results:—

Tannic Acid taken.	Absorbed.	Left in Solution.
Grm. 0.25	Grm. 0.1525	Grm. 0.0975

This is no doubt partly due to the fine state of division of the cellulose.

Generally speaking, our results confirm quantitatively what has been known for a long time qualitatively. It is interesting to note what a small proportion of the tannic acid employed is taken up by the cotton under the most favourable conditions. If this circumstance is taken into account, a great saving might frequently be effected, in our opinion, in the application of tannin in cotton dyeing.

NOTE ON THE ACTION OF CHLORINE ON WOOL.

EDMUND KNECHT, PH.D., F.I.C., AND E. E. MILNES,
MANCHESTER TECHNICAL SCHOOL.

THE chlorinating of wool with the object of rendering it better able to take up certain colouring matters in printing, appears to have been first suggested and carried out by Mercer. Since that time the chlorinating of all-wool and cotton warp delaines for printing has become a general practice among printers.

During the latter part of last session we had begun an investigation regarding the chemical changes which take place in this interesting operation, but owing to Mr. Milnes having accepted another appointment our work has been interrupted, and as we shall probably not be able to take it up again conjointly we wish to give in the following a short résumé of the results obtained.

Our original object was to determine whether the chlorine acted by substitution, addition, or oxidation, but unfortunately the work was prematurely interrupted. Nevertheless some points were brought to light which may be of some interest.

Action of Dry Chlorine.—Wool dried at 100° was treated for several hours in a current of dry chlorine gas. Very little change appeared to take place; a little hydrochloric acid gas was given off and the material (flannel) was not perceptibly injured. Its affinity for colouring matters is not increased.

Action of Moist Chlorine.—Wool in its natural state was treated for several hours in a current of moist chlorine. Large quantities of hydrochloric acid gas were evolved from the beginning and the edges of the flannel began to assume a gum-like, translucent appearance. Boiled afterwards in water the material lost over 60 per cent. in weight, a threadbare and tendered fabric being left behind. The aqueous solution evaporated to dryness left a brownish coloured deliquescent residue, which retains a large amount of (free?) hydrochloric acid. When heated this residue swells up and decomposes, evolving a smell of burning horn. It does not blacken alkaline lead solution, but is found to contain sulphur by the nitroprusside reaction. Its most characteristic property is that which it possesses of precipitating in aqueous solution the substantive colouring matters, as one of us found to be the case with lanuginic acid. It may be that this fact may account in some way for the increased affinity which chlorinated wool possesses for such colouring matters.

Flannel (11·13 grm.) treated for one hour with 5 per cent. bleaching powder and excess of hydrochloric acid was washed first in distilled water, then warmed for a short time with very dilute ammonia (to neutralise free acid), and then extracted repeatedly with boiling distilled water until the water showed no opalescence with silver nitrate. The wool was then dissolved in caustic soda, the solution acidulated with nitric acid, excess of sodium carbonate added, evaporated to dryness, calcined in a platinum dish, and the residue tested for chlorine. It was found to be entirely free from chlorine. This fact, coupled with the copious evolution of hydrochloric acid in presence of moisture that modification of sulphur which blackens with alkaline lead solution is not destroyed by the ordinary chlorination, and only disappears when the fibre is deeply attacked.

Another noteworthy fact is that the chlorinated wool, even after drying and exposing to the air for several hours or over night, is coloured brown when moistened with potassium iodide solution. Whether this property is due to the presence of free chlorine in the fibre or to the formation of quinone-like substances, we have not yet been able to determine. It is removed by prolonged treatment with sulphurous acid or bisulphite of soda.

In most textbooks and manuals on dyeing we find the statement that wool is deeply attacked and turned yellow by chlorine or hypochlorites. We find that dry chlorine has very little effect in discolouring wool. Neither has it this property in solution if a large excess of free hydrochloric acid be present. Free hypochlorous acid, however,

rapidly turns the wool brownish-yellow. Possibly this may account for the yellowing of pieces which sometimes takes place in working on the large scale.

Bromine acts on wool in a similar way to chlorine.

The soluble product above referred to does not appear to be formed by the action of permanganate on wool.

DISCUSSION.

THE CHAIRMAN: The results of Dr. Knecht's experiments were of the greatest importance, inasmuch as dyers have not time to make the necessary examinations, and the practical results were principally these:—They knew that immense quantities of tannic acid were used in dyeing, partly for the fixation of metallic mordant and partly for the fixation of the basic coal-tar colours, and it was evident that in this process there must be an immense waste. If dyers and printers really studied these results it would lead to considerable saving.

MR. GRIMSHAW said, speaking generally, he thought the papers were bound to be of great assistance to manufacturers in helping them to reduce what he might call the qualitative to the quantitative action, and he believed that these were the lines on which economy would be promoted in all chemical industries Dr. Knecht had mentioned. Mercier, who was a striking example of one who without adopting scientific knowledge arrived at a wonderful amount of practical results, and it was indeed strange that his name was so little known.

DR. WEBER: Dr. Knecht had told them that wool, under certain circumstances, produced lanuginic acid, which was one of the amido-acids. Would it not be probable that so strong an oxidising agent would attack this amido-acid, and thereby cause them to form a sort of condensation product of the oxidation product of lanuginic acid and the rest of the chloranil.

MR. J. CARTER BELL wished to know if Dr. Knecht had tried chlorination of the wool after it had been bleached, because it always contains a percentage of fatty matter?

DR. KNECHT replied that he had experimented with bleached flannel.

DR. KNOWLES, F.C.S., would like to suggest that Dr. Knecht should continue his researches. Delaine printing was an industry little known in this country as yet, and there was a great amount of difficulty in the proper application of colouring-matters. His mention of the application of induline to wool which was not chlorinated has a parallel in the application of naphthol black to woollen fibre. They would find that wool which is merely scoured and bleached is not capable of being printed on, whereas if chlorinated it is capable of being printed on by naphthol black, which black when properly applied is extremely fast.

LABORATORY NOTES.

BY W. F. LOWE, F.I.C., F.C.S., ASSOC.R.S.M.

(a) THE GRAVIMETRIC ESTIMATION OF ZINC AS SULPHIDE.

THE usual method of estimating zinc in blende and other ores of zinc is by a standard solution of sodic sulphide with a small quantity of ferric hydrate added to the solution as indicator, or better, with nickel chloride solution employed outside the solution as indicator; but as this method, even when most carefully carried out, does not yield results nearer than 0·5 per cent. (see Fresenius' Quantitative, vol. II., p. 281, and Mitchell's Manual of Assaying, p. 580) it cannot be considered a very satisfactory one, its only recommendation being that it is a fairly quick and sufficiently accurate for many purposes.

The great objection to it is that none of the indicators are sufficiently sharp; with ferric hydrate, for instance, the solution requires to be violently agitated during the whole of the titration and the white zinc sulphide merely turns to a dirty grey. Nickel chloride used on a white plate is somewhat sharper, but is by no means a really satisfactory indicator. The standard solution used is generally made of such a strength that 1 cc. = 0.01 grm., and for rich ore 0.5 grm. of ore is taken, a difference of 0.1 cc. is equal to 0.2 per cent. of zinc, so that a greater error than 0.5 per cent. can very easily be made.

There are also the volumetric methods of estimating zinc by means of a standard solution of potassic ferrocyanide, but these also are stated by Fresenius not to yield results nearer than 0.5 per cent.

There is also Mann's silver method, but in this the zinc is first precipitated and filtered as zinc sulphide; there is not much gained by it.

There is nothing specially novel in the method described, but it is one, I believe, that is very little used owing to the supposed difficulty of filtering zinc sulphide; but if the necessary precautions are taken very little difficulty will be found and exceedingly accurate results will be obtained. It certainly occupies more time, requiring two days, but when much greater accuracy can be obtained I do not think that a little more time and trouble should have much weight as an objection.

The sample having been first dried (samples from the mines being usually wet) is ground and the whole passed through a 60-mesh sieve, a small sample is then taken and finely ground in an agate mortar, and it is of great importance that it should be finely ground, for otherwise it will not readily dissolve in hydrochloric acid.

One grm. is taken, placed in a conical flask of about 300 cc. cap. 10 to 15 cc. of strong HCl added, the flask covered with a small funnel and boiled on an iron plate until dissolved. If the ore has been finely ground this will take place readily. Two or three drops of strong HNO₃ are then added to ensure the complete solution of the ore. This should not be added until the solution of the ore in the HCl is complete as otherwise a separation of sulphur will take place, and in such a case it is necessary to remove the sulphur, burn it and add any residue to the solution in the flask. For this reason it is not well to dissolve in a mixture of HNO₃ and HCl, as sulphur always seems to separate. In fact Fresenius recommends that the sulphur in blende should be estimated by deflagration with nitre and carbonate of soda instead of in the vat way.

As soon as all the nitrous fumes have passed off the solution is diluted to about 100 cc. with cold water, and a good stream of H₂S passed through until the precipitate turns black and settles readily. It is then filtered through a covered filter, and washed with water containing a little H₂S.

The solution is then heated in an uncovered beaker on the iron plate to a temperature just below boiling. As soon as the H₂S has passed off, some bromine water is added to peroxidise the iron, the solution cooled, and an excess of ammonia added. It is allowed to stand for a few minutes on the iron plate for the precipitate to settle, and is filtered through a large filter-paper. The precipitate is washed slightly, and is then redissolved in warm hydrochloric acid; it is reprecipitated with ammonia and filtered through the same paper, and is washed with hot water containing a little ammonia. It is very necessary to redissolve the precipitate (chiefly ferric hydrate) even though usually it is very small as it always carries down some zinc with it. The solution is made up with hot water to about 750 cc., and is heated in a conical flask nearly to boiling. Half a test-tube full (about 10 cc.) of freshly made colourless ammoniac sulphide (NH₄HS*) is added, and the solution boiled for two or three minutes and allowed to settle. The boiling converts the slimy precipitate into a granular one. The flask is then covered and left to stand all night, the clear portion is syphoned off to just above the precipitate, and this portion, although having only a slight opalescence, is filtered through

a double filter of good Swedish filter-paper, and it is important that the filter exactly fits the funnel, and is held down in its place whilst it is moistened before use. The filter-paper used has a diameter of 5½ in., and the ash of one of these weighs 0.0015 grm., so that the tare for the two is 0.003 grm. After the deanted portion has been filtered, the precipitate is washed once by decantation with hot water containing a little ammonia chloride and a few drops of ammoniac sulphide. It is then transferred with hot water containing a few drops of (NH₄)HS to the filter, the filter being kept covered with a ground glass plate. The whole of the precipitate is very readily removed from the flask as it does not stick to the glass. The precipitate is then dried and transferred to a Rose's crucible, the filter being burnt in a separate crucible and the ash added to the precipitate; a little pure sulphur is added, and it is then ignited in a current of coal-gas, at first gently, and then for about five minutes in a large Bunsen flame; it is then allowed to cool in the current of coal-gas, and weighed.

The following results are those obtained from ordinary samples of blende (dressed ore from the mines); I. and II. duplicates of the same sample—

I.			II.		
Zinc.		Difference.	Zinc.		Difference.
Per Cent.	Per Cent.		Per Cent.	Per Cent.	
57.55	57.68	0.1	60.67	60.59	0.08
61.79	62.01	0.22	56.42	56.55	0.13
57.28	57.40	0.12	58.39	58.39	Nil
61.88	61.32	0.56	59.17	59.43	0.26
56.62	56.65	0.03	59.48	59.7	0.22
57.19	57.53	0.34	57.83	58.06	0.23
58.73	58.57	0.16	60.4	60.06	0.34
60.31	60.57	0.26	53.79	53.84	0.05
58.46	58.55	0.09	61.38	61.53	0.15
54.94	54.88	0.06	60.67	60.77	0.1
59.00	59.04	0.04	52.5	52.47	0.03
57.8	57.63	0.17	58.43	58.63	0.2
59.76	59.64	0.12	44.09	44.26	0.17
57.74	57.71	0.03	57.19	57.05	0.14
58.36	58.39	0.03	57.42	57.72	0.3
57.96	58.13	0.17	54.71	54.68	0.03
60.41	60.21	0.2	60.14	60.14	Nil
53.94	54.17	0.23	59.27	59.28	0.01
57.5	57.36	0.14	56.8	56.93	0.13
55.72	55.52	0.2	58.43	58.7	0.27
55.84	55.84	Nil	58.7	58.73	0.03
59.96	60.16	0.2	59.94	59.91	0.03
60.77	60.91	0.14	59.4	59.6	0.2
57.93	58.03	0.1	57.58	57.68	0.1
53.81	53.74	0.07	59.01	59.03	0.02

The above table contains 100 ordinary results from 50 different samples of blende, of these results 2 differ by 0.56 per cent., 6 differ from 0.3 to 0.34 per cent, 24 differ from 0.2 to 0.27 per cent., and the remaining 68 differ by less than 0.2 per cent., and 36 out of these 68 differ by less than 0.1 per cent.

If the ores contain manganese the process requires to be modified; the zinc can be precipitated as sulphide in an acetic acid solution, or the manganese can first be removed by precipitation with bromine.

* This will keep for about a week in the dark, but soon turns yellow in the light, especially in direct sunlight.

That the precipitation of zinc as sulphide is more accurate than the precipitation as carbonate is obvious by the fact that if to the filtrate from the carbonate a few drops of ammoniac sulphide are added, a few flakes of zinc sulphide will separate on standing a few hours, and Fresenius states that with proper precautions a solution containing only $\frac{1}{800,000}$ of zinc may be precipitated by ammoniac sulphide. An important objection to the precipitation of the zinc as carbonate is that these ores always contain lime, so that the sulphide must be carefully washed before it can be redissolved and precipitated as carbonate.

(b.) PRESENCE OF LEAD IN AMMONIA SOLUTION.

In preparing ammoniac sulphide I have found that it is not unusual for so-called pure ammonia to become brownish or black in colour on passing H_2S through it. This is due to traces of lead, and it is advisable to examine every fresh bottle before employing it. It is easy to obtain ammonia that is pure, but there is certainly a good deal sold that contains this impurity, and it is one that may very easily be overlooked. I have been informed that it is due to the dilution of the solution in leaden vessels, when first prepared, to the requisite specific gravity.

(c.) ASSAY OF GALENA IN IRON CRUCIBLES.

The most satisfactory method for the assay of galena is undoubtedly that in which the assay is made in wrought-iron crucibles. The usual method is to charge the assay from a scoop into the red-hot crucible, removed from the furnace for the purpose. It is then heated for about 15 minutes, the sides of the crucible scraped down with an iron rod, and the heat continued a little more strongly for five minutes. This is the method recommended by Phillips, and is identical with the one taught at the Royal School of Mines.

Makin states that the assay should only be in the furnace for about 10 minutes, but I find from a large number of assays made in different ways that the best results are obtained if the fusion is completed in about five minutes, the furnace being kept a little hotter than is usual. The assay should be watched, and as soon as it has run down and is tranquil, it should be taken out and poured, and as usual the pot tapped on the top of the furnace, and any shots poured into another mould. In this way I have had excellent results in as short a time as three minutes.

From well-dressed ores the material yields from 83 to 83.7 per cent of lead; by the longer method, the same samples will only yield about 82.5 per cent. These assays were from samples representing from 50 to 200 tons of ore, and not from small samples of pure galena.

(d.) USE OF THE ASSAY TON.

Having had some time ago to make a large number of assays of gold quartz, many which contained very small quantities of gold, it occurred to me that it would be simpler than taking percentage weights, and more reliable than tables, to take a weight that would give the number of grains of gold per ton direct.

Thus for poor ores, if 78.4 grms. are taken, and two assays are made, $\frac{1}{10}$ mgrm. from the two assays will represent 10 grains of gold per ton (1 ton contains 15,680,000 grains), and as a good bullion assay balance will indicate distinctly $\frac{1}{20}$ mgrm. if the above weight is taken, one can obtain results down to 5 grains per ton.

For ores containing over 5 dwf. of gold per ton, 39.2 grms. is a convenient weight, $\frac{1}{10}$ mgrm. (from one assay) being then equal to 40 grains per ton. For richer ores, 31.36 grms. can be taken, when $\frac{1}{10}$ mgrm. is equal to 50 grains per ton.

Somewhat similar weights are, I believe, used in America, under the name of "assay tons," but at the time I first used them I did not know this, and worked out the quantities myself.

(e.) ESTIMATION OF FREE AND ALBUMINOID AMMONIA IN WATER.

A good method for checking these results I find to be as follows:—

A larger retort than what is usually employed is taken, and after both free and albuminoid ammonia have been estimated, a duplicate portion of water is added to the residue in the retort, which is now absolutely free from ammonia, and the total ammonia is determined. This will always be identical with the free plus the albuminoid ammonia if the first results were correct.

(f.) ESTIMATION OF SMALL QUANTITIES OF IRON IN PRESENCE OF ALUMINA BY STANDARD PERMANGANATE.

For quantities of iron from 0.5 to 4 or 5 per cent., such as occur in clays, the precipitate of Al_2O_3 and Fe_2O_3 can be weighed together, and the precipitate afterwards dissolved in strong HCl in a flat-bottomed conical flask; moderately strong H_2SO_4 is then added, and the flask heated on an iron plate till all HCl is driven off. The residue is dissolved in water and reduced with a little zinc, and the solution titrated with $\text{K}_2\text{Mn}_2\text{O}_8$. Very good results are obtained.

DISCUSSION.

J. CARTER BELL said he had had a good deal to do with the estimation of zinc in various ways. Thirty years ago he estimated zinc by means of sulphide of sodium, but found it a most unsatisfactory process, as a great amount of practice was necessary to obtain good results. He had also tried the method suggested by Mr. Lowe, but he had always found a difficulty in the zinc coming down in the slimy state. He wished to know how long Mr. Lowe boiled the sulphide to get it into a granular condition, because the success of the method depended upon the time it took to filter. He found a day or a day and a half were required to filter it. He washed it by decantation, and then dissolved it in hydrochloric acid, and estimated it as carbonate of zinc. This could be filtered and washed in less than an hour.

MR. GRIMSHAW wished to know what was the average percentage of zinc in the list of 100 ores given in the paper?

MR. LOWE replied from 56 to 60 per cent.

MR. GRIMSHAW asked if Mr. Bell weighed the carbonate of zinc or washed it through the filter and titrated it?

MR. BELL said that he always weighed.

MR. LOWE, in reply to Mr. Carter Bell, said that five minutes good boil was quite sufficient to convert the sulphide of zinc from the slimy state to the granular.

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SESSION 1891-92.

1892:—

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April 4th.—Mr. Thomas Fairley.

Meeting held at the Philosophical Hall, Leeds, Monday, February 1st, 1892.

DR. A. HESS IN THE CHAIR.

CONTRIBUTIONS TO THE ANALYSIS OF FATS. II. SPERM OIL.—WOOL-FAT.—CHOLESTERIN.

BY DR. J. LEWKOWITSCH.

IN the course of some research work I undertook in the laboratory whilst working out a technical process which I introduced into the works I am connected with, I had occasion to make some observations which may, perhaps, prove of some little use to chemists working in the same direction. Circumstances permit me only to give here incoherent notes and a few new observations which I had no time to pursue any further and round off in a satisfactory manner as I should have desired, for, unfortunately, a technical chemist has to break off research work just at the moment when it becomes highly interesting to the scientific chemist for the melancholy reason that "it does not pay." These prefatory remarks will have to excuse the scantiness and incoherence of the following notes.

In the course of my work the necessity arose of determining the nature and quantity of unsaponifiable matter in fats. The literature on that subject being very scanty, I had to look out for substances containing larger quantities of such unsaponifiable bodies and examine them myself. Suitable material for my purposes appeared to be sperm oil and wool-fat; the latter being difficult to obtain, I chose instead of it "recovered grease," or so-called "Yorkshire grease."

I.—SPERM OIL.

Sperm oil, the liquid part of the fatty substance found in the cavities of some whales, is known to contain higher alcohols of the aliphatic (*ἀλειφας*: fat) series. I prepared these alcohols in the usual way from sperm oil by saponifying a pure specimen of the latter by means of alcoholic potash, and obtained 41 per cent. of unsaponifiable substances. A preliminary experiment was made by distilling 50 gr. of the product in a vacuum of 24 in. The thermometer rose rapidly to 300 C., and the bulk distilled over between 300—305° C., representing on cooling a white crystalline mass melting between 22—30° C.

It is well known that the ethers of the alcohols and acids of the aliphatic series are easier to distil than the original bodies themselves, and that even the lower members can only be effectively separated by fractional distillation after they have been transformed into their ethers. It was

therefore thought that by converting the sperm oil alcohols into their acetates and by subsequent fractional distillation of these ethers, some separation might be effected. Of course, I did not and could not expect to arrive by this method at a complete or even approximate separation of bodies boiling at such high temperatures and apparently being so nearly related to each other. Anyone who is practically acquainted with the distillation of such high boiling substances as, *e.g.*, mineral oils or tar oils, will recognise at once the futility of such work, even if carried out with large quantities. At the outset I had, therefore, to give up every hope of obtaining substances the elementary analysis whereof might be undertaken with some result, but there appeared to be a chance of deriving more information from applying the methods used in the technical analysis of fats to the fractions (this Journal, 1890, p. 842).

I prepared the acetates by boiling 200 grms. of the mixture of alcohols with 300 grms. acetic anhydride in a flask connected with a reflux condenser for a couple of hours. The resulting product was freed from acetic acid and acetic anhydride by repeatedly heating it in vacuo up to a temperature of about 200° C. The mixture of acetates did not crystallise at the ordinary temperature, and therefore fractional distillation in vacuo was resorted to.

The distilling flask and adapter used have been described by me (Jour. Chem. Soc. 1889, 359), and it only remains to add that the flask was not heated over free fire, but immersed into an air-bath consisting of an iron dish, while a mantle of asbestos protected the flask against loss of heat. The acetates distilled very well indeed in a vacuum of 26 in., showing no signs of decomposition, which was proved by the excellent yield of the distillates and by the nature of the residue in the flask, for although dark in colour it gave, on examination, figures which stood in welcome correspondence to those of the distillates. The first fraction was put aside as possibly containing some acetic acid or acetic anhydride; in fact, it must have contained some, as the saponification value of it was very high, reaching as high a figure as 415. The distillates were collected in four fractions, the receivers being changed when the thermometer, which had appeared to remain constant for some time, began to rise, and when the distilled liquor seemed to possess another specific gravity. Thus I obtained in a vacuum of 26 in., between the temperature of 295° C. and 315° C., four fractions, which, on being saponified by means of standardised alcoholic potash, gave the following saponification values:—

Fraction.	Saponification Value.
1st	187.7
2nd	185.0
3rd	183.0
4th	168.0
Residue	159.5

The quantities of these four fractions did not differ considerably.

For the sake of comparison I subjoin the saponification values, which theory requires for the acetates of ethyl-alcohol and octadecylalcohol:—

Cetylacetate.....	197.5
Octadecylacetate.....	180.0

A second fractionation of the four fractions gave the following result (the first grm. or two were discarded as "first runnings") :—

Fraction.	Saponification Value.
1st	187.9
2nd	181.1
3rd	175.3
4th	163.7

The saponification value of the first fraction has not undergone any change, and although no definite conclusion can be derived from these figures, this much is clear, that Allen's* assertion that sperm oil contains alcohols of the composition indicated by the formula $C_{12}H_{26}O$ and $C_{13}H_{28}O$, as he has found by elementary analysis, is not borne out by my figures, for the acetates of dodecyl and pentadecyl alcohol have the saponification values 246 and 207.7 respectively. But to remove every doubt, a third fractionation was undertaken, although no further separation could reasonably be expected. The values, as found, are given here :—

Fraction.	Saponification Value.
1st	190.2
2nd	183.8
3rd	180.7
4th	174.4
Residue	161.4

Contrary to my expectation, these acetates were able to absorb iodine—a fact which Allen has already recorded for one specimen of sperm oil—and therefore the supposition that the alcohols consisted mainly of a mixture of cetyl alcohol and octodecyl alcohol, and some higher homologues thereof, had to be abandoned.

In order to prepare the alcohols themselves the acetates were saponified by means of alcoholic potash, the separated alcohols washed free from potash, and finally filtered in a drying oven. All the alcohols solidified on cooling.

Their iodine absorption values were found as follows :—

Fraction.	Iodine Absorption.
	Per Cent.
1st	46.18
2nd	63.3
3rd	69.8
4th	81.8
Residue	84.9

These figures clearly show that the alcohols, or, any way, large percentages thereof, belong to alcohols of the unsaturated series. For comparison's sake I add the saponification and iodine values of the following *unknown* alcohols of the ethylene series :—

Formula.	Saponific Value of the Acetates.	Iodine Value.
		Per Cent.
$C_{16}H_{32}O$	199	106.6
$C_{18}H_{36}O$	189	94.8
$C_{20}H_{40}O$	166	85.8

The presence of an alcohol of the formula $C_{15}H_{30}O$ (see Allen, *Comm. Org. Analys.* II., 170), seems to be excluded, but it remains open to doubt, whether alcohols of the series $C_nH_{2n-2}O$, may not be present. The higher alcohols of the ethylene and the acetylene series are hardly known. Sperm oil being a comparatively cheap raw material and at the same time easy to obtain, this subject seems only to be awaiting further research in order to fill up some of the gaps in the series of alcohols belonging to the aliphatic group. The occasion appeared, however, too tempting to leave off here, although time forbade to enter fully into the investigation, and therefore only three

experiments were carried out with some of the alcohols, which, I am sorry to say, did not yield any definite result on the first attack and had therefore to be abandoned.

Alcohols belonging to the series, $C_nH_{2n}O$, and therefore containing a $CH=CH$ group should, when acted upon by a mild oxidising agent, become transformed into an alcohol of the glycerol series, as has been shown by Wagner* who actually prepared glycerol from allyl alcohol by oxidising the latter with a 1–5 per cent. solution of potash permanganate. I tried to oxidise in this way 30 grms. of the alcohol fraction No. 4 (absorbing 81.8 per cent. iodine solution), adding the calculated quantity of a 3 per cent. permanganate and finally warming gently on the water-bath, until all the permanganate was used up. The solution was distilled down by means of steam passed through it and afterwards freed from the precipitate of manganese by filtration. The filtrate was concentrated to 300 cc. in a flask connected with a condenser. Along with the water a white flocculent substance passed over which was obtained in too small a quantity to allow any further examination. The distilled liquid did not reduce silver nitrate on boiling. The 300 cc. were treated with carbonic dioxide, boiled down until salt began to crystallise and finally extracted with a mixture of ether and alcohol. On evaporating the solvent I obtained 16 grms. of a liquid, solidifying on cooling to a crystalline mass. The iodine absorption value of this substance was 71.3, thus showing that of the obtained 50 per cent. a small quantity only could have been transformed into a product of the glycerol series.

A second quantity of the alcohols was dissolved in glacial acetic acid and bromine dissolved in the same menstruum added, until the bromine was no longer absorbed; it was hoped that a crystallising bromine-derivative might be obtained. As no crystals separated from the acetic acid solution, the acid was removed by washing with water and the substance dried by washing with alcohol and subsequently with ether. No crystals having been obtained, it was tried to distil the oily substance, but it was found impossible to carry this out, as at about 160° C. large quantities of hydrobromic acid were given off, pointing to a decomposition of the substance.

A third quantity of the alcohols was heated with potash lime in order to convert, if possible, the alcohol into the corresponding acid. A far larger quantity of hydrogen was evolved than theory would require for the formation of the expected acid, and on extracting from the potash lime the supposed potash salt by means of water and acidulating with hydrochloric acid, only a very small quantity of insoluble fatty acid was obtained. The acid solution was therefore exhausted with ether, when I obtained 0.374 gm. of an oily acid requiring 2.1 cc. per cent. of normal potash for neutralisation. It would not be permissible to calculate the molecular weight from a titration of this small amount. The exhausted aqueous solution seemed to contain a dibasic acid. The undissolved lime contained besides some unchanged alcohol, the lime salt of an organic acid.

It is evident that no value must be attached to these last-mentioned experiments, as they hardly constitute more than the very first steps towards the examination of these interesting alcohols.

II.—RECOVERED GREASE.

The "recovered grease," on which the following observations were made, was mainly a so-called "Yorkshire grease," a fat recovered from the soapsuds used in wool scouring; other samples, obtained from continental works, were also examined, but only for the purpose of controlling the methods adhibited.

The constituents of such a recovered fat would naturally and most conveniently be classified under the following three heads :—

(1) Free fatty acids, resulting from the decomposition of the waste soap by means of a mineral acid and partly owing their presence to the existence of free fatty acids, peculiar to the wool-fat, as has been shown by E. Schulze,

* Commercial Organic Analysis, Vol. II., p. 169.

* Berichte der deutschen chemischen Gesellschaft **21**, 1230, 3343, and Ref. 182.

whose three papers in the *Berichte der deutschen chemischen Gesellschaft* V. 1076, VI. 251, VII. 571, are the most valuable contributions to the chemistry of wool-fat.

(2.) Neutral, *i.e.* saponifiable fats. These are the real saponifiable constituents of wool-fat, the cholesteryl ethers and other ethers of fatty acids, *e.g.*, ceryl cerotate. Mixed with these characteristic bodies there may be present some glycerides, remainders of the oil that has been used in oiling the wool. Some text-books quote amongst the constituents of wool-fat the glycerides of lower fatty acids, but I was unable to find the original source in the literature, whilst Schulze distinctly states that no glycerol has been found in the wool fat examined by Hartmann (*cfr.* *Berichte* V. 1075, footnote). I may state here at once that I did not find any glycerol in the samples of recovered grease I examined.

(3.) Unsaponifiable matter, under which head we may comprise free alcohols, *e.g.*, cholesterol and ischolesterol, as characteristic for the wool-fat, and besides these, hydrocarbons, coming from oils used in greasing wool, which may have been adulterated with (or "improved" by, as some will have it) a smaller or larger quantity of mineral oil.

If we accept this classification as correct, a convenient method for separating these three classes of substances seems to be naturally given.

The free fatty acids would have to be eliminated first, by converting them into their soda soaps and separating these from the substances of classes 2 and 3.

The amount of alkali required was first ascertained by careful titration of smaller quantities and the greatest part of the caustic soda necessary for a weighed larger quantity, which had been previously dissolved in alcohol, added and titrated with half-normal alkali, until the solution became pink to phenolphthalein. A good deal of the neutral fats and unsaponifiable matter rose to the top as an oily layer and was thus separated from the soap solution, whilst a smaller quantity remained suspended in the latter. The oily layer was dissolved in ether and the soap solution repeatedly shaken out with ether. The ethereal extracts were united with the main quantity and the ethereal solution washed with water to remove the last traces of adhering soap. Although apparently simple, this process requires more than ordinary patience, because only too often emulsions are formed, and unfortunately at the last stages, which seem to defy any attempt to separate them into two layers. Allowing to settle out for a period of several weeks proved of no avail, and the last resource was to deal with the ethereal solution in small quantities, and to treat them alternately with a diluted solution of caustic soda, or with diluted alcohol and so on. Another source of trouble was the appearance of an intermediate layer between the ethereal solution and the soap solution. It was separated best by throwing it on a filter. This flocculent stratum was found later on to consist of a soap formed by a higher* fatty acid, which soap was not soluble in water but dissolved readily in the boiling alkaline solution of the other fatty acids.

Thus the free fatty acids were obtained in two parts: firstly the fatty acids of the dissolved soaps, and secondly those of the difficultly-soluble solid soaps. The ether dissolved in the soap solution was distilled off and finally the fatty acids set free by acidulating the liquor with hydrochloric acid. The fatty acids were washed until the washwaters were free from acid, separated from any water, and filtered in a drying oven. It will thus be seen that no attention was paid at this stage to the presence of any volatile, soluble, fatty acids, and this course was adopted throughout this examination—except for the ultimate analysis of this recovered grease, which will be found below. It may be further pointed out at once that all the substances have been dried and filtered before being examined.

Weighed quantities of the fatty acids recovered from the soap solution were dissolved in dilute alcohol and titrated with aqueous half-normal soda for the determination of their molecular weight. I found in three experiments 376, 378, 379, therefore the means 377.6. Later on in the

course of my research I noticed that some of the higher fatty acids very easily underwent an appreciable loss in the drying oven at a temperature not exceeding 100° C., pointing to the formation of anhydrides or possibly lactones, which manifested itself in a very high molecular weight being found; for these anhydrides behaved during the titration with aqueous caustic soda, so to speak, as an inert mass, not being hydrolysed by aqueous alkali, or, any way, not completely (this *Journal*, 1890, 846). That this was so, was easily proved by titrating with alcoholic potash, which would hydrolyse any anhydrides formed and consequently, the full amount of caustic being found, reduce the molecular weight to its proper value. The fatty acids, found above to possess the mean molecular weight 377.6, were therefore boiled with standardised alcoholic potash and gave now the molecular weight 327.7 and 326, wherefrom the means 326.8 may be derived as the true mean molecular weight. The solid soap which was obtained as an intermediate layer between the ethereal and aqueous solutions and had been collected on a filter, was treated with boiling water and hydrochloric acid, and thus the fatty acids were set free. Their molecular weight was found by titration with aqueous soda something like 3,920, which of course is absurd; boiled with standardised alcoholic potash they gave, on titrating back the excess of caustic potash, the molecular weight 520, as the means of two agreeing determinations. These fatty acids are very difficultly soluble in alcohol. The proportion of the free fatty acids forming easily soluble soaps to the free fatty acids, giving the solid soaps was as 9:1; the mean molecular weight of all free fatty acids may therefore be assumed to be $\frac{9 \times 326 + 520}{10} = 345$.

The free fatty acids from the soap solution were found to possess a higher molecular weight than was expected; the supposition that the higher free fatty acids peculiar to the wool-fat would be solely contained in the solid soap not having been borne out by the facts. An easy method for separating the fatty acids possessing a molecular weight above 280 from those of about 280 (stearic and oleic acid) seemed to be given by the observation contained in a patent of the *Norddeutsche Wollkammerei und Kammgarne-Spinnerei zu Bremen* (D. R. Pat. 55,110, December 3, 1889), that the soaps of the former acids are only soluble in hot alcohol and separate out on cooling the solution below 25° C., whilst the soaps of the latter fatty acids are soluble both in hot and cold alcohol. Therefore 50 grms. of the fatty acids recovered from the soap solution were dissolved in hot alcohol and titrated with alcoholic soda until neutral. Sufficient alcohol was added to hold the soaps easily in solution whilst warm, and then allowed to cool below 25° C. The soap deposited on cooling was separated by filtering and sucking off the mother-liquor, and subsequently the fatty acids of both the solid and the dissolved soaps were prepared and titrated in order to determine their molecular weights. The estimation by means of aqueous soda gave, for the acids of the solid soap, the mean molecular weight 343, while the fatty acids of the dissolved soap gave 394. When using alcoholic potash, as was necessary after the above-mentioned experience, I found the respective molecular weights, 303 and 338. The fatty acids of the molecular weight 303 were solid, those possessing the mean molecular weight 338 were liquid, which appeared at first surprising, but may find an explanation by the assumption that the liquid acids belonged to an unsaturated series.

It will be evident that the method of separating the sodium salts of the fatty acids by means of alcohol would require a tedious repetition of the same operation without, however, apparently possessing an advantage over the older equally tedious methods.

The higher fatty acids of the molecular weight 520 offered a special interest both on account of their high molecular weight and their property of easily losing water. It was easy to decide whether the normal anhydrides or lactones, *i.e.*, inner anhydrides, were formed. I have shown that on boiling fatty acids which possess the COOH group only, and no OH group besides, with acetic anhydride (this *Journal*, 1890, 843) the normal anhydrides are formed, and this can be easily ascertained by weighing the resulting product, for *e.g.*, $2 C_{15}H_{31}COOH$ being transformed by

* Under "higher" fatty acid I shall understand throughout this paper fatty acids possessing a molecular weight above 300.

that reagent into $(C_{15}H_{31}CO)_2O$, will lose one molecule of water. Hydroxylated acids, e.g., $C_{15}H_{31}(OH)COOH$, will, as far as the $COOH$ is concerned, undergo the same change, but the hydrogen atom of the OH group will at the same time be exchanged for an acetyl group and the resulting product, $[C_{15}H_{31}(OC_2H_5O)CO]_2O$, will, on weighing, show an increase, the loss of H_2O by two molecules of the acid being more than counterbalanced by the taking up of two C_2H_5O groups. I boiled, therefore, 5·9283 grms. of the fatty acids, molecular weight 520, with acetic anhydride, and obtained on a weighed filter 6·1960 grms., i.e., an increase of 4·52 per cent.; it was, therefore, evident that they contained to a large extent hydroxylated acids. A pure hydroxylated acid of the molecular weight 520 would, by the same operation, increase by 6·5 per cent. The iodine value of these fatty acids was 21·5, but from this no conclusion as to the series the acids or part of them belong to, can be drawn. One more point had to be decided by experiment, viz., whether the higher acids of the series, $C_nH_{2n+1}O_2$, easily lose water with formation of anhydrides. As I possessed a pure specimen of cerotic acid—molecular weight 410—I examined it in this respect. 5 grms. were heated to 130° C., dissolved in alcohol and titrated with aqueous half-normal soda. The molecular weight was found 415, so no anhydration has taken place.

The Neutral Fat and the Unsaponifiable Matter of the recovered grease were contained in the ethereal solution after the free fatty acids had been removed, and both were obtained together by distilling off the solvent. The substances one might expect to find in this part of the grease have been already enumerated above. The absence of glycerol, and consequently of glycerides, was proved by completely saponifying a larger quantity of the recovered grease and examining the aqueous solution. Hydrocarbons, or, to be more correct, appreciable quantities thereof, could not be present, as the substances extracted by ether after such a complete saponification of the recovered grease were completely dissolved by acetic anhydride without separating any mineral oil on cooling. The unsaponifiable matter would therefore most likely consist of cholesterol, ischolesterol, and perhaps other alcohols. To separate the latter from the neutral fat the mixture of both was repeatedly extracted with boiling alcohol, in which, as Berthelot has shown, the cholesteric ethers are nearly insoluble. That part, however, of them, which dissolved in the boiling liquid, separated on slight cooling as an amorphous mass, and although it was apparently identical with the insoluble substance, it was still kept separate, so as to ensure my having to deal with a substance free from any unsaponifiable matter. The extracted part will be spoken of later on, here the neutral fat only will be considered. This neutral fat is a viscous, wax-like substance, melting into a thick liquid when moderately heated. No doubt this substance is very similar to that part of Schulze's wool-fat which proved insoluble in alcohol and yielded to him on saponification cholesterol and ischolesterol, but with this important difference, that my substance is a neutral body, whilst that of Schulze, in the case of some specimens of wool-fat, contained free fatty acids, which, as stated above, are difficultly soluble in alcohol. For further examination this neutral fat had to be saponified, and to gain at the same time some insight into the nature of the unsaponifiable matter contained in the "recovered grease," the neutral fat was analysed alongside with the mixture of saponifiable fat and unsaponifiable matter, as obtained direct from the ethereal solution described above. The saponification of this neutral fat does not take place readily even when using a large excess of alcoholic potash and heating over free fire for an hour; the discordant figures which were obtained in parallel experiments showing that saponification had not been completed in every case. Satisfactory results were at last obtained when the saponification was carried out with alcoholic double normal potash under pressure. The use of a copper bottle, as shown in the diagram, was found very convenient for this purpose; the bottle was immersed into boiling water for an hour or so and the contents shaken up from time to time. Some time after I had finished these experiments a patent was taken out by Kossel and Obermüller (D.R. Pat. 55,057) for the saponification of fats by means of metallic sodium thrown

into a mixture of fat and absolute alcohol, or, what amounts to the same, by means of sodium alcoholate. I compared this method with the one I practised myself quantitatively, using of course a freshly-prepared solution of sodium alcoholate, as this could be titrated. The figures show an absolute correspondence between the two methods:—

1 grm. of	Requires of	
	Alcoholic Potash under pressure	Sodium Alcoholate.
	quantities corresponding to	
A. Neutral fat	1·825 cc. 1/1 KOH	1·825 cc. 1/1 KOH
B. Neutral fat + Unsaponifiable.....	1·733 cc. 1/1 KOH	1·727 cc. 1/1 KOH

Although more expedient, Kossel and Obermüller's method may be found a little too costly in the practice of the analytical chemist, and it is much to be feared that for the same reason the patentees may not find any manufacturer who will take a licence from them for saponifying glycerides—or even wool-fat—by means of metallic sodium and absolute alcohol.

The saponified fats were shaken out with ether to extract the alcohols (in case of B. the alcohols and unsaponifiable matter), and the exhausted soap solutions acidulated with hydrochloric acid. The separated acids were washed on a tared filter and weighed as in Hehner's method of the analysis of butter.

The following figures were obtained:—

	A. Neutral Fat.		B. Neutral Fat + Unsaponifiable.	
	I.	II.	I.	II.
Fatty acids	Per Cent. 56·3	Per Cent. 54·1	Per Cent. 50·7	Per Cent. 49·8
Alcohols	43·2	44·0	47·5	47·6
	99·5	98·1	98·2	97·4

The sum of the analyses does not come up to 100 per cent., although it was expected that the sum would be 102 per cent. to 103 per cent., as 2 to 3 per cent. of water have been taken up during saponification. The error can only be looked for in the figures for the fatty acids, and it was therefore impossible to calculate the molecular weight of these fatty acids from their weight and the quantity of normal potash used during saponification. That the figures for the fatty acids have been found too low may be partly accounted for by the above stated observation that the wool-fat acids lost some water during the operation of drying, or, in other words, through the fact that during the drying, anhydrides or lactones, or both, may have been formed. The latter opinion was sufficiently supported by the difference of the figures found for the molecular weights of these fatty acids, when these weights were determined both by means of aqueous half-normal soda and alcoholic potash. The titration with aqueous soda gave the molecular weight 363, whilst on using alcoholic standard solution the values found were 325 and 330, means 327·5. The latter value has to be considered as the correct one. It hardly needs mentioning that the fatty acids of A. and B. were identical.

By means of the values obtained for the molecular weight for the alcohols, and the amount of alkali used during saponification, it is possible to calculate the composition of A. and B.

	A. Neutral Fat.	B. Neutral Fat + Unsaponifiable.
Alcohols (means)	43.60	47.55
Fatty acids {	1.825 x 327.5	59.77
	1.73 x 327.5	..
	..	56.66
	103.37	104.21

These figures may be accepted as fairly representing the two constituents of A. and B. after they have undergone hydrolysis.

The analysis of the neutral fat gives us the means of calculating the mean molecular weight of the *alcohols* by means of the equation $M = \frac{13.6 \times 327.5}{59.77} = 239$. The same analysis also allows us to calculate the quantity of unsaponifiable matter, *i.e.*, free alcohol in the part B; for the 56.66 per cent. fatty acids of this part require for the mean molecular weight 239 of the alcohols, 41.34 per cent. alcohol to form neutral fat. (The same figure can be calculated more quickly from the proportion 59.77:43.60 = 56.66:x.) Consequently part B contained 47.55 - 41.34 = 6.21 per cent. free alcohols. Of course, this estimation has to be taken "cum grano salis," but analyses of this kind have to be supplemented to some extent by calculations which keep within permissible limits.

The fatty acids absorbed 17 per cent. iodine only, which excludes a larger quantity of unsaturated acids.

The fatty acids were not examined any further. The alcohols were boiled with twice their weight of acetic anhydride to transform them into their acetates; weighed quantities were used, and the increases in weight, the alcohols, acquired, were determined by collecting the resulting products on weighed filters, when the following figures were obtained:—

	Weight of Alcohol.	Weight of Acetate.	Increase.	Means.
	Grms.	Grms.	Per Cent.	Per Cent.
Neutral fat {	4.4574	5.9084	12.35	12.7
	7.7967	8.8149	13.06	
Neutral fat + } unsaponifiable {	6.024	6.8624	13.9	13.6
	7.077	8.0202	13.3	

For the sake of comparison I add the corresponding values (*i.e.*, the increase due to the exchange of one atom of hydrogen for an acetyl group) for several alcohols:—

Alcohol.	Increase.
	Per Cent.
Cetylalcohol.....	17.2
Cerylalcohol.....	10.6
Cholesterol or Isochol.....	11.3

The saponification values of the acetates obtained were determined next, as experiments mentioned below showed how tedious and comparatively useless it was to try to separate the acetates by crystallisation from alcohol. As will be seen in the third part of this paper a separation of cholesterol from cetylalcohol may be undertaken with some success by this method, but the higher aliphatic alcohols—and these were present to all appearances—yield oily liquids which could not be brought to crystallisation. The following figures were obtained:—

Acetates from Alcohols of	Weight.	Alcohol 1.1 KOH used for Saponifying.	Saponification Value.
	Grms.	cc.	
A. Neutral fat.....	8.5720	24.53	160.9
B. Neutral fat and unsaponifiable	17.3226	20.40	156.3

For the above-mentioned three alcohols we arrive at the following theoretical saponification values of their acetates:—

Acetate of	Saponification Value.
Cetylalcohol.....	197.5
Cerylalcohol.....	128.0
Cholesterol or Isochol.....	135.6

The corresponding values for octylalcohol, which Guetta states to have found in the distillates of wool-fat, is 330. I have not tabulated this alcohol along with the others, as Hannau* could not prove its existence in distilled wool-fat.

I prepared about 20 grms. of the alcohols from the neutral fat A, in the hope of isolating the cholesterol by crystallisation from ordinary alcohol or a mixture of alcohol and ether (a corresponding experiment carried out with the acetates of these alcohols will be described further on), but I discovered soon that it was impossible to arrive at satisfactory results in this way—anyhow, in the limited time at my disposal. Other solvents, like chloroform, petroleum spirit, benzene, did not prove of greater use. I obtained the same half-jelly-like, half-crystalline substances which Schulze described, and from which he successfully separated cholesterol and isocholesterol by means of their benzoates, while another alcohol which was present could not be identified by him. I had to give up any further attempts to isolate from the mixture of the alcohols any chemical individuals, and had recourse to the makeshift of colour reactions. I shall speak about these colour reactions in the third part of my paper, and shall therefore content myself here with stating that the colour reaction quite recently proposed by Schulze for isocholesterol (*Zeits. f. physiolog. Chem.* 14, 522) was obtained with very satisfactory sharpness, whilst the corresponding reaction for cholesterol could not be obtained, but this by no means excludes the presence of cholesterol.

The amount of *unsaponifiable matter*, judging from the analysis of the part B. (mixture of neutral fat and unsaponifiable) could be a very small one only; it has been calculated above as 6.21 per cent. of part B. As mentioned above, this third class of the constituents of the recovered grease had been obtained in the course of the preparation of the neutral fat, and was contained in the alcohol which had been used to effect the separation.

Whilst writing these lines I notice that Liebreich recently (*Arch. f. Physiol.* 1890, 363) proposed for the separation of cholesterol from cholesteryl ethers two reagents not very commonly met with, *viz.*: ethylaceto-acetate and ethyl-ethylaceto-acetate.

Mineral oil, to repeat this, which would have been extracted along with any free alcohols by the boiling alcohol, was not found as the solubility of the extracted mass in acetic anhydride proved. Consequently, I only expected to find cholesterol and isocholesterol. On cooling the alcoholic solution small crystals were obtained, which after being crystallised several times from that solvent seemed pure enough for examination. The melting point was found at 37°–58° C., consequently the crystals were neither cholesterol or isocholesterol. Moreover, on boiling the alcohol with acetic anhydride 108 per cent. of the original quantity was obtained as an amorphous substance melting between 37° and 39° C. The substance showed

* Public del Laboratorio Chimico Centrale delle Gabelle. Roma, 1891.

the ischolesterol reaction only very faintly and absorbed 3.7 per cent. iodine only. It is therefore safe to conclude that the isolated alcohol is cerylalcohol, the presence of which in wool-fat (as the cerotate) has been stated by Buisine.

The mother-liquors from that cerylalcohol yielded gelatinous and finally oily substances, which could not be identified any further than by colour reactions, which spoke very distinctly for the presence of ischolesterol.

In the hope of arriving perhaps at better results as far as the alcohols were concerned, a larger quantity of the original recovered grease was saponified and the soap solution at once extracted with ether. Here again a large quantity of the intermediate stratum was obtained and collected separately in some experiments, so that all the fatty acids contained in the recovered grease—both the free and the combined acids—were, so to speak, fractionated to some extent; in other experiments all the fatty acids of the recovered grease were obtained in one mass by dissolving the intermediate layer in the hot soap solution and acidulating the latter.

The molecular weight of all the fatty acids, as prepared in the last instance, was found by titration with aqueous half normal soda: (1) 411.5; (2) 412; (3) 410.8; (4) 400; the determination by means of alcoholic potash, however, gave the values 331 and 333, so that 332 must be assumed as the true mean molecular weight of all the fatty acids of the recovered grease (regardless of any volatile acids).

The two fractions of the fatty acids—if I may say so—i.e.: (a) the fatty acids of the easily soluble soaps; and (b) the fatty acids of the intermediate stratum were also titrated separately for their molecular weight, with the following result:—

FRACTION A.

Molecular weight by titration with aqueous soda.....	340
Molecular weight by titration with alcoholic potash ..	318

It was tried to further fractionate these fatty acids by means of the above-mentioned patented method; in this instance also the solid fatty acids, forming the less soluble soaps, showed a lower molecular weight than the liquid acids, the sodium salts whereof were soluble in alcohol below 25° C. The figures obtained for the molecular weights were—

1.—SOLID ACIDS.

(a) by means of aqueous soda.....	323
(β) by means of alcoholic potash	309

2.—LIQUID ACIDS.

(a) with aqueous soda.....	385
(β) with alcoholic potash.....	331

FRACTION B.

Molecular weight by titration with aqueous soda.....	670
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The determination by means of alcoholic potash had not been carried out, as at that time I was not yet aware of the fact, that the higher fatty acids of the recovered grease underwent some sort of anhydration when subjected to a temperature of 100° C. The separation of these acids—or rather of their soaps—by means of alcohol into two fractions yielded a very small quantity of liquid acids only, the mean molecular whereof was found by means of aqueous soda 1380, and by means of alcoholic potash 618, whilst the greatest part consisted of solid fatty acids of the mean molecular weight 660 with aqueous soda, and 483 with alcoholic potash. The latter contained hydroxylated acids, for on boiling with acetic anhydride an increase of 3.3 per cent. was found. Their iodine value was only 8.9.

The alcohols were prepared in either case by shaking the soap solution repeatedly with ether, regardless of the middle layer which, in this case, gave far less trouble than the corresponding separation of the neutral fat and saponifiable matter from the free fatty acids. Quantitative experiments showed me that—notwithstanding the troublesome middle layer, the filtering off of which is by far the best

way of dealing with it—the extraction of the aqueous solution by means of ether and subsequent washing of the ethereal solution with water gives the best and most reliable result. The extraction of the dried saponified mass, mixed with sand, in a Soxhlet tube caused more delay, as, owing to the large quantity of unsaponifiable matter, the ether dissolved larger quantities of soap, which had to be eliminated by renewed washing. The substitution of petroleum spirit for ether in the last method gives worse results still, as it is well known that petroleum spirit, when a large quantity of unsaponifiable matter is present, dissolves notable quantities of soap. At that juncture I may point out that Hösig and Spitz (Zeitschr. f. angewandte Chemie, 1891, 565) propose, for the quantitative estimation of unsaponifiable substance, the extraction of the aqueous soap solution by means of petroleum spirit and the washing of the latter with 50 per cent. alcohol.

The extracted alcohols gave, on being incinerated, no ash, a test which should never be omitted in the quantitative estimations of such-like substances. The alcohols were dried, boiled with twice their weight of acetic anhydride, and the resulting acetates washed until free from acetic acid and dried. The increase of weight was determined quantitatively in two experiments as 9.90 per cent. and 10.2 per cent. The saponification value of the mixed acetates was found to be 150.6 (means of 149.9 and 151.3); their iodine absorption value was 44.03. The acetates were divided into two parts. The first part—about 90 grms.—was fractionated in vacuo in the same way as the acetates of the sperm oil alcohols. The temperature rose quickly to 330° C.—in a vacuum of 26 in.—and between 330 and about 350° C. three fractions were obtained, all of which possessed in a very marked degree that peculiar smell which is so characteristic of the high-boiling fractions of mineral oils. From these distillates seemed to separate crystals embedded in a viscous mass. I subjoin the saponification and iodine values of the three fractions; the first fraction may still have contained a little acetic acid, judging from its high saponification value. The residue was lost:—

Fraction.	Solubility in Alcohol.	Saponification Value.	Iodine Absorption.
1st.....	Easily soluble	237.5 (1)	Per Cent. 32.2
2nd.....	Not easily soluble.	136.5	57.0
3rd.....	Difficultly soluble	59.3	78.3

The difference of the solubility of these three fractions in alcohols may be considered as a fair indication of the decomposition that evidently took place. Fraction 3 contained the largest amount of hydrocarbons. It can therefore only be looked upon as a chance that the values found for the second fraction agreed very well with those which cholesterol and ischolesterol would give, viz., 135.5 and 68.3 (see Third Part of this paper). On trying to separate any cholesteryl acetate or ischolesteryl acetate from the second fraction by crystallisation from alcohol, only floes were obtained, while the greater part separated as a heavy oil. After a great many vain efforts to obtain crystals, the whole mass was saponified to prepare the alcohols from it, in the hope that the latter might be more easily identified. On crystallising them from a mixture of ether and alcohol I obtained a half crystalline mass, which showed very distinctly the reaction of cholesterol, besides that of ischolesterol. I am inclined to believe (see Third Part of this paper) that cholesterol was present in a larger proportion than ischolesterol. A determination of iodine values would, of course, have been of no use. Schulze's method of separation by means of benzoic anhydride could not be carried out both for want of time and of the apparatus required for heating the sealed tubes. But even this method would not have furnished satisfactory quantitative results. The two other fractions of the acetates—the first and the third—were treated in the same way. From the alcohols of the first fraction I obtained crystals which gave

the reactions for cholesterol and ischolesterol. The third fraction gave, on saponification, an oily mass, gelatinising on cooling, and evidently containing a larger quantity of hydrocarbons. Colour reactions of the kind described could not give any result with such a mixture.

It was tried to break up the second part of the crude acetates into its constituents by crystallisation from absolute alcohol, as cholesteryl acetate is known to separate in characteristic crystals from it. I started with 100 grms. substance. I obtained on cooling some crystals, but the by far greatest part separated as an oily viscous mass. It would be too long to describe at any length the most tedious trials to obtain the crystals in a pure form and larger quantity. Just when they appeared pure and were only once more dissolved to take away the last traces of the adhering oily substance, as I thought, a larger quantity of the oil would separate, and thus cause a fresh repetition of the series of crystallisations and recrystallisations. To cut it short, I at last succeeded in obtaining 7 grms. of the crystallised acetate, which, on redissolving in alcohol, did not yield any more an oily substance, while the remaining 93 per cent. were brought into one lot; for although part of it seemed to have a tendency of crystallising, it was impossible to differentiate the oil into several parts.

The crystalline acetate melted, on drying in the oven, below 80°C ., and so it was conjectured that it consisted mainly of a mixture of cholesteryl- and ischolesteryl-acetates which, according to Schulze, melts below 100°C ., but the saponification value found at 161 showed that I was yet far from having the pure substances. The alcohols contained in the acetates were therefore prepared, and on dissolving them in a mixture of alcohol and ether I obtained on cooling an indistinctly-crystallised substance which showed the ischolesterol reaction most beautifully, whilst the cholesterol reaction was only occasionally noticed. The determination of the iodine absorption of the alcohols (see Third Part of this paper) could definitively settle the question whether larger quantities of the cholesterins were present. The alcohols absorbed only 5.1 per cent.; this shows that by far the greatest part consisted of an alcohol of the series $\text{C}_{27}\text{H}_{52}+\text{O}$ and, as I had found previously cerylalcohol, this mixture of alcohols has to be considered as consisting of cerylalcohol, ischolesterol, and cholesterol.

The oily acetates gave saponification values lying between 106 and 106.5; the alcohol from these acetates increased on boiling with acetic anhydride by 7.6 per cent., as found in two experiments. From the saponification values, we may calculate, assuming for a moment a homogeneous substance, the molecular weight 528 for the alcohol, for which again we should find the increase, on acetylating, 7.5 per cent. But these oily acetates undoubtedly contained cholesteryl- and ischolesteryl-acetate, and their quantity might be approximately determined by the iodine absorption of the acetates, providing the other alcohols be saturated alcohols, an assumption for which the presence of cerylalcohol is only slender support. The oily acetates absorbed 31.99 per cent. iodine, whilst theory would require for cholesteryl- and ischolesteryl-alcohol (see Third Part of this paper): 61.3 per cent. We may therefore assume, in round figures, that the oily acetates contained 50 per cent. of the cholesterol acetates; as the saponification value of the latter is 135.5, the remaining 50 per cent. of the acetates would have to possess the saponification value of 77.5, which again leads, for the above assumption, to an alcohol of the molecular weight 724, or, roughly speaking, to an alcohol of the formula $\text{C}_{32}\text{H}_{64}\text{O}$.

But I must break off here, as such calculations rest on too unsafe a ground, and it may justly be objected that they are nothing but "jeu de nombres."

The examination of the alcohols contained in the recovered grease has therefore not revealed any new fact, except perhaps that I proved the presence of free ceryl-alcohol in it.

The free fatty acids of the recovered grease, and consequently of the wool-fat, are composed to some extent of acids having a molecular weight of over 400 and 500. These fatty acids, or some of them, are characterised by their tendency of easily losing water, thereby being transformed into lactones or inner anhydrides. This property

of the acids, due to the presence of hydroxylated acids, has not been noticed before, and therefore the high molecular weights, which, for instance, Allen quotes for the free acids of lanoline (*Comm. Org. Anal.* Vol. II., 317) as 570.9, or which I calculate from a titration, given in the above-mentioned German patent (100 grms. acids require 122 cc. 1.1 normal NaOH) as 820, must be considered as inadmissible.

The neutral fat of the recovered grease, which is the chief constituent of wool-fat, contains amongst other not identified alcohols: cholesterol and ischolesterol. Buisine has stated the presence of ceryl cerotate and consequently of ceryl-alcohol in this part of the wool-fat; but the method he adopted (*Bulletin de la Société chimique*, 1887, 72, 201), does not place this beyond doubt. Buisine saponified the wool-fat completely, and found amongst the alcohols ceryl alcohol, whilst he isolated from the fatty acids the cerotic acid. I have shown above that cerylalcohol occurs in the free state in wool-fat. The analysis of this neutral fat led us to the molecular weight 239 for all the alcohols; as cholesterol and ischolesterol possess the molecular weight 372, we are forced to assume the presence of lower alcohols in the neutral fat. Buisine arrives at the same conclusion from his experiments; he thinks they are lower homologues of cerylalcohol, but he has not isolated chemical individuals. Guetta's opinion that octylalcohol occurs in wool-fat is not necessarily invalidated by Ilanau's remark, that he could not detect it in distilled grease (see below). The fatty acids of this neutral fat share with some of the free fatty acids the property of easily forming lactones or inner anhydrides; consequently they contain hydroxylated fatty acids what has been further proved by the increase of weight on boiling with acetic anhydride. It is generally assumed and stated by text-books that the fatty acids of the wool-fat are essentially stearic and oleic acid, to which Buisine, accepting their presence, has added cerotic acid. I am of the opinion that this statement rests mainly on the resemblance the neutral fat bears to the cholesteryl-oleate and stearate, which Berthelot prepared synthetically, and further on Schulze's authority, I believe. But the latter simply bases his opinion that the cholesteryl and ischolesteryl oleates and stearates are present, on the statement of Ullrich and Reich (*Annal. der Landwirtschaft* 49, 122; a paper which is not accessible to me) that they have found stearic and oleic acids in the wool-fat, and remarks occasionally that oleic acid seems to be present in large quantities. But he hastens to add that he did not isolate the oleic acid from it. The fact that the fatty acids of the neutral fat melt at a low temperature, may have been the cause of this annotation. The iodine absorption of these fatty acids was found by me 17 per cent., and this definitely excludes a larger quantity of oleic and other unsaturated fatty acids.

In conclusion I wish to give the complete analysis of this recovered grease; the figures with which the preceding notes are interspersed, furnish us with the necessary data to base our calculations upon. For the quantitative estimation I proceeded as follows:—About 5 grms. of the recovered grease were dissolved in alcohol and titrated with half-normal aqueous caustic soda until pink to phenolphthalein; thus I found that 1 grm. of the grease required 0.71 cc. 1/1 normal KOH for saturating all the free acids.* Another 5 grms. were boiled with an excess of alcoholic potash and the amount actually used for saturating the free acids and the combined acids determined by titrating back that excess; it was found that 1 grm. of the fat wanted 2.19 cc. 1/1 normal potash. The same test was used for estimating the unsaponifiable matter (*i.e.*, the alcohols), for which I obtained the figure 36.47 per cent. It was now only necessary to determine the volatile fatty acids by the well-known Reichert-Meissl process. One grm. of the fat

* One point, that might be raised, has not been considered at all, viz., the possible presence of anhydrides in the recovered grease. Supposing they were present, the titration for free acids would not show them. They would have passed into the ethereal solution of the neutral fat and unsaponifiable matter, and at last been extracted along with unsaponifiable matter by means of alcohol; for the comparison of the analysis of parts A. and B. shows that B. contains less fatty acids than A. But an error due to such a possibility is completely eliminated by the method adopted sub. II of the complete analysis.

contained a quantity of volatile acids which required 0.124 cc. 1/1 KOH for their neutralisation.

All the figures given are the means of three experiments, agreeing well with each other. The calculation is now easy. The volatile acids may be assumed to have the mean molecular weight 104 (for $C_3H_7O_2$), which gives us $10.4 \times 0.124 = 1.28$ per cent. volatile fatty acids. It is pretty safe to assume that the volatile acids occur in the free state, although Sebülze points to the possibility of the presence of cholesteryl acetate; therefore we calculate for the remaining free acids in one gram.—

$$0.71 - 0.124 = 0.586 \text{ cc. } 1/1 \text{ KOH,}$$

which, for the mean molecular weight 345 (as found above), gives $34.5 \times 0.586 = 20.22$ as the percentage of the remaining free fatty acids. The combined fatty acids required $2.19 - 0.71$ cc. 1.48 cc. = 1/1 KOH, and this leads us for the mean molecular weight 327.5 to—

$$32.75 \times 1.48 = 48.47 \text{ per cent.}$$

as the amount of combined fatty acids, calculated as hydrated acids.

In practical analysis it may not be possible to use such a detailed method as I did, but it is at least necessary to prepare all the fatty acids (both free and combined acids) washed free from the volatile acids and determine their mean molecular weight by titrating with alcoholic potash. I found in this way the mean molecular weight of all the fatty acids (minus the volatile acids) 332 (see above), and this gives, as their saturation required—

$$2.19 - 0.124 = 2.066 \text{ cc. } 1/1 \text{ KOH;}$$

$$33.2 \times 2.066 = 68.59 \text{ per cent.}$$

for all the fatty acids as hydrated acids.

For better comparison I subjoin the analysis calculated by both ways in the tabulated form:—

	I.	II.
	Per Cent.	Per Cent.
Volatile acids.....	1.28	1.28
Insoluble free fatty acids	20.22	68.59
Combined fatty acids*	48.47	
Unsaponifiable matter†	36.47	36.47
	106.44	106.34

* As hydrated acids.

† *i.e.*, alcohols.

The figure 68.59 might be checked by directly weighing all the fatty acids on a weighed filter; but in this case, owing to the formation of inner anhydrides, Hehner's value would be found too low. Still, for a commercial analysis such a method may have some advantages and may be worthy of the notice of analytical chemists.

Considering the difficulty of titrating such dark solutions as were obtained in the course of the analysis and the consequent errors caused by a slightly erroneous determination of the molecular weights, I think, the *sm* may be looked upon as working out in a fairly satisfactory way. Of course, part of the surplus above 100 is due to the elements of water having been added during the saponification.

If we wish to further detail these figures, all of which have been determined directly, we may introduce the percentage of unsaponifiable matter which was found above by calculation as 6.21 per cent. of part B. Part B, forms $(48.47 + 36.47)$ per cent. = 84.94 per cent. of the recovered grease or, rather, as we have to make a deduction for the elements of water added—say 1.94 per cent. = 83 per cent. wherefrom we calculate $83 \times 0.0621 = 5.15$ per cent. for the unsaponifiable matter in the grease. Then the analysis would read thus:—

	Per Cent.
Volatile acids.....	1.28
Insoluble free fatty acids.....	20.22
Combined fatty acids.....	48.47
Combined alcohols.....	31.32
Unsaponifiable.....	5.15
	36.41

The recovered grease contains therefore, in round figures, after deduction of 1.76 per cent. for the elements of water added during saponification, 78 per cent. neutral fat.

I was fortunate enough to obtain the distillates of this very same wool-fat, both the liquid and the solid parts of it, which had been prepared on a large scale in oil-works. The examination of the liquid part was conducted on similar lines as that of the raw fat. First the free acids were neutralised and the neutral fat *plus* unsaponifiable matter extracted by means of ether and recovered from it. It is important to note that no intermediate layer was noticed in this case. The mean molecular weight of the free fatty acids was found to be 286, and therefore they may be looked upon as a mixture of oleic, stearic, and palmitic acids with a small percentage of higher fatty acids.

1 gram. of the oil required 1.92 cc. 1/1 KOH for neutralisation of the free fatty acids; therefore we have $1.92 \times 28.6 = 54.91$ per cent. free fatty acids in the oils. As the complete saponification of the neutral oil took only 2.10 cc. 1/1 KOH it was evident that the amount of neutral oil could be very small only. A method for separating the neutral fat from the unsaponifiable matter could not be found as the latter was also insoluble in alcohol. I had therefore to content myself with preparing and estimating the acids only which were contained in the neutral fat. For this purpose the oil obtained from the ether was saponified by means of alcoholic potash, and the fatty acids recovered from the resulting soap solution; here it was noticed that the intermediate layer mentioned repeatedly above made its appearance. The acids from the neutral fat titrated with aqueous soda gave in one case the molecular weight 558; another preparation from another quantity gave 466. The latter heated to 150° C. gave the molecular weight 763, and this figure remained the same when the acid which had been used for the titration was recovered from its soap and reheated to 160° C. It was clear that the difference of the molecular weights was due to a varying degree of anhydration, and in that case both preparations ought to yield the same molecular weight, when boiled with an excess of alcoholic potash. Such, indeed, was the case, for I found for both acids the molecular weights 393 and 395, which settles definitively 394 as the true value. The percentage of combined fatty acids in the oil is therefore $39.4 \times (2.10 - 1.92) = 7.09$ per cent.

The alcohols combined with these fatty acids would be found in the unsaponifiable matter, which had to be examined next. On complete saponification the distilled fat showed 38.8 per cent. unsaponifiable matter. A preliminary estimate of the quantity of alcohols contained in the unsaponifiable part could be gained by boiling weighed quantities with acetic anhydride and collecting the resulting product on a weighed filter. The following four experiments were carried out:—

Substance employed.	Acetate obtained.	Substance employed.
Grms.	Grms.	Per Cent.
4.9167	4.9483	100.9
5.2735	5.2874	100.2
2.9995	3.0281	100.9
4.3592	4.3979	100.85
	Means	100.71

At the first blush one might feel inclined to ascribe the *plus* of 0.71 per cent. to the errors of the method, but in that case the question had to be answered: What has become of the alcohol with which the combined fatty acids have formed the neutral oil, no glycerol having been found, even if the oil contained no free alcohol? Assuming for a moment that that alcohol was cholesterol, molecular weight 372, then about an equal percentage to that of the combined fatty acids (M.W. 394) must be present in the oil, *i.e.*, 7 per cent.; therefore the unsaponifiable matter, in which these 7 per cent. are dissolved would contain the

alcohol to an extent of 18 per cent., and on boiling with acetic anhydride an increase of $18 \times 0.113 = 2.35$ would take place, or in other words the unsaponifiable matter, as used in the last four analyses, ought to have yielded 102.35 per cent. But, naturally, we have to base such a calculation on the figures found when examining the neutral fat of the recovered grease (see above), namely, 239 as the mean molecular weight of the alcohols, and 12.7 per cent. as their increase on boiling with acetic anhydride; this leads us to 101.3 per cent., with which the 100.71 actually found compare favourably. (An elementary analysis with the view of finding oxygen by difference would not have given unmistakable results.) The same calculation gives 4.26 per cent. alcohols in the distilled grease or 11 per cent. alcohols in the unsaponifiable part; consequently, the by far greatest part of the latter consists of hydrocarbons, a conclusion which is confirmed by its insolubility in acetic anhydride. The alcohol might have been extracted by means of this reagent, but on account of its high cost I had to prefer common alcohol, in which the hydrocarbons, especially at ordinary temperature, are far less soluble than the alcohols. The unsaponifiable matter was therefore repeatedly boiled up with alcohol, and the latter, after a moment's settling, poured off from the undissolved oil. On cooling slightly there separated the greatest part of the dissolved hydrocarbons, and the still warm alcohol gave at ordinary temperature a crop of indistinct crystals, which, on recrystallising from alcohol-ether yielded a semi-crystalline mass, to all appearances similar to the mixtures of alcohols as obtained during the examination of the recovered grease. The alcohols thus prepared show very distinctly the ischolesterol reaction.

Through the exhaustion of the unsaponifiable matter by means of alcohol the hydrocarbons were at last left behind. Their insolubility in acetic anhydride, and to some extent in alcohol, as well as their behaviour towards nitric acid, characterised them as hydrocarbons. A closer examination of them is, for want of proper methods, a hopeless task, and all that could therefore be done with them was to distil them in vacuo. Thus three fractions were obtained. All of them possessed the smell which the crude distillates of paraffin oils, boiling at the same temperature, possess. These fractions are a little more defined in the subjoined table:—

Fraction.	Sp. Gr. at 80° F. compared with Water at 80° F.	Appearance.
1st	0.8513	Clear, bright yellow oil; bloom.
2nd	0.9162	Bright oil, partly solidifying; bloom.
3rd	0.9180	Darker oil, solidified; bloom.

The residue was pitch.

I repeat the complete analysis of the distilled grease in a tabulated form:—

	Per Cent.
Free fatty acids	54.91
Combined fatty acids	7.02
Unsaponifiable	38.80
	100.73

which can be resolved in the following way:—

	Per Cent.
Free fatty acids	54.91
Combined fatty acids	7.02
Combined alcohols	4.26
Hydrocarbons	31.54
	100.73

A more rapid way of analysing such distilled grease, recommendable to analytical chemists, would be to titrate as above, but to use for the determination of the mean molecular weight *all* the fatty acids (free and combined) and *alcoholic* potash or soda. Proceeding in this way I

found the mean molecular weight of all the fatty acids 300.5 (titration with aqueous soda gave 317), and therefore the percentage of all the fatty acids 300.5×2.1 per cent. This way of calculating leads to the equally satisfactory result:—

	Per Cent.
Fatty acids	63.1
Unsaponifiable	38.8

The weighing of all the fatty acids directly—Hehner's method—would in *this* case be nearly as accurate as can be wished for, and the adoption of such a gravimetric method (preferably combined with the direct determination of the Unsaponifiable) would remove the uncertainty adhering to the commercial analysis of such distilled grease, and caused by the *assumption* of a molecular weight for the acids and calculation of the unsaponifiable matter by difference.

The solid part of the distilled grease was only cursorily examined. 1 grm. of it required 2.19 cc. normal caustic soda for saturating the free fatty acids. On boiling the fat with alcoholic potash 1 grm. consumed 2.30 cc. The last figure points to the presence of neutral fat, and its quantity would be found corresponding to the difference $2.30 - 2.19 = 0.11$. The unsaponifiable matter amounted to 34.05 per cent.

A comparison of the analyses of the recovered grease and of the distillates therefrom shows that hydrocarbons have been formed during the distillation to a large extent—a fact which cannot be at all surprising. On examining such distilled oils, the origin of which may not be known, one might easily feel inclined to declare these hydrocarbons as mineral oil. But such a misnomer, besides suggesting fraudulent intentions, might lead to unpleasant consequences for the buyer of such oils, for insurance companies generally become suspicious when “mineral oil” is only mentioned. The distilled grease legitimately contains a larger amount of hydrocarbons, which, as *I am given to understand*, are said to constitute the valuable properties of such oils.

As there is no method known for distinguishing the hydrocarbons formed by destructive distillation from any (fraudulently) added mineral oil, due caution should be exercised in giving a report on such oils.

A comparison of the two analyses further throws an interesting light on the destruction that takes place. We notice at once that the neutral fat constituting as much as 78 per cent. of the recovered grease has been destroyed nearly completely.

In the first instance the ethers will have been broken up into their fatty acids and hydrocarbons, the latter being naturally formed in consequence of the fatty acids claiming all the available oxygen for themselves. We know this from actual experiments. Berthelot has shown that cholesteryl stearate becomes acid on heating. We know further from Smith's experiments (Ann. Chim. Phys. [3] 6, 40) that cetyl palmitate distilled under ordinary pressure splits up into palmitic acid and cetene according to the equation $C_{15}H_{31}CO.O.C_{16}H_{32} = C_{15}H_{31}COOH + C_{16}H_{32}$. Finally Kraft (Ber. 16, 3019) has prepared, by the same reaction, from the palmitates of dodecetyl alcohol, tetradecyl alcohol, cetyl alcohol, and octadecyl alcohol the hydrocarbons: dodecylene, $C_{12}H_{24}$; tetradecylene, $C_{14}H_{28}$; cetene, $C_{16}H_{32}$; and octadecylene, $C_{18}H_{36}$.

As the distillation of the recovered grease is carried out by means of superheated steam, it is not surprising to find that part of the neutral fat escaped destruction, for we know that cetyl palmitate, e.g. can be distilled in vacuo without undergoing decomposition.

The free alcohols—or if any be formed by the destruction taking place in such a direction—will at such high temperatures easily lose water and contribute their share to the production of hydrocarbons.

It is well known that the cholesterol is decomposed into hydrocarbons when subjected to dry distillation; the other alcohols may undergo similar changes, and that not only during distillation, but already in the preceding operation of washing with concentrated sulphuric acid. Cholesterol,

e.g. is converted by this acid into three isomeric hydrocarbons as Zwenger (Liebig's Annalen (1848), 66, 5) has shown.

The fatty acids in their turn undergo a breaking up into acids of lower molecular weight, and, to all appearances, in particular the higher fatty acids will be subject to this change, for oleic, stearic, and palmitic acids can be easily distilled without much destruction in a current of superheated steam. A small quantity of hydrocarbons, however, are always formed when these lower fatty acids are distilled in candle works, and so we have to look to some extent to the fatty acids as a further source of the distilled-grease-hydrocarbons.

The chemical constitution of some of these higher fatty acids, which must be claimed as hydroxylated fatty acids, seems to make them specially fit—I nearly said to predispose them—for this change. A certain amount of proof can be adduced from the above-recorded observations for this supposition. The formation of that difficultly-soluble soap, so unpleasantly noticeable during the neutralisation of the free fatty acids of the recovered grease, was completely absent when the distilled grease underwent the same operation. On saponifying, however, the neutral fat of the latter, that intermediate layer made its appearance again; this cannot be adduced as contradicting my assumption, for it simply shows that the current of steam mechanically carries over the neutral fat, and thus withdraws it from the destructive influence of the high temperature.

III.—QUANTITATIVE ESTIMATION OF CHOLESTEROL.

During the examination of the recovered grease I felt very much the want of a method of estimating cholesterol quantitatively. The separation of cholesterol in substance or in form of its ethers as cholesteryl acetate or benzoate could, of course, not lead to quantitative results. An optical method: the determination of the cholesterol by the rotation of the plane of polarised light, was *a priori* excluded as isocholesterol, which is also present in the wool-fat, is dextro-rotatory, and would by compensation with the laevo-rotatory cholesterol lead to completely erroneous results.

A colorimetric method, based on Liebermann's cholesterol reaction, has been proposed recently by Burchard (Ber. 1890, Ref. 752), but it was, of course, out of the question to use this method for my purposes.

I had therefore to look out for some new method. A contemplation of the formula for cholesterol, $C_{26}H_{42}O$, suggests at once the possible use of methods which are generally practised in the analysis of fats. Cholesterol being an alcohol, it should be easily transformed into an ether; moreover, cholesterol being an unsaturated compound it might add iodine; and the existence of the dibromide, which has been described by Wislicenus and Moldenhauer (Liebig's Annalen, 146, 178), seemed to point to such a method. All that had to be settled by experiment was to determine whether the two reactions took place quantitatively, and for this purpose it was by no means necessary to isolate the resulting derivatives, as the saponification value and the iodine absorption value could give a satisfactory answer to that question. The experiments showed that the cholesteryl acetate and the di-iodide of cholesterol are formed quantitatively, and that these two methods afford an easy means for the quantitative estimation of cholesterol, and consequently also of isocholesterol. I subjoin the details of the analysis:—

Pure cholesterol, prepared from calf brains (in the works of Kahlbaum), was boiled with $1\frac{1}{2}$ its quantity of acetic anhydride in a flask connected with a reflux condenser; the resulting product was washed on the filter with warm water until the wash-waters showed no longer an acid reaction, and the filter with the precipitate brought into a flask to be boiled with an excess of standardised alcoholic potash. The alkali used was determined by titrating back the excess.

I.

1.5681 grm. cholesterol transformed into the acetate required for saponification 8.55 cc. $\frac{1}{2}$ normal KOH; consequently saponific. value 137.4.

II.

1.9860 grm. cholesterol required 10.3 cc. $\frac{1}{2}$ normal KOH saponific. value 132.4.

Theory indicates for the formula $C_{26}H_{42}O.C_2H_3O$ the saponification value 135.5.

For the determination of the iodine absorption value the cholesterol was dissolved in 50 cc. chloroform and 25 cc. of an iodine solution as well as of a mercury bichloride solution—prepared according to Hubl's prescription and kept separately until used—added. The unabsorbed iodine was titrated back with a sodium hyposulphite solution, 17.4 cc. of which corresponded to a quantity of 0.2 grm. iodine. It goes without saying that a blank test was used at the same time.

I.

0.6060 grm. cholesterol absorbed iodine equivalent to 35.9 cc. of the above sodium hyposulphite solution; wherefrom iodine value 68.09.

II.

0.5617 grm. cholesterol took 33.65 cc. of the solution; iodine value 67.3.

Theory requires for the formation of $C_{26}H_{41}OI_2$: 68.3 per cent. The last experiments prove that cholesterol contains one $CH=CH$ group in the lateral chain of one benzene nucleus.

After the above results had been obtained I could try how far cholesterol could be separated from other alcohols. Possessing a pure specimen of cetyl alcohol I prepared from weighed quantities a mixture of cholesterol and cetyl alcohol. The iodine value of the mixture gave the quantity of cholesterol direct. This acetate method could not be employed in a desired way, as the cetyl acetate—melting at about 22° C.—would pass through the filter, and when I cooled the filter by means of ice, filtration could not be brought to an end. I dissolved therefore the acetates in absolute alcohol, from which cholesteryl acetate is well known to crystallise in needles. Thus I obtained a crop of crystals, having a saponification value of 138.4 and 132.6 in two experiments, while the respective yields were 69.03 per cent. and 59.92 per cent. of the cholesteryl acetate which had been formed from the cholesterol weighed in. The mother-liquor from the crystals gave another crop, which in the second experiment yielded another 9 per cent. with the saponification value 168.

The first crop of crystals were nearly pure cholesteryl acetate, whilst the second crystallisation contained already notable quantities of cetyl alcohol (saponification value 197.5). It is evident that cholesteryl acetate cannot be separated completely from cetyl acetate by crystallisation from alcohol.

As I had obtained in the examination of the distilled grease mixtures of alcohols and hydrocarbons I prepared mixtures of pure cholesterol and of a mineral oil 0.880 sp. gr. to test both methods for the estimation of cholesterol in such a case.

0.8220 grm. cholesterol were mixed with 0.2393 grm. of the mineral oil (which had been tested before with acetate anhydride and found—as expected—not to require any KOH) and boiled with acetic anhydride. The mixture required for saponification 4.44 cc. half-normal KOH. The 0.8220 grm. cholesterol must have given theoretically 0.9148 grm. acetate, which had consequently the saponification value 136.1 instead of 135.5.

The percentage of cholesterol in the mixture could have been found at once by means of the formula—

$$P = \frac{a \times 561 + 372}{S \times 414 + 135.5 \times 100}$$

where a is the number of cc. 1/1 normal potash used, S the substance weighed, 56.1 the molecular weight of KOH, 372 that of cholesterol, and 414 of cholesteryl acetate, whilst 135.5 is the saponification value of cholesterol. The calculation gives 77.82 per cent. cholesterol; the mixture actually contained 77.45 per cent.

The iodine method gave for the mixture of cholesterol and mineral oil equally good results. The mineral oil absorbed 26.3 per cent. iodine when tested separately.

(1.) A mixture of 0.7208 gm. cholesterol and 0.3379 gm. of this mineral oil absorbed 54.38 per cent. iodine, that is for the sum $0.7208 + 0.3379$ a quantity of 0.5757 gm. iodine. The theoretical calculation gives—

$$\frac{0.7208 \times 68.3 + 0.3379 \times 26.3}{100} = 0.5810 \text{ gm.}$$

(2.) 0.7263 gm. cholesterol + 0.3361 gm. mineral oil absorbed 54.3 per cent. or 0.5771 gm. iodine; theory requires 0.5845 gm.

This second method will allow a limited application only, as the iodine value of the hydrocarbons must be known, which will not be always the case.

In conclusion I wish to say a few words about the qualitative reactions for cholesterol and ischolesterol. Colour reactions, especially those requiring the use of concentrated sulphuric acid, should always be looked upon with some suspicion, which can only be heightened if we remember the fate of, e.g. the isatine reaction for benzene, of Laubenheimer's reaction for phenanthrenequinone, &c. Liebermann's "Cholesterol" reaction for cholesterol—acetic anhydride and sulphuric acid; sharper still is the test in the modified form proposed by Burchard, 2 cc. chloroform, 20 drops of acetic anhydride and sulphuric acid—is a beautiful reaction for pure cholesterol, but unfortunately resins possess a reaction so similar to the cholesterol reaction that a discrimination would be difficult. The corresponding reaction for ischolesterol, recently proposed by Schulze (Ber. 24, Ref. 671), (green fluorescence) is very sharp too, but in a mixture of ischolesterol and cholesterol, which which we undoubtedly have in the alcohols prepared from "Lanolin," the ischolesterol reaction prevails, as I had occasion to observe. Amongst a large number of experiments I only occasionally succeeded in noticing the pink colouration due to the presence of cholesterol, and it would therefore be rash to pronounce absence of cholesterol, if the green fluorescence only is noticed. The reaction with iron perchloride and strong hydrochloric acid on a porcelain crucible cover is not exclusively peculiar to cholesterol, for turpentine, camphor a.o. behave in the same way (Weyl, Ber. 1886, Ref. 619).

DISCUSSION.

The CHAIRMAN remarked that the subject was one of great interest to members, as some 12,000 tons of wool grease were recovered annually from mills in the district alone. The author had shown that the analysis was complicated in the case of pure wool grease; this was much more the case when grease was adulterated with mineral and rosin oils. Samples of greases, though similar in appearance and containing equal amounts of saponifiable matter, might vary in value from 8*l.* to 16*l.* per ton. He exhibited samples and illustrated the methods of determining commercial value in the case of a grease worth 13*l.*, which showed:—

1. Specific gravity.....	0.941
2. Flash point	415° F.
This shows it can contain no mineral oil after it has been established that no rosin oil is present.	
3. Setting point of fatty acids	101° F.
4. By titration of saponifiable matter and calculation to a molecular weight of 282 there was found:—	
Saponifiable	= 51.21 per cent.
Unsaponifiable (by difference).....	= 46.79 "
" (by ether extraction) = 41.70 "	

The difference between the calculated and observed amount of unsaponifiable matter gave, roughly, an indication of cholesterolinoid bodies present. He calculated for every 1 per cent. of difference 10 per cent. of cholesterolin present. The cerotic compounds left unsaponified formed a hard mass of high specific gravity. On distillation the cholesterolinoid bodies changed into other hydrocarbons, and the specific gravity sank (in this sample) to 0.914 and the flash point to 330° F. The proportion of fatty acid did not alter more than 2 per cent. These hydrocarbons had the appearance of mineral oils. Dr. Hess concluded by

expressing a wish that chemists would adopt some uniform method of determining the amounts of saponifiable and unsaponifiable constituents in such greases, since results of analyses of the same material by different chemists sometimes differed as much as 5 per cent.

Mr. FAIRLEY asked whether dry distillation, or distillation with superheated steam, was employed for purifying the grease?

The CHAIRMAN said that superheated steam was always used.

Mr. FAIRLEY thought it surprising that so much hydrocarbon should be formed in presence of an excess of steam.

The CHAIRMAN replied that the hydrocarbons were present before, but in a different form.

Mr. RICHARDSON asked Dr. Lewkowitsch if he considered the "acetyl values" were reliable, the process being used as supplementary to the ordinary methods in the general analysis of oils in soap, &c. He mentioned the action of oils on samples of tops; after an interval of a month the iodine absorption value was reduced from 100 to 50, due apparently to oxidation of the oil.

Professor HUMMEL was surprised to learn that there was so much unsaponifiable matter in distilled grease used to oil wool for spinning. He believed such bodies were difficult to scour; the difficulty had been attributed to intentional adulteration with mineral oil. He desired to know what sort of a residue was left on distillation, and whether anything was known of its composition. He had some years ago obtained a similar waxy product from apple parings by extraction with ether, and it had recently been shown that cholesterolin exists in vegetable material.

The CHAIRMAN said mineral oil was often mixed with grease and was undoubtedly deleterious to the wool. He thought Dr. Lewkowitsch wished to find some method of distinguishing this from cholesterolinoid material. In reply to Professor Hummel he stated that the residue left on distilling grease was pitch. The distilled grease from the sample shown was pressed into stearine and oleine, and the former contained 33 per cent. of unsaponifiable matter, and had a melting point of 118° F.

Mr. PROCTER inquired if Dr. Lewkowitsch had ever come across an animal oil possessing a distinct bloom like mineral oils. He had once obtained, by pressing fats obtained in gelatin manufacture, an amber-coloured oil with green fluorescence.

The CHAIRMAN replied that the hydrocarbons obtained by the distillation of cholesterolin had a distinct bloom, palm oleine occasionally, showed this fluorescence.

Mr. MACKAY asked how it was that an increase of 10 per cent. in the unsaponifiable matter caused a rise in value of 3*l.* per ton, and, if so, would not the pure cholesterolin products be very valuable.

The CHAIRMAN said the increased value was due to the extended application of such greases, as, for instance, in the manufacture of lanolin and vinolia soap. If it were possible to obtain cholesterolinoid substances cheaply and free from fatty acids they would be most valuable for lubricating purposes.

Mr. MANSBRIDGE said he had examined large numbers of greases and had never found more than 1½ per cent. of neutral oils; he believes that neutral fats to be almost entirely decomposed in the still.

Professor HUMMEL stated that attempts had been made of recent years to scour wool with petroleum ether, carbon disulphide, &c., thus extracting a fatty matter containing cholesterolin. He wished to know whether a large sale of the extracted matter could be assured, supposing such a process were introduced.

The CHAIRMAN replied that such processes had often been tried, but without success; under the influence of hot solvents, the wool became brittle and yellow. The products would be very valuable, but the wool would be spoilt.

Dr. LEWKOWITSCH severely criticised Dr. Hess' analyses (the details of one of which are given above). The 51 per cent. "saponifiable" would only be free fatty acid. The 46.79 per cent. "unsaponifiable" be considered not at all reliable; it was determined merely by difference, but he should like to know how and whether that was so, since 51.21 and 46.79 gave 98 per cent. only. "Saponifiable" was also determined by calculating from an assumed molecular weight. The extraction with ether could not give too low a value; it might give a value *higher* than the true one, as a small amount of soap might have been extracted and overlooked. He therefore attached no scientific value to these figures.

The CHAIRMAN defended his analyses and remarked that they agreed within 0.1 per cent. with analyses by Allen and other chemists of the same samples. When cholesterinoid bodies were present it was usual to assume a molecular weight not of 282 but over 300 in calculating the results. In the results above given, 41.7 per cent. would be taken as correct. He knew the other figure was incorrect, but the difference between it and the experimental figure gave a rough idea of the amount of cholesterin present.

Dr. LEWKOWITSCH, answering Mr. Mansbridge, said that his paper only dealt with this one fat, and that if Mr. Mansbridge questioned the amount of combined fatty acids in the distilled grease, he could only refer to his figures. He had found the mean molecular weight of the free fatty acids of the distilled grease = 286; the molecular weight of all fatty acids (combined and free) = 300.5 and the molecular weight of the combined acids 394. The amount of combined fatty acids corresponds to the difference of KOH used for neutralising and saponifying = $2.10 - 1.92 = 0.18$ and $0.18 \times 39.2 = 7.02$ as to the hydrocarbons. He showed three fractions obtained by the distillation of the crude hydrocarbons contained in distilled wool-grease, the specific gravity of which was respectively 0.851, 0.918, 0.92. Admixture of resin oils would, he remarked, be shown by the high specific gravity of these distillates. The polariscope could not be used as the hydrocarbons obtained from cholesterins are optically active, and would contain cholesterin as shown. In answer to Mr. Fairley, he said that superheated steam does not act as so much water would do, but simply as a vehicle to convey the products out of the still as quickly as possible. Replying to Mr. Richardson, Dr. Lewkowitsch suggested that the oil used on "tops" may have been adulterated with linseed oil, which, as is well known, contains a series of acids from $C_{18}H_{36}O_2$ to $C_{18}H_{30}O_2$, the least saturated of which ($C_{18}H_{32}O_2 = C_{18}H_{20}O_2$) easily take up O.

Mr. RICHARDSON explained that he had been unable to find any linoleic acid in the oil.

Dr. LEWKOWITSCH, speaking of the "acetyl values," remarked that acetic anhydride, as he had shown recently, acted on normal fatty acids, forming anhydrides, e.g. $(C_{15}H_{31}CO)_2O$ which is not attacked easily by aqueous caustic soda, and not hydrolysed completely by it; on the other hand, acids of a constitution similar to—



take up one (C_2H_3O) group, and the saponification value comes out twice as great as that of the original acid.

With regard to *bloom*, he had not noticed it on animal oils, but it was shown by the hydrocarbons under discussion.

He further stated that the substances obtained from recovered grease should not be used in the manufacture of household soaps, but are said to do for milling soaps.

The *pitch* left behind in the retort is valuable for greasing the necks of hot rollers.

Glasgow and Scottish Section.

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Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1891—92.

March 1st (Glasgow):—

Mr. G. Watson, jun. "The Preparation of Pure Phosphoric Acid from Phosphate of Soda."
Mr. W. J. A. Donald. "On Bauxite."

April 5th (Glasgow):—

Mr. C. A. Fawsitt. "The 'Dry Heat' Vulcanisation of Rubber with Special Reference to the Use of an improved Vulcaniser."

Obituary.

THOMAS W. B. MUMFORD.

It is with regret that we have to announce the death of Mr. Thomas W. B. Mumford, Honorary Secretary of the London Section of the Society.

Early in life he entered the employment of Messrs. James Gibbs and Co., vitriol and manure manufacturers, in a comparatively humble position, and by his skill, energy, and perseverance, rapidly rose in the estimation of the firm, and was appointed manager of their Plymouth works, and at a later date held the same position at their principal works in London. He joined the Society of Chemical Industry in 1883, and succeeded Mr. Tyrer as secretary of the London Section in 1890, on the elevation of the latter to the Chair. He was the author of various improvements in his own branch of manufacture, particularly in the construction of roller-mills for phosphates, and was joint inventor with his colleague, Mr. Moodie, of the now well-known Separator. He discharged his secretarial duties in an admirable manner, and was universally esteemed by all who knew him, not only for his high intellectual and moral qualities, but also for his kindness of heart and readiness to serve others, which endeared him to all and rendered his early death so much to be deplored. He was taken ill at the Annual General Meeting in Dublin in July last year, and soon afterwards symptoms of consumption declared themselves. A visit to Bournemouth failed to effect any improvement, and upon his return he took to his bed.

He died on 26th December 1891, in the 47th year of his age, leaving a wife and two children to mourn his loss.

CHARLES HEISCH.

MEMBER OF THE SOCIETY OF CHEMICAL INDUSTRY.
THE CITY GAS EXAMINER; ALSO PAST PRESIDENT OF
THE SOCIETY OF PUBLIC ANALYSTS.

CHARLES HEISCH was born at Blackheath, Kent, on the 2nd August 1820, and was the youngest son of the late Frederick Heisch, of Messrs. Cox, Heisch, and Co., America Square, London. Even in boyhood he was distinguished by his partiality for chemical studies, and was clever in constructing scientific apparatus and models. This led to his being placed with Mr. Richard Phillips, who was then occupying temporary premises at Craig's Court, Charing Cross, during the construction of his laboratory and lecture room in the Museum of Economic Geology, Jermyn Street. In 1842, Heisch became assistant to Dr. Leeson at St. Thomas's Hospital, and whilst here made chemical analyses of the large number of calculi forming the collection in the Anatomical Museum. Six years later, in 1848, he was elected joint Lecturer on Chemistry with Mr. Thomas Taylor at the Middlesex Hospital, a post which he retained for upwards of 20 years. Meanwhile, in 1868, he was appointed Superintending Gas Examiner to the Corporation of London, the duties of which office he continued to fulfil almost up to the time of his death on the 2nd January last.

Mr. Heisch attended the Jubilee Meeting of the Chemical Society in May last, and was publicly referred to as being one of the three or four survivors who took part in the original formation of that Society in March 1841. He was, besides, one of the founders of the Society of Public Analysts, and for some years Secretary, becoming President, as stated, in 1881-82. He likewise took an active part in the formation of the Photographic Society, and has been for many years a member of this Society. His most important contribution to chemical science was the "Sugar Test" for determining the quality of potable waters (*Chem. Soc. Jour.* 1870, Vol. XXIII., 371.) This, with other papers in the *Journal of Gas Lighting*, the *Analyst*, and *Chemical News*, besides sundry researches in photographic practice, such as the accurate rendering of coloured objects by means of bromized collodion, and improvements in apparatus, make up the sum of Mr. Heisch's experimental record. He married somewhat late in life, and leaves a widow, besides many private friends, to mourn his loss.

WILLIAM DITTMAR, LL.D., F.R.S.

FORMERLY VICE-CHAIRMAN OF THE GLASGOW AND
SCOTTISH SECTION OF THE SOCIETY
OF CHEMICAL INDUSTRY.

PROFESSOR OF CHEMISTRY IN THE GLASGOW AND
WEST OF SCOTLAND TECHNICAL COLLEGE.

It is with deep regret that we have to announce the death of Professor Dittmar, of the Glasgow and West of Scotland Technical College. Although for the past few weeks he had not been quite well, no symptoms of a serious kind presented themselves so as to interfere with the discharge of his duties or to cause anxiety to his friends. On Tuesday forenoon he delivered his lecture as usual, although a want of readiness was noticeable. In the earlier part of the afternoon he returned home, and, while evidently out of sorts, it was only after four o'clock that it seemed needful to ask medical advice. He passed away shortly before midnight. It is satisfactory to know that he was spared pain, and complained merely of a feeling of uneasiness. The immediate cause of death was a failure of the nerve centre regulating the breathing, and there was a slight cerebral hemorrhage.

Since the year 1874, when he was appointed, on Professor Thorpe's resignation, to the Chair of Chemistry in the Anderson's College, the striking personality and the high repute of Dr. Dittmar have been well known to the Glasgow public. He was called to occupy a chair deriving its prestige from the names and work of Graham, Ure, and Penny, and the success with which Professor Dittmar discharged his academic duties, while extending the domain of his science, proves that his presence and work shed an additional lustre on the chair and college, already illustrious through these names. During his 17 years of work here, Professor Dittmar has made his laboratory second to none perhaps in Great Britain as a training school of young men devoted to chemistry as a profession. From comparatively small numbers in the earlier years, the laboratory roll has risen to on an average over 50. The reason was not far to seek. Professor Dittmar was a man of admittedly profound knowledge, standing in the front rank of chemists both as a theorist and a practical analyst, an enthusiast gifted, strange as that may seem to be, with an indomitable scientific pertinacity and a far-reaching speculative power, brought into harmony and rendered practically effective by a clear conception of the value of routine. Above all, he had the mark of every great teacher—the power of drawing to himself the hearts of his students, and of controlling and stimulating in them the aspirations which his instruction engendered.

Professor William Dittmar, LL.D., F.R.S., L. and E., was born at Umstadt, near Darmstadt, Germany, in the year 1833, and adds one more name to the list of distinguished chemists, embracing Liebig, Strecker, Kekule, and Schorlemmer, who have made the latter town famous. Intending at first to follow the pharmaceutical profession, he fortunately changed his mind, and entered in 1857 the laboratory of the celebrated Bunsen, who, discerning the promise of his student, offered to Dittmar an assistantship. In this capacity it was that Professor Sir Henry Roscoe made his acquaintance, and he, too, impressed by Dittmar's rare powers, invited him to become his private assistant. After Roscoe's appointment to the Chair of Chemistry in Owens College, Mr. Dittmar accompanied him thither, and only left Manchester to become in 1861 Dr. Lyon Playfair's chief laboratory assistant. In 1869 he returned to Germany, and during the next three years acted as a "Privat Dozent" and lecturer on meteorology at Poppelsdorff. Though offered a chair in Cassel he preferred to return to Scotland in 1872 to hold under Professor Crum Brown the same post that he had held under Sir Lyon Playfair. It is pleasing to think that this led to a deep and lifelong friendship based upon the excellence of heart, frank and genial bearing, and high-souled integrity of both him who is left and him who is gone. It is hard to tell which entertained the higher opinion of the other's nature and scientific power. One thing is certain that Professor Dittmar was habitually called in to co-operate by authorities such as Crum Brown and Dewar as a fellow-expert whose opinion was, to men of science at least, *absolute*. On being offered the newly-instituted Chair of Practical Chemistry in Owens College, he removed to Manchester, only to return after a brief period to Scotland. The trustees of the Anderson's College here did honour to their own judgment and a lasting benefit to chemical science in Scotland in recognising the claims of William Dittmar to a chair such as they had to offer. To the transcendent ability of Professor Dittmar the governors who elected him and their successors have never been blind. So perfectly, indeed, has he performed his functions, and furthered the interests of his college, that, though his ideal of his sphere was by many felt to be almost impracticably high, there must be in all the conviction that it will be very difficult soon to make good his loss.

The labours of Professor Dittmar are, in their abstruseness, thoroughness, and extent, incapable of being either duly detailed here or adequately valued by anyone not himself an expert in physics and chemistry. As a

lecturer we knew him and admired his natural, spontaneous, clear way of conveying his ideas. As a laboratory teacher it was impossible not to be impressed by the light value in which he held labour so long as truth and accuracy might be attained, nor to be almost taken aback by his enormous fertility of resource. Even as a practical analyst commercial men knew his worth. But his work as a scientist must be left to time to estimate. One thing is certain, critics are united in recognising the thoroughness, great variety, and true scientific worth of all he has done. It is not too much to say that the honours which have fallen to him of late years, and the crowning honour of the Graham medal, conferred on him for his laborious, difficult, and successful investigation of the "Gravimetric composition of water," are only first hints of the recognition of his great scientific services. It is only necessary to mention here two of his more generally known original contributions, and which, like the whole of his extensive scientific work, show that striking originality and character that were peculiarly his own. The contribution which is probably best known to the ordinary non-scientific world comprised the incessant and painstaking work of three years, namely, that in connection with the "Challenger" expedition of 1873-76. His work and publications on the chemical balance are known to every scientist, and he was universally recognised as one of the highest authorities on this as on many other subjects. He also wrote numerous and voluminous articles in all the best known cyclopædias of Britain and the Continent, and was a constant contributor to some of the most famous Continental scientific periodicals.

As a man, it is impossible to speak too highly of Professor Dittmar. Widely cultivated, simple in his tastes, unaffected in his manners, genial even to jocularity, he was one who readily endeared himself to all with whom he came in contact. But he was also a man of thorough uprightness, who persisted without flinching in what he thought was right, and who, generous in his antagonism, might find opponents but could leave no enemies. By his family, his students, and his many friends his loss is deeply felt, for it was impossible to find one more domestic in his affections, one more able and willing to advise and aid, or one in whom the light of friendship shone with greater steadiness and purity.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

A New Syphon F. Konther. Chem. Zeit. 1891, 15, 1126.

See under XXIII., page 181.

PATENTS.

A Crusher and Pulveriser. W. C. Morison, Plymouth. Eng. Pat. 14,945, September 22, 1890. 8d.

The apparatus consists of an upright stationary vessel having a hemispherically-shaped bottom, with sides inclining outwards, and having a circular hole in the bottom corresponding with a circular hole formed in the central portion of a hemispherically-shaped cast-iron "piece," upon which it fits and works. The sides of this "solid piece," are also inclined outwards. The material to be operated upon is broken between the "solid piece" and the sides of the vessel, and when crushed sufficiently small, drops into the gradually diminishing space between the sides of the "solid piece" and the vessel, until it reaches the lower end, where it is subjected to a further grinding action, and is finally discharged through the hole in the bottom. The incline of the solid piece can be regulated at pleasure. This piece is prevented from rising during the crushing of the material by the upper portion of the revolving shaft working against discs placed in a rigid frame, thus resisting the upward pressure. The "solid piece" is covered and the sides of the vessel are suitably lined with hard metal.—E. S.

Improved Filter for Oils, Lubricants, and other Fluids. W. H. Wilcox, London. Eng. Pat. 101, January 2, 1891. 6d.

See under XII., page 169.

Improvements in Multiple Effect Evaporating Apparatus. A. Chapman, Liverpool. Eng. Pat. 1194, January 22, 1891. 8d.

THE object of this invention is an improvement of "Yaryan" triple effect apparatus. Owing mostly to the employment of long tubular worms, the pipes get readily furled and filled with deposit when treating certain liquors, unless they are blown out and cleaned once or twice a day. This reduces the quantity of work done as well as the density of the concentrated liquor, and the difficulty is sought to be overcome by the addition of a vertical tubular evaporating vessel as shown in the arrangement illustrated.

a b c represent three vessels of a triple effect apparatus; *d* is the additional vessel containing vertical tubes passing through a steam drum; *e* vapour pipe from the last vessel *c* of the "Yaryan" apparatus leading to the steam space of drum *d*. The inverted syphon *f* removes the condensed

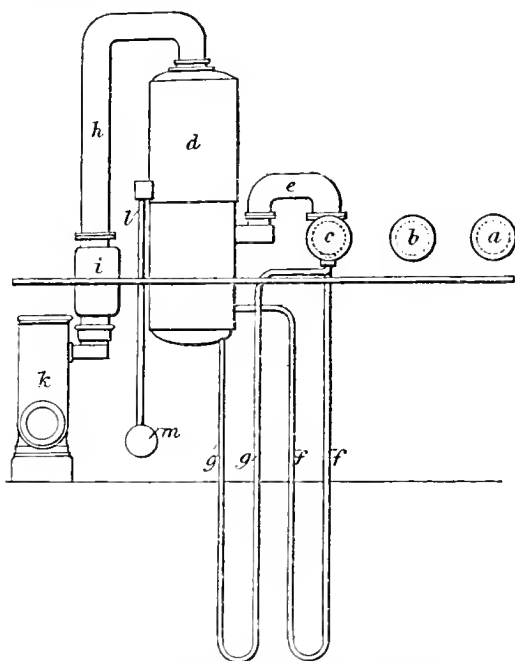
* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	½d.
Above 8d., and not exceeding 1s. 6d.	1d.
" 1s. 6d., " " 2s. 4d.	1½d.
" 2s. 4d., " " 3s. 4d.	2d.

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water from *c*, and syphon *g* conducts the partially concentrated liquor to the lower end of the vertical tubes in the vessel *d*, after passing which it overflows through *l* and is



taken away by the pump *m*. The vapour passes through the pipe *h* into the condenser *i* and air-pump *k*.

There are two claims.—B.

Improved Oil Filter. C. E. Masterman and "Woodhouse and Rawson United Limited," London. Eng. Pat. 1766, February 3, 1891. 8d.

See under XII., page 169.

An Improved Evaporator and Surface Condenser for Producing Pure Distilled Water. W. P. Cotton, London, and E. L. Garrett, Wallington. Eng. Pat. 2141, February 5, 1891. 8d.

In this apparatus the water is evaporated by means of steam and is afterwards condensed. Within a vertical chamber two series of tubes are arranged surrounded by cold water admitted at the lower part of the chamber. Steam admitted to the upper series of tubes heats the water surrounding them, and the steam formed rises to the upper part of the chamber, and passing down pipes to the lower series of tubes is condensed by the cold water surrounding them, flowing away through a pipe to any suitable receptacle.

—E. S.

An Improved Apparatus for Distilling Water and other Liquids. W. T. Cotton, London, and E. L. Garrett, Wallington. Eng. Pat. 2142, February 5, 1891. 6d.

This invention is a modification of Eng. Pat. 2141 of 1891 (see preceding abstract). Two suitably shaped vessels are each divided into two chambers by plates, from which are suspended, in the chamber below, a number of tubes, open at the top but closed at the bottom. Between the two vessels is a cistern supplying water. A pipe from the bottom of the cistern conveys the water to the upper chamber of one vessel, and to the tubes beneath, and overflows through a pipe in the lower part of the upper chamber into the upper chamber and tubes of the second vessel. Beneath these latter tubes an atmospheric gas burner is

placed; this heats the water and the steam rises into the upper chamber and passes by a pipe to the space beneath the tubes in the first-named vessel, and being condensed falls into the space beneath them, whence the distilled water is conducted to any suitable receptacle.—E. S.

Improvements in Couplings for Glass Tubes or for Tubes Lined with Glass. D. Rylands, Stairfoot, and R. Morant, Barnsley. Eng. Pat. 3172, February 21, 1891. 6d.

See under VIII., page 162.

Improvements in or Connected with Vacuum Distillatory Apparatus. E. Luck, London. Eng. Pat. 3955, March 5, 1891. 6d.

THE patentee's aim is to withdraw the spent or exhausted liquor from an ordinary vacuum still without destroying the vacuum, thereby enabling the process to be carried on continuously. For this purpose he connects to the lower part of the still when required, either a pump, or a descending tube of such length as to enable the liquor therein to balance the atmospheric pressure.

The claim is illustrated by one drawing.—B.

Improvements in Machinery or Apparatus for Producing Cold by the Employment of Carbonic Anhydride. E. Hesketh and A. Mareet, London. Eng. Pat. 12,469, July 22, 1891. 8d.

THE patentees claim:—(1.) An arrangement of compound engine with cylinders fixed tandem fashion, and two compressing cylinders attached capable of being thrown out of gear separately, and the whole power of the engine applied to one of the compressors. (2.) An arrangement of condensing pipes in the foundation plate. (3.) and (4.) Passing the cold carbonic acid gas through passages cast on the compression cylinders for keeping them cool.

For details the specification and three sheets of drawings should be consulted.—B.

Improvements in Machinery or Apparatus for Producing Cold by the Employment of Carbonic Anhydride. E. Hesketh and A. Mareet, London. Eng. Pat. 12,676, July 23, 1891. 11d.

To avoid dangerous over-pressure in the passage between the compressor and condenser of such apparatus, when the screw-down valve has been inadvertently closed, the patentees introduce a thin plate of copper or other material calculated to burst when a certain pressure has been exceeded, and they further add a safety valve in some cases outside the relief plate, for the purpose of preventing the escape of the whole of the gas after the plate has burst. The patent also covers a provision for separating any lubricant from the carbonic anhydride after leaving the compressor, and arrangements for facilitating the cleaning of the exterior of the refrigerator pipes by constructing the outer tank in parts for easy removal. When used for the production of ice the pipes are placed close together so as to touch, with a view to separate the ice coating into two parts as it is being formed on the circumference of the pipes, thereby enabling its easy disconnection.

Cross partitions or walls of wood may be fitted to the pipes for further subdivision of the blocks.

There are seven claims and three sheets of drawings.—B.

Improvements in Apparatus for the Automatic Control of Sulphuric Acid Supply to Carbonic Acid Generators used in Aired Water Manufacture and other Industries. H. C. Cox, Olton. Eng. Pat. 17,034, October 7, 1891. 6d.

See under VII., page 162.

Improvements in or relating to Centrifugal Separators for Granular Substances. H. Pape and W. Henneberg, Hamburg, Germany. Eng. Pat. 19,694, November 13, 1891. 6d.

THE object of this invention is to arrange the shaft or spindle carrying the distributing disc, in a continuous working centrifugal separator, in such a manner that all the bearings requiring lubrication are situated above the disc and cover of the machine, whilst also securing a central receiving cavity under the distributing disc. To effect this, the spindle carrying the disc, and the framework are supported on the cover of the receiving chamber. The materials are brought to the disc through a pipe from a suitable hopper, and are prevented from touching the spindle by a sleeve extending centrally within the pipe, and surrounding the central spindle, and are distributed into a series of concentric receivers, the heavier materials being thrown on to the outer receivers, and the lighter particles on to the inner receivers, the lightest of all falling into a central cavity below the disc, whence they may be continuously removed.—E. S.

An Improved Tool for Cutting Glass Tubes. A. W. Chesterton, Boston, U.S.A. Eng. Pat. 20,211, November 20, 1891. 6d.

See under VIII., page 163.

II.—FUEL, GAS, AND LIGHT.

Petroleum and Asphalt at Palena, in Payta. Analogy between Salt and Coal Deposits. C. Ochsnius. Chem. Zeit. 1891, 15, 1866—1867.

See under III., next page.

PATENTS.

An Improved Manufacture of Incandescent Bodies for Incandescent Gas Lamps. L. Haitinger, Klosterneuburg, Austria. Eng. Pat. 586, January 12, 1891. 6d.

A SUITABLE refractory material for incandescent gas lights is made by mixing alumina with a small proportion of chromium oxide, and heating the mixture for some time at a high degree of incandescence. The chromium oxide may be partly or wholly replaced by manganese oxide, and either magnesia or zirconium oxide or lime may be substituted for part or all the alumina. Salts may be employed instead of oxides. Fixed acids or alkalis in small quantities are not prejudicial.—D. A. L.

A New Fuel. A. L. Keller, London. Eng. Pat. 1237, January, 23, 1891. 4d.

NATURAL or compressed peat, which may be mixed with sawdust or coal-dust, is taken and moulded into bricks or left in its natural form. Any other suitable absorbing material may be used.

The material after drying is immersed in a suitable bath of hydrocarbons heated to 120° to 150° C. The refuse of petroleum or of shale oils or gas-tar may be used alone or combined with resins, naphthalene, or other cheap solid hydrocarbons.

About 70 per cent. of the original weight of the weighed peat can be absorbed. After drying it is ready for use as fuel.—D. A. S.

Improvements in or connected with the Manufacture of Illuminating and Heating Gases. J. H. R. Dinsmore, Liverpool. Eng. Pat. 2948, February 18, 1891. 8d.

A HYDROCARBON liquid, such as tar, and ordinary coal-gas or water-gas, are passed into an ordinary gas retort heated in the usual manner; in this way a gas of high illuminating power is produced in large quantities. The mixed vapours and gases immediately pass downwards through a vertical pipe which dips under water, and which is kept cool by a water-jacket; the object of this arrangement is to prevent the choking of the retort outlet and to condense the unfixed tarry vapours and arrest any solid particles, so that the other pipes will not get stopped up.

The tar or other liquid may be simply dropped on to the floor of the retort through a sealed pipe, or forced in by the usual devices.—F. S. K.

Improvements in the Manufacture and Storage of Illuminating and Heating Gas. H. Fourness, Manchester. Eng. Pat. 15,469, September 12, 1891. 8d.

THIS invention consists chiefly in passing water-gas combined with that from heavy oil through an additional retort or fixing chamber, which is heated by the producer-gas formed in heating up the producer; in this chamber the gas is further enriched by the vaporisation of light oil which is admitted into the chamber. The inventor claims that by means of this fixing chamber, the gas, besides being enriched, is rendered more stable and so may be carried distances or stored for considerable periods without condensation taking place. Further, that in the formation of the water-gas, when the coke is getting cool, in order to prevent the formation of explosive mixtures on the admission of air to reheat the producer, the supply of oil is shut off and steam blown through for some time, thus clearing the retorts somewhat as well as removing explosive gases. The inventor also claims the mixing of water-gas and oil-gas in a gas-holder provided with an index, by which the proportions of the gases may be ascertained and regulated.—J. C. C.

Improved Arrangement of Coke Ovens and Retorts for the Manufacture of Coke and Illuminating Gas. W. Creswick, Wakefield. Eng. Pat. 17,222, October 9, 1891. 11d.

See under III., page 152.

Improvements in Apparatus for Manufacturing Gas. A. Kitson, Philadelphia, U.S.A. Eng. Pat. 17,557, October 14, 1891. 8d.

THIS invention consists of a somewhat complicated furnace for producing fuel gas for domestic heating, &c. Steam and air are passed downwards through the heated fuel, and the gases are conducted away through the perforated hearth and ash-pit. The furnace is slightly conical to allow the contents to fall easily; the hearth, which has a ring of vertical bars, is perforated, and has both a rotary and up-and-down motion on a hollow shaft which serves as the gas pipe. Near the bottom of this is the horizontal take-off pipe, the lower part of the hollow shaft serves as the ash-pit, and this communicates with a second chamber sealed with water, into which the ash is dumped without escape of gas. By means of the moveable hearth the fuel is stirred, caking prevented, and ash removed. Around the furnace body there are two sets of coils, in the lower of which steam is generated and passes into a chamber, where if necessary it can be charged with oil; then it is superheated in the second coil and is injected with air into the top of the furnace, the air being also heated by having circulated round an annular space round the furnace.—J. C. C.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Distillation of Coal. P. Mahler. Compt. Rend. 1891, 113, 862—864.

The products of distillation of the Commentry coal were collected and weighed, and their calorific power determined by means of an apparatus of Berthelot. It was found that the calorific power of the products was 96.5 per cent. that of the coal put into the retort. A real loss of calorific power, but a relatively small one, accompanies the process of the destructive distillation of coal.—V. C.

Petroleum and Asphalt at Palena, in Payta. Analogy between Salt and Coal Deposits. C. Ochsenius. Chem. Zeit. 1891, 15, 1866—1867.

The occurrence of petroleum on the coast of Peru between Payta and Tumbes has been known for a considerable time. The exploration has been largely in the hands of an English company, and about one-fourth of the territory for which a concession was granted has been found productive. The oil does not flow with sufficient force to rise spontaneously from the wells, and has to be pumped out. In the valley of Tucigal about 4.7 kilometres from the coast, there are 28 wells varying in depth from 45 to 240 metres, the total daily output of which varies from 1,000 to 2,000 barrels. The crude oil from Zorritos has, according to J. Salathe, a specific gravity of 0.868, and an ultimate composition of 84.9 per cent. of carbon, 13.7 per cent. of hydrogen, and 1.4 of oxygen. The sample gave the following results on distillation:—

° C.	Per Cent.	
20—30	2.8	Rhizoline.
30—80	9.0	Gasoline, of very pleasant aromatic odour.
80—150	11.1	Benzoline.
150—230	18.5	Light kerosene.
230—280	10.0	Heavy kerosene.
	12.8	Light lubricating oil.
Above 280	4.8	Heavy lubricating oil. Free from paraffin wax; becomes buttery at -30°.
	31.0	Pitchy residue.

The petroleum is brought by a pipe-line to the newly made harbour of Palena, which is about 11 kilometres from the wells.

Petroleum also occurs in Peru at Cerro de Paseo and Puno; asphalt is also found in the neighbourhood of the petroleum deposit.

The author draws an analogy between the method by which coal measures have been formed and those resulting in the production of salt deposits. In each case a bar has formed enclosing a bay which serves as a trap for any material that may be deposited therein. Thus, in the case of the salt deposits, a portion of sea-water may be supposed to have obtained access to the bay, and there under the influence of a dry atmosphere evaporated, leaving its saline constituents. In the case of the coal deposits, suspended matter swept down by a river may be conceived as being caught in the bay and gradually consolidated under climatic conditions the converse of those necessary for the formation of a salt deposit into fossil fuel. Many points of resemblance or of diametrical difference between the two processes are indicated in the author's argument.—B. B.

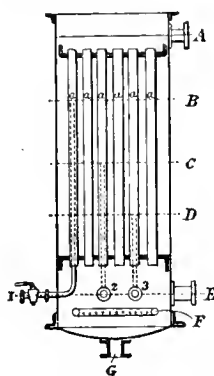
The Origin of Petroleum. A. Veith and C. Schestopal. Dingl. Polyt. J. 1891, 282, 136—138.

THE authors consider that Engler's researches (this Journal, 1889, 607) go far to prove the animal origin of petroleum, the slow decomposition of the bodies of marine animals under the influence of warmth and pressure being capable, under suitable conditions, of its production. The precise mechanism of this change is, however, not yet clear. Zalozecki and Ochsenius have put forward hypotheses (this Journal, 1891, 753; see also preceding abstract), neither of which can be accepted without reservation. The contention of the former that the natural production of petroleum cannot have been effected in the manner indicated by Engler on account of the high temperature (400° C.) used in the researches of the latter, and of the fact that naphthenes are present in petroleum but not in the artificial product, is refuted on the ground that Zalozecki himself postulates a fairly high temperature, and this, in the opinion of the authors, might be produced by the decomposition of animal matter, and that naphthenes were actually present in Engler's product, although confessedly in small quantity. Further, the argument deduced from the alleged absence of nitrogen in petroleum is demolished by the figures of actual analyses, which show that an appreciable quantity is present. Beilby has proved (this Journal, 1891, 120) that almost all samples of petroleum, of whatever origin, contain nitrogen, either in the form of organic bases or ammonium salts. He found that the quantity in petroleum residues, which contain more than the distilled oil, varied from 0.05 per cent. in Baku oil to 3.2 per cent. in the coke from a Scotch raw oil. Nitrogen is also found in the gases accompanying petroleum, 4.31 per cent. being found in an American sample, and 0.94 per cent. and 7.32 per cent. in two samples from Baku. The fact that water is commonly found accompanying petroleum does not necessarily substantiate Zalozecki's idea that it must have played an important part in the production of the latter, as its presence may be due to extraneous sources tapped by the penetration of water-bearing strata, or to the decomposition of the nitrogenous substances and the fatty material from which the petroleum was produced. The salts found in these accompanying waters may well have been derived from saline deposits in which the decomposition of the animal remains took place. The first reaction tending towards the production of petroleum would probably be the splitting off of the glycerol from the fat acids, the latter then changing into hydrocarbons of the fatty and aromatic series (with elimination of carbon dioxide, carbon monoxide, and water), and the conversion of the former into acrolein, which would then give rise to hydrocarbons of the aromatic series. Zalozecki's assumption that the origin of ozokerite may be assigned to causes similar to those governing the formation of petroleum, would necessitate the occurrence of aromatic hydrocarbons in the former substance; experimental proof on this point is therefore requisite.

The hypothesis put forward by Ochsenius (preceding abstract) that the saline waters found accompanying petroleum have had a direct influence on the formation of hydrocarbons from animal remains, has to encounter the same objection as that of Zalozecki, namely, that the water may be present either entirely adventitiously, or result from the decomposition of the animal remains themselves in the manner described above. The action of the halogen compounds of potassium, sodium, and magnesium, upon fatty materials, would appear to be, as far as our present knowledge goes, too slight to rank as the chief factor in the production of petroleum; experiments to ascertain the precise result of treating fats with the saturated solutions of these substances at high pressures are, however, very desirable.

The fundamental objection held by the authors to the above-mentioned hypotheses, lies in the fact that such water as may be necessary to carry out the reactions resulting in the formation of petroleum or to form those supplies which commonly accompany petroleum, may be accounted for by the decomposition of animal matter in the process of conversion into petroleum, instead of being of extraneous origin.—B. B.

The Rectification of Petroleum Spirit. A. Veith. Dingl. Polyt. J. 282, 159—161.



APPARATUS FOR RECTIFYING PETROLEUM SPIRIT.

THE crude spirit obtained from the first distillation of petroleum usually boils below 150° — 160° C., and has a specific gravity of 0.750 to 0.760 (the Russian spirit being generally somewhat heavier). This product has little commercial value as such, owing to its odour, colour, and the considerable amount of oil it contains; the latter characteristic especially preventing its use as an oil solvent. By careful distillation through Linneman's or Le Bel's fractionating apparatus it may be split up into four products as follows:—

	Boiling Point.
1st spirit (ether)	30° — 55° or 60°
2nd spirit	60° — 80°
3rd spirit	80° — 100° or 110°
4th spirit	110° — 140°

On the large scale, distillation with a simple condenser fed with cold water is not sufficient to obtain more than a spirit free from oil; the boiling points of the distillates varying too much to render them valuable. A considerable advantage, however, is gained even in this case by the use of horizontal stills, as the available heating surface does not decrease during the distillation to the same extent as it does with the perpendicular form.

When an efficient fractionating apparatus, such as is described below, is employed, the heating surface of the still should be sufficient to evaporate five times the amount of the distillate obtained, the remaining four parts being condensed in the fractionator and running back into the still; thus with an hourly yield of 200 litres (boiling point, 40° — 100°), the heating surface of the still should be 3.5 square metres, the still being heated with dry steam at a temperature of 140° C.

By means of the fractionator shown in the Figure, spirits may be obtained containing only from 2 to 5 per cent. of the higher and lower fractions, boiling, with this exception, within the limits given above. Water, cold at first, is supplied through the orifice G at the bottom, passing through the tubes *a* and running off from A. When the first fraction is all off the cock *b* is opened, lowering the surface of the water to the level B, and thus reducing the condensing surface; at the end of the second fraction, cock 2 being opened, the water falls to C, and so on. The temperature may also be regulated by adjusting the supply, and at the close may be raised by admitting steam through the perforated tube F. The apparatus is connected with two horizontal stills having each a heating surface of 3.5 square metres in the ordinary way, and with its aid, spirits having a specific gravity of 0.640—0.650, or even as low as 0.625, may be obtained. Owing to the amount of sulphur contained in the crude petroleum the apparatus should not be made of copper.—F. H. L.

PATENTS.

Improvements in the Production of Coke for Foundry and other Purposes. F. J. Jones, Bedford. Eng. Pat. 19,501, November 29, 1890. 8d.

IN using the process previously patented (this Journal, 1891, 242) in which coking was effected by the passage of gases from the combustion of fuel from a separate producer, the coke produced has been found to contain sulphur and other impurities derived from the producer-gases.

It is now proposed to utilise the gases given off in the coking operation for this purpose. As the gases so obtained are more than sufficient to coke a similar charge, producer-gas is only necessary to start the cycle of operations in the first ovens of a series, the formerly wasted gases serving in turn to effect the coking of the remainder and of the subsequent charges.

To ensure the purity of the coke, the gases are led through condensers and purifiers, by which means ammonia and other by-products can be recovered. The purified gases are then passed through a reheater till raised to the required temperature, and finally introduced into combustion chambers or flues round the ovens. Here sufficient air is admitted to ensure almost perfect combustion, and the products are led into the ovens to effect the coking of the fresh charge.

In practice the purified gases are preferably reheated by mixing them with fresh gases from pure fuel in the producer, the fuel used being the "breeze" or small coke from a previous charge coked by this process, and consequently pure. To ensure production of pure coke in the ovens from the commencement, the producer should be charged at first with wood or charcoal.

By suitably timing the heats and intermediate operations, the process is rendered continuous.

The details of the plant are clearly illustrated by means of drawings attached to the specification.—D. A. S.

Improvements in and Apparatus for Distilling, more especially intended for Distilling Tar. F. Lennard, London. Eng. Pat. 844, January 16, 1891. 1s. 1d.

THIS patent is said to provide means by which the distillation of coal-tar can be conducted economically and expeditiously, and so as to obtain in a manner readily under control the different products of distillation, the heat of the vapours of distillation being employed to effect the partial heating of the materials to be distilled which in their turn assist the condensation of the vapours. The invention, although not restricted to the distillation of coal-tar, is more especially intended for the same. The tar to be distilled passes or is forced from the store tank into boilers in which the ammoniacal liquor separates, the tar having been previously heated by being forced on its way to the boilers through a series of condensers, so that the tar forms the condensing medium. It is then passed or forced through heated coils placed in an oven or sand-bath. By this arrangement the tar is heated to, or above, the point at which its vaporisable constituents required to be extracted would be given off in the form of vapour if not confined in the coils. It now enters a scrubber in which the volatile constituents vaporise and meet a current of steam, the pitch being deposited in the scrubber whilst the other constituents pass off by a pipe to the first condenser wherein the heaviest products (anthracene oils) deposit, the noncondensed vapours passing by a pipe to the second condenser wherein the next product (creosote oils) deposits and the vapours which are still uncondensed passing into the last condenser wherein the lightest products (naphthas) and the water are condensed.

The heating apparatus consists of a furnace with return flues, and above it a sand-bath in which are situated coils which are in communication with other coils contained in a chamber through which the products of combustion pass, and which the patentee calls the "economiser." The furnace is heated by means of liquid or gaseous fuel which the patentee prefers to use, although he does not restrict

himself to its employment. The scrubber forms a vertical tower provided with a series of tubular passages so arranged that the tar passes downwards in a circuitous manner, meeting a current of steam which carries off the more volatile constituents, the pitch which is thus formed depositing at the bottom of the scrubber. The condensers consist of vertical vessels provided with tubes and with outlets and inlets so arranged that the vapours pass inside the tubes, whilst the condensing agent (the tar) passes on to the outside of the tubes. "In the first condenser of the series the condensing agent may be the tar from the ammoniacal liquor separators, whilst in the others it may be the tar which is ultimately to be distilled." The tar to be distilled may be pumped through, say, the last condenser, and passes around the tubes and thence either direct by a pipe to the vessels in which the ammoniacal liquor is separated, or before passing to these vessels, it may be passed through another of the condensers. From the ammoniacal liquor separating tanks the tar is forced into the first condenser, then through the coils in the economiser, and finally through the coils in the oven or sand-bath. Thus the tar is heated to the temperature necessary to cause the vaporisable constituents to vaporise. The coils of the economiser and oven or sand-bath are preferably flattened, and to provide extended heating surface they may have fins on them, and there may be pipes or passages of refractory material extending from the furnace or flues (or both) to between the convolutions of the coils. Asbestos or slag wool and sand may be used to retain the heat. By regulating the speed at which the tar is passed through the apparatus the proper degree of heat for distilling is obtained irrespective of the temperature above that required for distilling the tar at which the furnace and the oven or sand-bath may be maintained. The specification is accompanied by seven sheets of drawings.—D. B.

Improvements in or connected with Ovens, Furnaces, or Retorts used for the Making of Coke or Charcoal, or for Distilling or Roasting Carbonaceous Matter, or otherwise subjecting Carbonaceous Matter to the Action of Heat. L. H. Armour, Gateshead-on-Tyne. Eng. Pat. 1579, January 28, 1891. 6d.

This invention substantially consists of means for supplying water or other liquid, or aqueous vapour, at a temperature lower than that of the effluent gases, and in regulated quantity, at or near the outlet for the gases escaping from the retort or oven above the charge.

It is claimed that the clogging or obstruction of the outlet by pitchy or tarry deposit is prevented, and that decomposition of ammonia is either partially or completely prevented.—D. A. S.

Apparatus for the Manufacture of Lamp-black Carbon-black. E. Binney, New York, U.S.A. Eng. Pat. 17,221, October 9, 1891. By Internat. Conv. March 9, 1891. 8d.

See under XIII., page 171.

A New or Improved Method of and Apparatus for Distilling Liquid Hydrocarbons. P. Dvorkovitz, "The Kerosene Company, Limited," and "The Tank Storage and Carriage Company, Limited," London. Eng. Pat. 13,089, August 1, 1891. 8d.

In carrying this invention into effect crude petroleum or other liquid hydrocarbon is passed from a tank to an oil superheater of any convenient construction, in which the oil is heated to a high temperature. It is then led to a retort where it is met by superheated steam, the temperature of which is higher than that of the heated oil. The latter is thereby split up into two portions, one consisting of oil vapour and the other of tar and precipitated matter. The mixed oil vapours and steam then pass through a large dome and are carried to a condenser. The tar is conveyed

to a second oil superheater, and the heated tar subjected to distillation in a retort aided by the injection of superheated steam, the vaporised part of the hydrocarbon being carried with the steam to a second condenser. The precipitated matter in the tar retort is collected or removed in any convenient manner.—D. B.

Improved Arrangement of Coke Ovens and Retorts for the Manufacture of Coke and Illuminating Gas. W. Creswick, Wakefield. Eng. Pat. 17,222, October 9, 1891. 11d.

In this invention the heated gases passing off from coke ovens are utilised for carbonising coal in closed retorts so constructed that gas and by-products are generated in the roasting of such coal and are collected for use elsewhere.

This is effected by ranging a series of coke ovens with exit apertures opening into a large receiving flue, and a series of retorts is also ranged, round any of which heated gases can be led before passing to the exit flue. The coke ovens are worked in the usual way, the escaping gases being coursed round the retorts by means of regulator dampers. The retorts are charged and drawn in the ordinary manner.

The claim is essentially for the combination of the ovens and retorts in this way, and for the special settings, two varieties of which are shown in detail in the sheets of drawings attached to the specification.—D. A. S.

Improvements in Retorts for the Carbonisation of Wood and other Vegetable Substances, and in the Drying of Manures, Sewage Sludge, and other Substances and Products. W. H. Bowers, Manchester. Eng. Pat. 17,623, October 15, 1891. 8d.

The retort used by the inventor is constructed with two or more parallel flues, extending in a longitudinal direction and lying one above the other. These are fed by the same furnace and eventually discharged into the same outlet. To make the description more intelligible, it is assumed that the retort is constructed with two flues. The space immediately above each flue forms a chamber through which the material to be operated upon is drawn by means of an endless chain, which is carried upon sprocket wheels, and is provided with bars at suitable intervals and of such width as to sweep the flow of the chamber. From the hopper where it is supplied to the retort, it is carried along and over the upper flue to its extremity, and it then falls into a space between such extremity and the sprocket wheel on to the chain as it runs below. The material is then drawn by the chain in the reverse direction along the lower flue until it falls over the extremity of that flue through an aperture provided for its discharge from the retort. The flues are connected by an elbow or external flue at the point most distant from the furnace. The gas driven off during the operation escapes by condenser pipes, and is dealt with in the ordinary manner.

By means of this arrangement the heat from a single furnace is utilised to heat both chambers, and the material as it is drawn through the lower chamber is exposed to heat coming from above as well as from below, with the result that labour and time as well as fuel are economised.

—D. B.

IV.—COLOURING MATTERS AND DYES.

Dyewood Extracts and their Manufacture. F. E. Mafat. Bull. Soc. Ind. Mulhouse, 1891, 361—452. (See also this Journal, 1889, 612—618.)

MEISSONIER, in 1829, initiated in France the manufacture of extracts for printing on woollens. This industry did not rise to importance until 1835.

In 1842—43 Panay succeeded in obtaining from logwood liquor crystals of a deep red colour, almost black on the surface, which were in fact hematein (oxidised hematoxylin) more or less pure. He arrived at this result by placing the rasped logwood in heaps and watering and turning it over periodically for several weeks. Varillat (of St. Hilaire) was the first in 1855 to adopt vacuum pans for the concentration of the weak liquors, their use being borrowed from the sugar industry. At present there are 44 works in Europe and 5 in America devoted to the production of wood extracts.

Campeachy or Logwood.—The introduction of logwood into Europe dates from the discovery of America by the Spaniards, who denominated the wood *palo campechío*. The tree (*Hematoxylon campechianum*) grows to a height of 12—15 metres, and the trunk alone is employed in dyeing. The wood is imported into Europe principally from Carmen (Lower California), the State of Campeachy in Mexico, Honduras, Yucatan, St. Domingo, Hayti, Guadeloupe, Martinique, Trinidad, Jamaica, and Cuba. The woods most esteemed for the manufacture of extracts are those from the island of Hayti; the ones most employed at Havre being Fort Liberty, Cape, Aquinus, St. Mark, and Monte Christi woods. The Jamaica woods, in yield of extract, are inferior to those of Hayti, both in quantity and quality; the colour is not so strong or the shade so good. The roots of the Jamaica wood are also imported. Whilst low in price they are very difficult to grind, and their yield is in every respect unsatisfactory. The woods from Laguna, Carmen, Honduras, and Yucatan, whilst belonging to the same family, give a different shade; the colour yielded is very fine, but wanting in depth, and these woods are not so economical in the production of blacks as the Hayti wood. The woods from Guadeloupe, Martinique, &c. are less esteemed, and, like those of Jamaica, are used only because of the scarcity of the Hayti wood.

Yellow Wood or Fustic (Morus tinctoria).—The yellow woods are mostly got from Mexico and the neighbouring States, the West Indies, and South America. The wood most valued is that from the island of Cuba; it is a hard, compact, and heavy wood of an orange-yellow colour. The wood most employed in the manufacture of extracts is undoubtedly that of Nicaragua, which is known as Corinto, from its port of export; it is a heavy close-grained wood of a fine yellowish-orange colour.

Young fustic (the French *fustet*) is a shrub (*Rhus cotinus*) the branches of which, sawn and stripped of their bark, are used in dyeing. The young fustic of America is held in good esteem. The colouring matter is reddish-yellow, readily soluble in boiling water, and tolerably rich in tannin. The colouring matter of young fustic has great analogy with that of Persian berries (*Rhamnus tinctoria*), and the extracts of the latter are frequently mixed with young fustic.

Red Woods.—Pernambuco wood (*Cesalpinia echinata*) comes from Brazil and Jamaica. It is a hard, compact wood, heavier than water, and its surface after long exposure to air is of a black-red colour. That from Paraibo is most valued. Nicaragua, Bahia, St. Martha, and Lima woods (*Cesalpinia brasiliensis*) come from Mexico, Nicaragua, California, the Philippine Islands, and Brazil. Amongst them, the St. Martha and Lima woods are most esteemed, as they approximate most closely to the Pernambuco wood in shade, but on account of their high price the cheaper Bahia wood is almost always used in the manufacture of Lima wood extract. Sapan wood (*Cesalpinia sapan*) is imported from India, Réunion, Ceylon, Siam, Manilla, China, and Japan.

It yields colours which have a considerable resemblance to those of the St. Martha wood; it is not so rich in colouring matter, but the shades produced are very bright. All these red woods appear to contain the same colouring matter named "*Bravilin*" by Chevreul, who first isolated it. The extracts of red woods, both liquid and solid, are frequently mixed with arsenious acid and tin salts to brighten or modify their shade. A well-made solid extract represents 12 times its weight of original ground wood. It may be remarked with regard to red woods that the heart of the wood alone is rich in colouring matter.

There are other red woods of which the colouring matter is insoluble or only slightly soluble in water, such as santal (*Pterocarpus santalinus*), caliatour, barwood, and camwood. Santal wood comes from Asia, Ceylon, Madagascar, Coromandel, Australia, and Indo-China; caliatour wood from Caliatour and Madagascar; and barwood and camwood from Sierra Leone. These woods, finely ground, are only used directly in dyeing, and are not applicable for the manufacture of extracts.

The introduction of aniline colours has led to a greatly diminished use of the red woods, notably those of Pernambuco, Lima, St. Martha, and Sapan.

Manufacture of Dyewood Extracts.—The manufacture consists of four distinct stages—(1), the ageing of the woods; (2), the extraction of the colouring matter; (3), the concentration of the liquors; and (4), the preparation of the solid extract. The wood, after grinding, is carried by means of an elevator to the upper floor, where the logwood is sprinkled with water and exposed in heaps for 24 to 48 hours, whilst the fustic goes direct to the extractors. The extracting vats have their opening on a level with the upper floor; they are conical in form and are made of oak or pitch-pine. They are arranged in sets (say of six vats), and after being charged with the ground wood, boiling water is circulated methodically from vat No. 1 to vat No. 6, and so becomes more and more charged with colour; it leaves the last vat at a strength of 2° to 2½° B., and passes as strong liquor to the stock vats and is ready for concentration. The wood receives three successive treatments with water, and becoming more and more exhausted the third course gives only a strength of 1° B. Finally the wood is subjected to a fourth treatment with water, and this last liquor is returned to vat No. 1, the whole of the vats having in the meantime been recharged with fresh wood. The vats are provided with a false bottom pierced with holes and covered by a wire-work netting held in position by a grating. There are manholes at the side for discharging the spent wood, and steam-pipes are provided for heating the liquors.

The strong liquors at 1½° to 2¾° B. are pumped into the concentrating pans and there evaporated to the required strength. Up to 6° B. the liquors are only considered as strong decoctions; above 7° B. they are looked upon as extracts. Extracts marking respectively 26°, 23°, and 6½° B. in the concentrators will be 30°, 27°, and 10° B. when cold. To make the pure dry extract, the liquor is carefully evaporated in the vacuum pan to a density of 45° B., which is the proper strength for making a good dry extract. The charge is quickly run out, before it has time to thicken, into wood or metal moulds.

In the German works closed vats (usually in sets of 10) are used, and the woods are extracted under a pressure of 1½ to 2 atmospheres.

The quality of the water used in making the decoctions is of the highest importance; it should be pure, clear, and soft, and if not absolutely pure, it should by preference be slightly alkaline. It is of importance to avoid the use of water containing iron, bicarbonate of lime, metallic salts, or excess of alkali.

Dyewood Extracts of Commerce.—Hayti logwood yields 25 per cent. of its weight of extract at 30° B., or 16½ per cent. of dry extract. The woods most commonly used at the present time are of inferior quality to the above and yield only 22 per cent. of extract at 30° B., or 14.66 per cent. of dry extract. The logwood extracts produced in the early days of the industry were pure products, containing only the extract of the wood itself. The competition amongst makers and the demand for cheap products has

resulted in the manufacture of logwood and fustic extracts admixed with cheaper mineral and organic bodies, such as molasses, glucose, quercitron bark, sumac leaf, divi-divi, turmeric root, chestnut extract or the ground wood, dextrine, &c. When such admixed bodies are liable to fermentation in presence of acids or alkalis it becomes a necessary precaution to add suitable neutralising substances. Several of the latter bodies serve at the same time to brighten the shade of the extract, whilst others, such as potassium ferrieyanide and alizarine orange are added to both logwood and fustic extracts to impart a colour which is quite factitious. The *molasses* are obtained from the sugar refineries at a strength of 42° B.; 100 kilos. of this correspond to 140 kilos. at 30° B. *Glucose* is prepared from potato starch by treatment with dilute sulphuric acid and subsequent neutralisation of the acid with chalk. *Quercitron bark* (*Quercus tinctoria*), is obtained from Philadelphia and Baltimore; 100 kilos. of bark yield 30 kilos. of extract at 30° B. or 20 kilos. of dry extract. *Sumac* (*Rhus coriaria*) is got from Sicily, Italy, the Tyrol, Dalmatia, Illyria, France, Spain, Portugal, and North America; it contains tannic acid varying in amount from 10 to 22 per cent. The decoctions of sumac are only prepared as required as they readily ferment, the tannic acid being converted into gallic acid. 100 kilos. of Sicilian sumac yield 75 kilos. of extract at 30° B., or 50 kilos. of dry extract. *Divi-divi* (*Casalpinia coriaria*) is obtained from the West Indies and Central America. Its contents in tannin varies from 18 to 45 per cent.; 100 kilos. of divi-divi yield 52 to 56 kilos. of extract at 30° B., or 35 to 37 kilos. of dry extract. *Turmeric root* (*Curcuma rotunda*) is obtained from the East Indies, China, and Persia, and contains 68 per cent. of colouring matter. It is used in the form of an impalpable powder, being added in this state to fustic extracts which are to be converted in dry extracts. *Chestnut extract* is prepared from the wood of the chestnut tree (*Fagus castanea*) which grows in abundance in Central and Southern France, in Italy, Corsica, Spain, and Portugal. The wood of very old trees contains 6 per cent. of tannin; young trees not more than the half of this. Chestnut extract is brown and astringent; at 20° B. it keeps well, but if weaker than this its tannic acid is readily transformed into gallic acid. 630 kilos. of chestnut wood yield 100 kilos. of extract at 30° B., containing usually from 22 to 25 per cent. tannin. *Dextrin* is potato starch rendered soluble by treatment with nitric or other acid and subsequent drying in a stove.

Commercial Extracts manufactured at Havre and Rouen.—There are two systems of manufacture; the first, in which the woods are extracted with water only; the second, in which the water used is charged with molasses. In the first system the pure decoction serves as a base to which the admixtures are subsequently added; in the second system the extracting tanks are charged, not only with the ground woods, but also with several of the admixed bodies that enter into the composition of the final product. The first system is to be preferred as being best adapted to the manufacture of products of unvarying composition. It is seldom that logwood extract at 30° B. is sold in the absolutely pure state; that sold as pure usually contains from 14 to 17 per cent. of molasses at 30° B. Similarly the dry extracts sold as pure are seldom such in reality. Usually they contain 3 per cent. of chestnut extract at 30° B. and 5 per cent. of molasses at 42° B. The commercial hemateine in powder is prepared from 100 parts pure logwood extract at 30° B. and three parts of chestnut extract at 30° B. The solid extract is dried by lying on shelves for several days and then ground in the mill. It forms an orange-red powder of good appearance and is packed in hermetically sealed cases, as contact with air changes its appearance. In the preparation of the lower grades of extracts by the first system the admixtures are added to the strong liquors in the evaporating pans. In the second system the only substances that are added to the extracting vats are molasses, chestnut extract or the ground wood, and sumac leaves. The "foots" from the clarification of logwood extract, the powdered gypsum, potassium, ferrieyanide, &c., are added to the strong extracts in the evaporating pans.

In the second system the chestnut is added as ground wood, and the sumac in the form of leaves, to the extracting vats.

The manufacture of logwood extracts for calico printers is uniform in all the works. The logwood liquor at 10° B. is allowed to settle for 20 to 25 days, and the clear liquor is then evaporated in the concentrating pans to a strength of from 15° to 30° B. as required. Nevertheless logwood extracts for printers often contain molasses; thus one frequently sold is prepared from 3,000 kilos. logwood liquor at 10° B., 630 kilos. molasses at 30° B., and 5 kilos. soda crystals, yielding 1,625 kilos. extract at 30° B.

Commercial Fustic Extracts.—Fustic extracts are seldom sold pure; with few exceptions the extracts, both paste and dry, are admixed with foreign matter to reduce their cost. A comparison of the price at which the "dry fustic extract, superior" is sold at Havre, and the cost of the wood itself, shows a margin too small to admit of the profitable manufacture of a pure product. Fustic of good quality (Corinto, Cuba, or Tuspan) yields 11 to 12 per cent. of dry extract, or 16 to 18 per cent. of 30° B. The commercial fustic extracts contain, as admixtures, molasses, glucose, and dextrine, which are added to the weak liquors before passing to the concentrating pans; whilst quercitron bark, sumac leaves, powdered turmeric root, and divi-divi are mixed with the rasped wood in the extracting vats. Sulphates of soda and zinc and alizarin orange are also added to modify or brighten the shade of the extract.

Sumac Extract.—For the manufacture of sumac extract the Sicilian sumac is preferred; the sumacs of Italy, the Tyrol, Illyria, Dalmatia, France, &c., are less suitable. Sumac extract is mixed with molasses and chestnut extract, &c. In the manufacture the process must be continuous, the liquors passing at once from the vats to the concentrating pans. Vacuum pans are the most suitable and the extract, when ready, should at once be put up in casks. Sicilian sumac, when carefully treated, yields 75 per cent. of extract of 30° B.; the Dalmatian and Illyrian sumacs yield from 65 to 70 per cent.

Residues.—The spent woods are available only for burning in the furnaces. The "foots" which settle from the clarified logwood liquors contain, when dry, 48 per cent. of colouring matter. They are utilised as admixtures in preparing low qualities of dry logwood extracts. Logwood extract at 30° B. is calculated as yielding 7½ per cent. of such deposit.

Valuation of Extracts.—The paper concludes with a description of the valuation of logwood extracts by comparative dyeing trials and by colorimetric comparison. This portion of the paper has been discussed in the note by M. Geigy, abstract of which follows this.—W. E. K.

Report on Mafat's Memoir on Dyewood Extracts. R. Geigy, jun. Bull. Soc. Ind. de Mulhouse, 1891, 357–360.

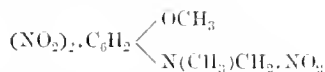
M. GEIGY, having been appointed to examine M. Mafat's paper (see following abstract) presented for Prize LXI. offered by the Mulhouse Society for "a practical method for determining the quantity of hematein contained in logwood and its extracts without recourse to dyeing or printing," reports that the memoir consists of two distinct parts; the one a very complete account of the sources of the various dyewoods and the manufacture of extracts from them; and the second a brief description of the methods of determining the amount of colouring principle in logwood extracts. With respect to the former part of the memoir, M. Geigy reports that it presents a sufficiently complete and reliable description of the manufacture of dyewood extracts; at the same time he points out certain inaccuracies and inconsistencies. Thus, whilst in one place the author states that in logwood extracts the whole of the hematoxylin has been oxidised to hematein, he quotes later that Erdmann has isolated hematoxylin from dry logwood extract; the latter statement being in consonance

with the reporter's experience. Again, the percentage of colouring matter in the dye extract is stated by the author at 84.7 per cent., which is very much too high a figure; this arises from the supposition that the portion soluble in alcohol is all due to hematein, whilst as a fact the greater part of the resins are also soluble in alcohol. In the reporter's experience not more than 10 per cent. of crystallisable hematoxylin is contained in logwood extract at 30° B. The colouring principle of logwood includes in addition to hematoxylin, and perhaps traces of hematein, a resinous non-crystallisable substance which is distinguished by its property of giving a black dye with wool mordanted with bichrome, whilst hematoxylin gives a pure blue shade.

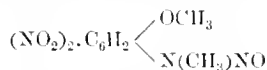
The method given by the author for determining the amount of hematein in logwood extract is a colorimetric one, applied to a mixture of logwood extract with chestnut extract and molasses in certain proportions, such as are used in the Havre and Rouen works. The reporter points out that the method is useful only for extracts falsified in a similar way, and has no general application. He quotes instances of two classes of logwood extract quite different from the above; the one containing only molasses in addition to the logwood extract, and used in wool dyeing; the other consisting of pure logwood extract without any foreign addition whatever, the use of the latter pure extract increasing year by year. The reporter considers the method of comparative dyeing or printing trials to be the only one at present known that gives reliable information as to the value of logwood extracts.—W. E. K.

Action of Nitric Acid on Dimethylortho-anisidine. P. van Romburgh. Compt. Rend. 1891, 113, 305—308.

By the action of nitric acid on dimethylortho-anisidine Grimaux and Lefèvre obtained a product which melted at 135°, and to which they assigned the formula—



(Compt. Rend. 112, 727; this Journal, 1891, 692). The author finds, however, that this formula is incorrect, and that dimethylortho-anisidine, when acted on by nitric acid, behaves like other dimethyl-aromatic amines which he has examined. The product described by Grimaux and Lefèvre is in fact the nitrosamine of dinitro-monomethylortho-anisidine—



and can be formed also from dinitro-orthomethylanisidine obtained by boiling the corresponding nitramine with phenol. When dinitro-orthomethylanisidine is dissolved in nitric acid and treated with nitrous acid, the above product melting at 135° is obtained.—A. K. M.

β-Naphthaquinone Sulphonic Acids. O. N. Witt. Ber. 1891, 24, 3154—3157.

The oxidising agents, ferric chloride and potassium bichromate, usually employed for the preparation of β-naphthaquinone, cannot be used for the preparation of β-naphthaquinone sulphonic acid from amido-β-naphthol-β-sulphonic acid, as that compound, like the similarly-constituted nitrosonaphthol sulphonic acids, has an extraordinary affinity for the metals of the iron group, the salts thus produced being decomposable only with great difficulty. Nitric acid was, therefore, used: 10 grms. of amido-β-naphthol-β-sulphonic acid ("Eikonogen") were gradually added to 10 cc. of nitric acid of sp. gr. 1.2; the crystalline mass produced was drained on porcelain, and then dissolved in a small quantity of water, 6—7.5 grms. of golden-yellow needles of the quinone compound being obtained on cooling the solution to 0° C. They consist of the ammonium

sulphonate of β-naphthaquinone which is formed according to the equation—



This salt may be dried at 100°—110° without decomposing. The ammonia in it is not displaced by the action of dilute acids, but is removed by sodium hydrate, a sodium sulphonate being formed, which is decomposed with the production of a brown substance by excess of sodium hydrate. It is very soluble in water, less so in alcohol. It interacts in the cold with o-diamines, forming azine sulphonic acids. Sulphurous acid reduces it to the corresponding quinol compound, which may be conveniently prepared from amido-β-naphthol-β-sulphonic acid by acting on the same with the calculated quantity of bromine and adding the solution of the quinone compound so produced to an excess of sulphurous acid. The ammonium salt of β-naphthaquinolsulphonic acid thus obtained crystallises in snow-white plates, is very soluble in water, reduces silver salts, is unacted upon by nitric acid of less density than 1.2, but is reconverted by acid of that or of greater density into the quinone compound; when oxidised in the presence of a para-diamine it yields a dye of the indophenol class; and, unlike o-dihydroxybenzene, interacts with diazo-compounds forming azo-dyes which have the property of combining with metallic-oxide mordants (Eng. Pat. 2499 of 1889; this Journal, 1890, 172).

The β-quinone compounds of naphthalene α- and β-sulphonic and γ- and δ-disulphonic acids, form yellow crystals; that of the α-sulphonic acid appears to be uncrystallisable. All these compounds are reduced to o-dihydroxy compounds by sulphurous acid.—E. B.

α-Naphthol-α-Sulphonic Acid. O. N. Witt and H. Kaufmann. Ber. 1891, 24, 3157—3163.

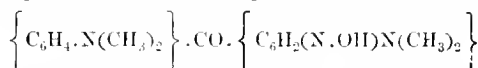
α-NAPHTHOL-α-SULPHONIC acid is industrially prepared from naphthionic acid by two methods, namely, by diazotising and boiling with dilute sulphuric acid and by fusing with sodium hydrate under pressure. The first method yields a red uncrystallisable product, the second a grey crystalline mass which turns brown on exposure to air. The two products, moreover, differ considerably in regard to the solubility and crystalline form of their azo-derivatives. The authors, who have made a study of the two preparations with a view of explaining these differences, find that each product consists chiefly of α-naphthol-α-sulphonic acid, but that the product obtained by the diazo reaction contains a compound (not isolated) which prevents it crystallising, while that of the fusion process contains an isomeride of α-naphthol-α-sulphonic acid as well as α-naphthol. This was proved to be the case by preparing the phenylazo-derivative of each product, the sodium sulphonate obtained by the second method being, however, previously purified from α-naphthol by extracting with ether, after acidifying with acetic acid. The respective azo-dyes obtained were repeatedly recrystallised until they were undistinguishable from each other. They were then reduced with acidified stannous chloride in the manner devised by Witt (this Journal, 1889, 276) the same amidonaphthol-sulphonic acid, $\text{C}_{10}\text{H}_7 \cdot \text{OH} \cdot \text{NH}_2 \cdot \text{SO}_3\text{H} + \text{H}_2\text{O}$, being obtained from each.

A very characteristic derivative of α-naphthol-α-sulphonic acid, and one which is readily obtained, even from a very crude preparation of that substance, is the β-nitroso compound. This is best prepared from technical α-naphthol-α-sulphonic acid (24.6 grms.) by dissolving in water (300 cc.), adding concentrated hydrochloric acid (19 cc.) and then gradually, the mixture meanwhile being well cooled, a solution of sodium nitrite (6.9 grms.). The free nitroso-sulphonic acid which quickly separates out is collected on a filter, pressed, and recrystallised from dilute hydrochloric acid. It is thus obtained in lustrous, golden-brown crystals containing $3\frac{1}{2}$ H₂O. It is easily soluble in water and alcohol; possesses a strongly acid reaction; dissolves in concentrated sulphuric acid with an orange colour, turning yellow on dilution; hydrochloric acid reduces its solubility in water to a remarkable extent, nitric acid converts it into dinitro-naphthol. It forms two series of salts, acid and neutral;

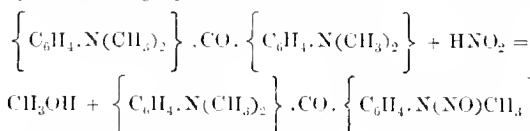
the latter in general crystallise well. The neutral ammonium and sodium salts in solution have an intense purple colour, the acid sodium salt forms orange-red needles or prisms which dissolve readily in pure water, but with difficulty in saline solutions. The acid barium salt is very sparingly soluble, but may be crystallised from a large quantity of water in scarlet crystals containing 3 H₂O. The cobalt compound has a red, and the ferrous iron compound a green colour, as O. Hoffmann has already pointed out (Ber. 18, 46). β -nitroso- α -naphthol- α -sulphonic acid readily interacts with amines, &c.: with ammonia at 160°—180°, with the hydrochlorides of aniline, phenylhydrazine, hydroxylamine at lower temperatures, yielding compounds of complex constitution; with aniline and zinc chloride yielding naphthaquinone-dianilide. Its most striking interaction, however, is with *o*-diamines in aqueous solution, the sulphonic acid group being split off and scarlet dyestuffs of the Eurlidine class being formed. The colour base of that obtained from *o*-toluylenediamine crystallises in golden-yellow needles melting at 257°; sufficient of it was not obtained for analysis. Acidified stannous chloride, and acid sodium sulphite reduce the nitroso-compound to the above-mentioned amido-compound. This is oxidised by nitric acid (see preceding abstract) to β -naphthaquinonesulphonic acid, the sodium salt of which is easily soluble in water but quite insoluble in alcohol. Sulphurous acid reduces the quinone to the corresponding dihydroxy-compound.—E. B.

The Action of Nitrous Acid on Tetramethyldiamidobenzophenone. W. Herzberg and M. Polonowsky. Ber. 1891, 24, 3197—3201.

E. Bischoff (this Journal, 1888, 742) has stated that the product of the action of nitrous acid on tetramethyldiamidobenzophenone is a nitroso compound of the formula—



The authors have re-examined the product, and interpret the reaction by which it is formed in the manner indicated by the following equation—



the analysis and properties of the body in question according with this view. The nitrosamine thus produced crystallises from alcohol in yellow plates, melting with decomposition at 182°—183°. On heating with concentrated hydrochloric acid, it is decomposed with evolution of gas into trimethyldiamidobenzophenone, a substance crystallising from alcohol in pale-yellow plates, which melt at 203°—204°. The latter compound in its properties closely resembles the tetramethyl compound; its acetyl derivative melts at 145°; on fusion with ammonium chloride it yields a dye of similar shade to ordinary Auramine.

Nitrous acid has a similar action on the leuco-bases of Malachite green and Crystal violet, a nitro-compound in addition to a nitrosamine, being obtained from the leuco-base of the latter dye.

Tetramethyldiamidodiphenylmethane (1 mol.) in hydrochloric acid solution, is acted upon by nitrous acid (from 2 mols. of NaNO₂) with formation of *p*-nitrodimehylamine, a 25 per cent. yield of this substance being obtained.

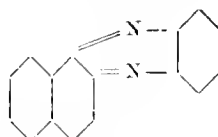
The agreement of Bischoff's analytical numbers with those required for the nitroso-derivative of tetramethyldiamidobenzophenone is explained by the presence of unaltered ketone-base in the precipitate obtained on rendering alkaline the crude solution of trimethyldiamidobenzophenone-nitrosamine.

Wichelhaus (this Journal, 1886, 318) has previously prepared trimethyldiamidobenzophenone. As, however, this chemist has described it as possessing different properties from those observed by the authors, and as, moreover,

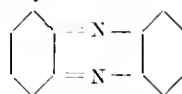
Wichelhaus's description of the leuco-base of (penta-) methyl violet (from which he prepared it) does not agree with that of O. Fischer and others, the authors consider it probable that Wichelhaus's preparation was mixed with tetramethyldiamidobenzophenone, which would be produced by the decomposition of the leuco-base of hexamethyl violet intermixed with the pentamethyl compound.—E. B.

Studies in the Induline Group III. O. Fischer and E. Hepp. Annalen, 266, 249—263.

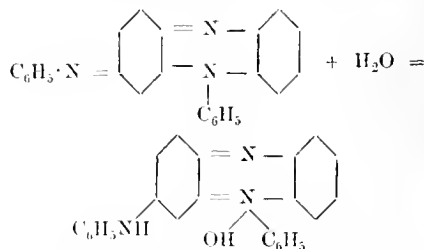
Benzindulines.—The authors previously succeeded in showing that the rosindulines are derivatives of the well-known naphthophenazine—



and they now show that an analogous relation obtains for the benzindulines and phenazine—

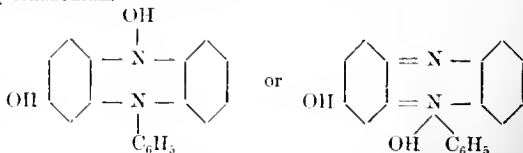


Operating with phenylinduline (Ann. 262, 256) the authors obtained from it by heating with glacial acetic acid and dilute sulphuric acid for about six hours at 200° C., besides aniline three decomposition products, the largest quantity of which consists of a brown crystalline substance which is hydrated phenylinduline—



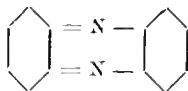
This base melts at about 218° C., heated to a higher temperature it is converted into carbazol fluorindine, which substance is already contained in small quantities in the original phenylinduline melt. On heating the base with concentrated hydrochloric acid aniline is separated and a hydroxy derivative of the base is obtained. This hydroxy-derivative is soluble in alkalis.

The original phenylinduline is heated to 170° with hydrochloric acid, and on filtering yields a red-brown filtrate containing two new compounds. One is a hydroxy-compound of the formula C₁₅H₁₁N₂O₂, the other is benzindone, C₁₅H₁₂N₂O. They may be separated by addition of an alkali and subsequent filtration, when the hydroxy compound remains in solution, whilst the benzindone remains insoluble on the filter. From the alkaline solution the hydroxy-compound may be isolated by means of acetic acid and subsequent extraction with ether, from which it is obtained in the form of reddish-yellow crystals. From alcohol or benzene it crystallises in the form of beautiful brown-yellow prisms or tables. The substance possesses the properties of both a base and a phenol. It melts at about 280° C. The authors consider this compound to be either a hydrate of benzindone or a derivative of hydroxy-phenazonium—

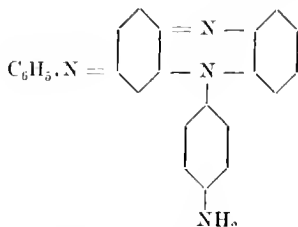


From the properties of the compound in question the authors conclude the second of these formulae to represent its constitution.

The benzindone, $C_{18}H_{12}N_2O$, which is insoluble in alkalis, crystallises from alcohol in well-formed plates with metallic lustre. The substance is soluble in acids, dissolving in strong sulphuric acid, and forming a green solution; by this behaviour it proves itself to be a true analogue of the rosindones. This is further proved by the fact that whereas rosindone on dry distillation with zinc-dust yields naphtho-phenazine, benzindone under the same conditions yields the corresponding phenazine—

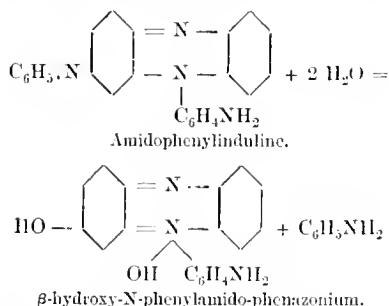


Decomposition of Amidophenylinduline with Acids.—This induline, $C_{25}H_{18}N_4$, contains a primary amido-group, the position of which has not been yet ascertained. The authors prove that in treating this induline with acids neither phenylenediamine nor benzindone is formed, so that the composition of this induline is best expressed by the formula—



than by the formula of Schultz and Juius.

Amongst the products of the decomposition of amidophenylinduline with acids, a compound, $C_{18}H_{12}N_2O_2$, was formed, which is soluble in alkalis, and this is evidently an amido-derivative of the already described hydroxy-compound, $C_{18}H_{12}N_2O_2$. From the strong fluorescence of the solutions of this compound, as well as from its solubility in water and the pink colour of its salts, the authors consider that it belongs to the safranines. The formation of this substance is supposed to be expressed by the equation—



In studying the indulines, the safranines prove to be always their inseparable companions. Safranines, rosindulines, indazines show very great similarity (Ann. 262, 262—263), so that it is frequently a matter of some doubt whether a certain compound is to be classed amongst the indulines or amongst the safranines. This is explained by the fact that the paraquinone-azine group of the indulines, either by hydration or by oxidation, is readily converted into the orthoquinone group of the safranines.

Action of Aniline upon Amidophenylinduline.—On heating the hydrochloride of the induline, $C_{24}H_{18}N_4$, with two parts of aniline for some hours at $160^\circ C$, two new indulines are obtained, which the authors believe to be phenylamido-phenylinduline, $C_{30}H_{22}N_4$, and amidophenylamidophenylinduline, $C_{36}H_{27}N_5$. The two indulines may be separated by means of hot alcohol, in which only the first-named is soluble. The induline, $C_{30}H_{22}N_4$, can advantageously be

obtained by heating a mixture of phenylamidoazobenzene (136 grs.), aniline (140 grs.), aniline hydrochloride (65 grs.), and alcohol (500 grs.), at about $160^\circ C$ for 12 hours. The induline obtained is purified by recrystallisation from hot alcohol. The melting point of the base is at from 245° to $250^\circ C$.

The induline, $C_{36}H_{27}N_5$, is identical with a substance previously obtained by Witt and Thomas, and is the most insoluble of all known indulines. It is contained in the ordinary amidoazobenzene, melts in very small quantities only, but by employing the azobenzene melt it may be obtained in considerable quantities. The base of this induline melts at from 286° to $288^\circ C$.

To determine the molecular weight of phenylinduline the authors used Raoult's method. The results of the experiments are in favour of the formula, $C_{24}H_{17}N_3$. The bases of the indulines, $C_{24}H_{17}N_3$, $C_{30}H_{22}N_4$, and $C_{36}H_{27}N_5$, are too insoluble to allow of the estimation of their molecular weights by the above process.

The authors, whilst promising further data, especially on rosindulines, point to the fact that these colouring matters are coming more and more into prominence, and will very probably soon acquire great importance in the coal-tar colour industry.—C. O. W.

Preparation of the Dinitrophenol, $C_6H_3(OH)(NO_2)_2$ 1:2:4 and some Properties of the Diamidophenol. B. Reverdin and C. de la Harpe. Chem. Zeit. 1891, 16, 45—46.

For the preparation of considerable quantities of dinitrophenol the authors made use of the following method:—400 parts of sulphuric acid $66^\circ B$. are heated to 110° , and 200 parts of phenol are added, and the mixture is kept heated to 130° — 140° for five hours. The product is mixed with 600 cc. of water, and then a mixture of 800 grms. of nitric acid $36^\circ B$. with 575 cc. of water is slowly added, care being taken that the temperature does not exceed 40° — 50° . The mixture is allowed to stand for 24 hours at the ordinary temperature, and afterwards is slowly heated for three days on a water-bath, then allowed to cool, and filtered. The cake of crystals produced consist almost entirely of pure dinitrophenol. To obtain the chemically pure product it must be beaten twice with 21 parts of water. With these quantities 100 parts of dinitrophenol can be obtained. The authors point out that the diamidophenol obtained from this nitro-body by reduction possesses the property of giving to fabrics, when oxidised, an intense brown colour which is fast to light and soap. The oxidation can be produced by a dilute solution of chlorate of sodium mixed with a very small quantity of ammonium vanadate and by other metallic salts. The wool or cotton is put into a hot solution of the hydrochloride of the diamidophenol and the oxidising agent added.

The hydrochloric acid salt gives colour reactions on being heated with aromatic amines. For example, 1 part of the salt heated with 10 parts of aniline gives a dark blue dye, from which a blue dyestuff can be isolated. Azophenine is obtained as a by-product in this reaction.

The authors have paid particular attention to the behaviour of the hydrochloric acid salt of the diamidophenol as a photographic developer, and they find that its solution in water with 5—6 parts of sulphite of sodium acts on exposed plates with energy, but they have not yet been able to satisfactorily control its working. The body loses this property when mixed with a small quantity of bromide of sodium.—E. C. C. B.

PATENTS.

Improvements in the Manufacture of Colouring Matters.

H. H. Lake, London. From "A. Leonhardt and Co.," Mühlheim-on-the-Maine, Germany. Eng. Pat. 2805, February 16, 1891. 4d.

If β -naphthalene disulphonic acid be converted into the dinitro-compound and this reduced, a diamido-compound is obtained which on diazotisation combines with phenol. The dyestuff thus formed is, however, sensitive to alkalis.

By methylating, ethylating, or benzylating the product it is rendered fast to alkalis, the process being similar to that described in Eng. Pat. 3994 of 1887 (this Journal, 1888, 319).—T. A. L.

Improvements in the Manufacture of Azo Dyes. B. Willeox, London. From the "Farbenfabriken vormals F. Bayer & Co.," Elberfeld, Germany. Eng. Pat. 3439, February 25, 1891. 8d.

This is an extension of Eng. Pat. 13,235 of 1890 (this Journal, 1891, 760) and refers to the sulphonation of the dyestuffs there mentioned. The specification also describes the preparation of a number of dyestuffs from tetrazo-compounds by combining these with α -naphthylamine or α -amidonaphthol ether and either with or without sulphonation, combining these products, after diazotisation, with a phenol, naphthol, dihydroxynaphthalene, amine, amidonaphthol, or their sulphonie or carboxylic acids, if necessary, sulphonating the final product. The colouring matters dye unmodified cotton in various shades, such as brown, green, violet-blue, and black, those obtained from the naphthol ethers giving bluer or greener shades than those from naphthylamine.—T. A. L.

Erratum.—In the January number of this Journal, page 27, col. 2, in the first formula given for $(\text{NOH})^{(3)}$ read $(\text{NOH})^{(4)}$; and in paragraph 4, for $[\text{CH}_3 : \text{NH}_2 : \text{NO}_2 = 1 : 3 : 5]$ read $[\text{CH}_3 : \text{NH}_2 : \text{NO}_2 = 1 : 3 : 4]$.

V.—TEXTILES: COTTON, WOOL, SILK, Etc. PATENTS.

Improvements in Fabrics for Sacks or Bags. P. B. Hollick, London. Eng. Pat. 16,801, October 21, 1890. 4d.

This invention refers to the introduction of some heavy and stout warp or weft threads into sackings or baggings which are made of jute, these being interwoven with the said threads at intervals throughout the width or length of the cloth. The heavier warp or weft threads may also be made of material other than jute, namely, flax, cotton, leather, wire, Manilla, or any other kind of hemp, the object being to give additional strength without materially increasing the weight.—H. S.

Improvements in Self-registering Apparatus for Measuring the Sensibility and Breaking Strain of Paper and other Light and Flexible Material. F. Lennig, London. Eng. Pat. 18,431, November 15, 1890. 6d.

This invention cannot be suitably described without reference to the drawing.—J. C. C.

Improvements in or applicable to Machines for Scouring and Washing Wool and other Fibrous Materials. J. McNaught and W. McNaught, Rochdale. Eng. Pat. 19,878, December 5, 1890. 6d.

This invention relates to an improved construction of scouring machines, whereby the sand and other heavy foreign substances in the scouring liquor are separated therefrom and allowed to settle in a detached tank. The liquid is caught from the squeezing rollers and elevated to an auxiliary tank arranged alongside the washing tank, by means of a rotary wheel having scoops. The liquor drains from the auxiliary tank to the washing tank through a suitable aperture or communication pipe, while the heavy substances settle and are retained in the said tank.—H. S.

Improvements connected with the Manufacture of Yarns and Fabrics from Waste Silk, and with the Washing of the Resulting Material or of the Clothing Produced therefrom. B. Beyer, Grossenhain, Germany. Eng. Pat. 12,817, July 28, 1891. 4d.

This process, it is claimed, relieves all waste raw silk of the offensive smell which it is well known to retain, owing to the bast adhering to it, and thus enables clothing to be manufactured therefrom at a cost not expected to greatly exceed that of woollen underclothing. The yarn is boiled for about 15 minutes daily in a bath prepared with oil soap for a number of days. Removed from this bath the material is washed in cold water and conveyed into a steam-bath, where it is left for several hours, after being sprinkled with a thin layer of chloride of sodium. After a repeated steaming and washing the material is bleached or conveyed into a drying chamber, a moderate temperature being maintained. The whole operation is repeated daily for preferably at least 20 days, after which the material is suspended in a course of water for 24 hours. The colour of the material is then a dull white, and it is perfectly inodorous. The material is then ready for manufacture, and the finished articles should be washed in cold water containing permanganate of potash, and steeped in a weak solution of chloride of sodium, the same solution being used for washing the clothes when worn.—H. S.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Orange in Calico and Wool Printing. Oester. Wollen und Leinen-ind. December 15, 1891.

THE method for the production of orange in calico printing, which has been in use for a long time, and is still largely made use of, is based on the fact that lead acetate and potassium chromate yield yellow lead chromate, which on treatment with lime becomes orange. One can also proceed in such a way that the orange lake is prepared ready and then printed with blood albumen, or by printing the material with a thickened lead salt, chroming, and then passing through a bath of caustic alkali. Two and a half parts of lead acetate are precipitated with one part potassium bichromate in a sufficiently dilute solution, the precipitate washed and boiled with milk of lime, well washed, filtered, and pressed, and about 400 grms. orange lake thickened with 600 grms. albumen solution, printed and steamed. If the orange is required yellower, one part of the orange lake is replaced by one part of yellow lead chromate.

On printing the lead salt, about 300 grms. lead acetate or nitrate must be taken per litre of thickening, printed and steamed, or aged, passed through ammonia, chromed according to the size of the pattern with the necessary quantity of bichromate, and then passed through a boiling concentrated milk of lime solution.

Another orange is produced with *Alizarin orange*, which gives a brilliant lake with aluminium salts. Either aluminium acetate, nitrate, or sulphocyanide may be used, with the addition of calcium nitrate or acetate, printing on material which has been impregnated with Turkey-red oil, steaming and soaping. 550 grms. thickening and 150 grms. Alizarin orange R (20 per cent.) are well mixed, and 50 grms. acetic acid 9° Tw. (30 per cent.), 200 grms. aluminium acetate at 10° B., and 50 grms. calcium acetate at 10° B. are added. The colour should be printed immediately after its preparation. Alizarin orange may, for instance, be turned more yellow by the addition of lead acetate with subsequent chroming. A second method is to mix with it some Gallacetophenone or Alizarin yellow (B.A.S.F.). This yellow is fixed by means of aluminium sulphocyanide and calcium acetate, and agrees perfectly well with Alizarin orange.

Another orange, which up to the present has not had much application, is *Acridine orange* (L.). This is fixed by means of tannin on cotton material, and finally the latter is passed through an ordinary bath.

With *Persian-berry extract*, or *Flavin* and a tin-salt, very fine oranges may be obtained; but these, as a rule, are not fast to soaping.

Lately, a new orange for printing, under the name of *Diamond orange* (Bayer), has been brought out. It is a reddish-brown paste, which has the advantage over Alizarin orange of not settling at the bottom of the casks like the latter, and can consequently be stirred better. A further advantage lies in the fact that the printing colour can be preserved for some time without losing any of its intensity. Alizarin orange, on the other hand, after a very short exposure loses as much as 50 per cent. of its colouring power, even when sulphocyanide is employed instead of aluminium acetate.

The printing colour is best prepared by mixing well 740 grms. of thickening, 200 grms. of Diamond orange, and 60 grms. of chromium acetate.

The chrome lake produced with *Diamond orange* on oiled material is redder than the one obtained with Alizarin orange and alumina, but can be turned yellow with Diamond yellow (Bayer), Alizarin yellow (Hoechst), or Diamond flavine (Bayer), as all these colours, like Diamond orange, may be fixed with chromium acetate. A shade similar to Alizarin orange may be obtained as follows:—787 grms. thickening (containing acetic acid), 100 grms. Diamond flavine G (Bayer), 66 grms. Diamond orange, and 47 grms. chromium acetate at 20° B., are mixed together. This is printed on material impregnated with Turkey-red oil, steamed one hour, without pressure, passed through a alk bath, and soaped about 20 minutes at 50° C.

In wool-printing, *Alizarin orange R* gives an orange fast to soaping when produced as follows:—110 grms. of Alizarin orange R (20 per cent.), 590 grms. of thickening, 40 grms. aluminium sulphate dissolved in 140 grms. water, 20 grms. oxalic acid dissolved in 50 grms. water, and 50 grms. glycerin at 28° B., are mixed together. The colour is developed on prepared wool by means of steaming, washing, and soaping.

Of other colours, *Croceine orange* and *Orange II.* (B) are much employed in wool printing. Both give fiery shades by dissolving in water and acetic acid and thickening with gum-water, printing on chlorinated wool, then steaming and washing well. The proportions are about 1—2 grms. colouring matter, 8—9 grms. acetic acid at 6° B., 30 grms. water, and 60 grms. gum water.

The Application of Coal-Tar Colours in Paper Dyeing. A. Beaimann. *Färb. Zeit.* November 5, 1891.

For several years coal-tar colours have been largely used in this branch of industry, though formerly, in the manufacture of paper, mineral and vegetable colours were used almost exclusively. As in the dyeing of textile fabrics, so in this case it is chiefly on account of their easy application and their brilliant colour-effects that they have replaced the duller mineral and vegetable colouring matters in comparatively so short a time.

In paper dyeing there are two separate methods of applying the colours: first, surface dyeing; and secondly, the dyeing of the pulp itself. By the former process, in the manufacture of the so-called enamelled paper, the colours are mixed with water and starch paste, dextrin, &c. For highly-polished enamelled paper, the colours are mixed with kaolin, artificial barium sulphate (blanc fixe), or other similar products, and fixed on the surface of the paper with glue or gelatin.

Instead of these mixtures the general method, instead of using the colours themselves, is to employ colour lakes. By this means a more even surface is obtained with the colour. The colour mixture obtained by either of the above two methods is brushed on to the paper by means of either hand brushes or machine brushes, and then worked up for a higher polish.

The second process is the dyeing of the paper pulp. In order to render the following description more comprehensible, the author first follows up the method of the manufacture of the paper. The paper, according to its future use, is manufactured from linen, hemp, cotton, or jute rags, or from esparto grass, wood shavings, straw, wood cellulose, or straw cellulose. Better qualities, are, however, almost exclusively manufactured from rags. This raw material, after having been thoroughly ground and disintegrated in a paper mill, is bleached and then glued with colophonium and resin soap, prepared with caustic soda or potash with the addition of aluminium sulphate, through which treatment the precipitation of insoluble aluminium rosinate on to the paper fibre takes place. After this treatment the paper pulp is dyed, and then worked through the paper machine into rolls of paper.

The same property which vegetable and animal colouring matters possess, of forming insoluble or difficultly soluble colour lakes with certain metallic salts or organic acids, is also possessed to a certain extent by aniline colours. The properties of vegetable colours are made use of in paper dyeing, in so far that the paper pulp is saturated with the solutions of such bodies as are suitable for producing a colour lake with the colouring matters applied. Aniline colours, the application of which in paper dyeing has become so general on account of their many advantages, are usually employed as such—i.e., in concentrated solutions—in spite of the fact that they possess the property of forming colour lakes, by which latter a saving of colouring matter is effected, and, besides, the waste water is free from colour—often a serious question in the manufacture of paper. The reason of this is because the proper method of dyeing paper is not known in the trade.

This method of dyeing is also to be recommended because the colouring matter becomes evenly distributed in the paper pulp, however complex its composition may be, and combines very firmly with the fibre by reason of the adhesion. Through the presence of the rosin glue, which possesses an especial affinity for colour lakes, the combination becomes still firmer, and the water remains colourless, whether the material was glued before or after the dyeing. When this method of dyeing is used, it is advisable first to make small dyeings, because the colour lakes, as a rule, give rather different shades from the directly applied colours.

For precipitating the colouring matters, both the precipitants and the colours are made in fairly concentrated solutions; the colour solution is first added to the paper pulp, and then to the precipitating agent, after a thorough stirring.

Basic colours are precipitated by *tannin*.

Lead Acetate or *Barium Salts* in aqueous solution are used for precipitating Ponceaux and almost all azo-colouring matters. In the application of lead acetate, the aluminium sulphate of the rosin glue undergoes double decomposition, which, however, has little influence in the dyeing if the lead acetate solution is added gradually. By the formation of insoluble lead sulphate, the otherwise soluble lead salts are prevented from being carried away by the waste water, and in this way much inconvenience is obviated.

Resorcinol Colouring Matters, such as eosin, phloxin, &c., are precipitated most profitably with lead nitrate, or better with lead acetate; this latter can be prepared by treating sugar of lead with litharge for some time, or by adding ammonia to the sugar of lead solution until a permanent precipitate is formed. Besides the above-mentioned compounds for producing colour lakes from aniline colours, there exists a whole series, such as stannous chloride, calcium and magnesium chloride, acid and neutral salts of the alkalis, &c.—especially, however, aluminium salts. In glued paper pulp there is always an excess of aluminium sulphate present, and with such colours as are very easily precipitated, its presence is sometimes detrimental rather than useful. The necessary quantity of the precipitating agent varies according to its quality and to the colouring matter, and can be determined at the first trial with it. The price of the tannin and the lead salts, compared with that of the colouring matter saved by their use, is infinitesimal.

To see whether the whole of the colour has been precipitated it is necessary to take out a small pattern of the pulp, press it, and observe whether the water which runs out is coloured. If it should be coloured the precipitation is not yet complete, and consequently more precipitating agent must be added.

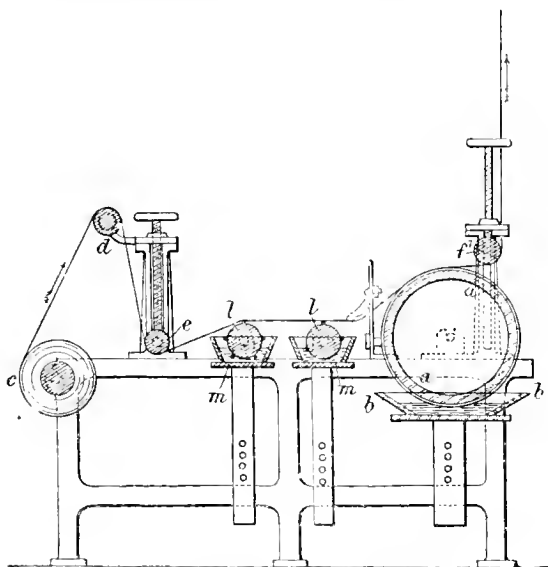
For deep shades of paper this method of dyeing offers the great advantage over the surface dyeing, of preventing the waste of unused colouring matter. For the preparation of certain kinds of paper, full shades can only be obtained by this method, and these productions are very much sought after.

Paper dyeing would to-day stand on an equal level with textile dyeing if more attention had been paid to this branch of industry. In spite of the above mention of the more economical yield of aniline colours, there are up to the present but a few of these colouring matters which can be applied in paper dyeing.

PATENTS.

Improvements in Printing Calicoes and other Woven Fabrics, and in Apparatus therefor. J. V. Hulme, Manchester. Eng. Pat. 1799, January 31, 1891. 8d.

IRREGULAR patterns, especially in indigo, suitable for the Indian, Chinese, Japanese, and African markets, are printed on calico by wooden rollers wrapped with ropes, chains, wire-netting, matting, &c. or partly covered with projecting pieces of india-rubber or of lead of various sizes. The printing-surfaces may also be formed of nails, screws, pegs, or pins with regularly or irregularly shaped projecting heads, either employed alone or interspersed with pieces of lead, roping, &c. Tufts of bristles arranged in an irregular manner may also be used. The effects may further be varied by passing the cloth *c* over two rollers *l* (see Figure) furnished with projecting strips of india-rubber, or of other suitable material, and revolving in water-troughs *m*, prior to printing with the roller *a*.



CALICO PRINTING APPARATUS.

After printing, the cloth is exposed to the air to oxidise the indigo and is then washed. Sometimes, in order to produce a blurred or clouded effect, the calico is brushed or sprinkled with water immediately after being printed. When a dark indigo ground with a pale indigo pattern is required, the cloth is first dyed with indigo and then printed in the above-described manner with a discharge solution.—E. B.

Improvements in the Construction of Machines for Printing Calico and other Woven Fabrics on both Sides. W. Buckley, Manchester. Eng. Pat. 1996, February 4, 1891. 6d.

The adjustable sliding bearings and adjusting screws of a duplex printing machine are arranged diagonally in opposite directions, instead of vertically as hitherto. The bowls can, consequently, not only be raised and lowered as usual, but can be brought very close together (when the machine is in action) or separated (to allow access for the occasional arrangement of the printing blankets and wrappings) as required. A more exact "register" of the pattern on the two sides of the fabric than was formerly possible can thus be obtained.

The printing rollers are adjustable in a radial direction as usual.—E. B.

Production of Azo-Colours in Discharge-printing on Indigo Dyed Fabrics. O. Imray, London. From the "Farbwerke vormals Meister, Lucius, und Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 2818, February 16, 1891. 6d.

INSTEAD of adding to the thickened solutions of diazo-compounds an alkaline chromate and passing the cloth, printed with such a mixture, through an acid bath, to liberate chromic acid and effect the discharge of the indigo, as described in Eng. Pat. 7522 of 1890 (this Journal, 1891, 924), potassium ferricyanide is added and the printed cloth passed through an alkaline bath. The blue-dyed cloth is prepared with an alkaline solution of β -naphthol (29 grms. in 25 cc. of caustic soda solution at 22° B. and 200 cc. of water) and oleine (50 grms. of 50 per cent. quality per litre), and the following mixture, for example, printed on it for a red discharge:—83 grms. of *p*-nitraniline N ("a mixture of $\frac{15}{100}$ molecules of *p*-nitraniline and $\frac{15}{100}$ molecules of sodium nitrite with 5 per cent. of nitrite in excess of the theoretical quantity"), 572 cc. of water, 300 grms. of paste thickening, 45 cc. of hydrochloric acid at 22° B., 300 grms. of potassium ferricyanide, and 60 grms. of sodium acetate. After printing the cloth is passed through a solution of caustic soda of 5°–10° B. at 50°–60°, and is afterwards washed or soaped and dried. The above method has the advantage of allowing all diazo-compounds to be employed, whereas the process with chromic acid only admits of the employment of diazoazobenzene, other diazo-compounds not resisting the action of chromic acid.—E. B.

Improved Machinery for Dyeing Textile Materials in Hanks. E. Decock, Roubaix, France. Eng. Pat. 7511, April 30, 1891. 11d.

THE hanks are placed on bearers which are carried horizontally a little above the dye-vat, on two sets of endless chains furnished with projecting abutments for their support. The first set of chains conveys the hanks rapidly through a portion of the dye-bath, thus opening them out and allowing "the dye to come in contact freely with all parts," and then delivers them to the second set, which travels more slowly "in order to ensure a gradual and enduring action upon the material being dyed." From the latter set of chains the bearers are taken by a series of vertical and horizontal endless chains and carried upwards over the vat to the front of the same, for the purpose of again passing the hanks through the bath, this being repeated as many times as is necessary. The hanks are conveyed through the bath without rotary motion, but in passing along the overhead system toothed pinions on the ends of the bearers come into gear with toothed racks, so causing the hanks to alter their position upon the bearers before the following dip. Three sheets of drawings accompany the specification.—E. B.

Improvements in Apparatus for Dyeing or Bleaching Textile Materials. J. Bertrand - Leplat, Tourcoing, France. Eng. Pat. 11,692, July 9, 1891. 8d.

A RECTANGULAR tube, closed at one end and connected at the other with a rotary pump, is fixed horizontally at the bottom of a vat. The tube is perforated at intervals for the reception of a number of tapering socket tubes which project from the bottoms of dye-boxes, in which the material (more particularly cotton sliver) to be bleached, &c., is placed. These boxes are divided into compartments and perforated to admit the liquor. When the pump is set in motion, the liquor passes through the mass of material to the pump, returning thence to the vat, to circulate again through the material. Two sheets of drawings accompany the original specification.—E. B.

Process for Printing and Dyeing Textiles, Fibres, Hair, Feathers, and the Like by Means of Metal Salts. E. Odenheimer, Stuttgart, Germany. Eng. Pat. 17,887, October 19, 1891. 4d.

TEXTILE fabrics, &c. are impregnated with solutions of the salts of gold, silver, copper, iron, uranium, or chromium, and subjected to pressure between heated cylinders or plates. In the case of certain of these salts the effect may be varied by immersing the material to be coloured in a solution of a reducing agent, or exposing it to the action of reducing gases, such as hydrogen and hydrogen phosphide, prior to pressing or calendering. The materials thus operated upon are coloured by the deposition on the same of metallic oxides, basic salts, or finely-divided metals. From sodium "aurochlorate," for example, according to the process employed and the nature and concentration of the reducing solutions, there are obtained perfectly fast shades of grey, purple, red, bronze, and gold.—E. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Specific Gravity of Solutions of Acetic Acid. E. Nickel. Chem. Zeit. 1891, 15, 1793.

THE specific gravity of solutions of acetic acid in water at 15°, rises gradually until a maximum gravity of 1.0748 is reached with solutions of about 80 per cent., after which point, with increasing strength of solution, the gravity falls again until it reaches 1.0553, the anhydrous acid having the same gravity as a 43 per cent. solution. Therefore, taken as an indication of the strength of a solution, any gravity below 1.0552 can only represent one strength, but above 1.0552 the gravity would be that of two strengths; for example, with a gravity of 1.0674 the strength may be either 94 or 58 per cent., a point which is decided by adding water. A rise of gravity would then indicate the higher percentage, whilst a fall would indicate the weaker solution.

—D. A. L.

Petroleum and Asphalt at Palena, in Payta. Analogy between Salt and Coal Deposits. C. Oehsenius. Chem. Zeit. 1891, 15, 1866—1867.

See under III., page 150.

PATENTS.

An Improved Method of Enriching Phosphated Chalk and other Calcareous Phosphates. L. C. Delahaye, Paris, France. Eng. Pat. 18,899, November 21, 1890. 6d.

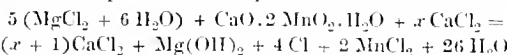
THE phosphatic material is furnaceed in order to transform the calcium carbonate it contains into caustic lime. It is then slaked with water and digested with a solution of

ammonium chloride or nitrate which dissolves out the free lime, and thereby concentrates the phosphatic residue, which is collected on a filter. The solution containing a soluble calcium salt and free ammonia is regenerated for use again by passing a stream of carbonic acid, when calcium carbonate is precipitated and the original ammoniacal salt again formed.

The inventor also claims "the substitution for the ammonia of any kind of ammonia compounds, such as methylamines, ethylamines, whatever be their formula and constitution."—G. H. B.

Improvements in the Production of Chlorine and of Strong Hydrochloric Acid. F. M. Lyte and O. J. Steinhart, London. Eng. Pat. 21,225, December 30, 1890. 8d.

THIS invention is for the purpose of producing chlorine from waste liquors containing calcium or magnesium chloride, and is based on the fact that chlorine and hydrochloric acid are evolved when magnesium chloride is heated in admixture with a suitable magnesite such as Weldon mud, and the yield of chlorine is considerably increased in the presence of substances capable of retarding the giving off of the moisture present under the action of heat. The general reaction is expressed in the equation—



In the presence of sufficient moisture the evolution of chlorine is completed during the heating from 150° to 350° C. The hydrochloric acid evolved in the reaction is separated from the chlorine by condensation and is used in one or other of the various operations so as to be converted ultimately into chlorine only. The invention comprises a series of operations of which the final products are calcium carbonate and chlorine. Calcium chloride is decomposed by treatment with magnesia and carbonic acid. The specification is accompanied by a graphic representation of the interdependent reactions comprised in the process, and this diagram should be consulted in order to follow the cycle of operations. A feature of the process is the low degree of temperature used by which the magnesia is obtained in a "soft burnt" condition, which facilitates the reactions.

—G. H. B.

Improvements in the Manufacture of Sulphate of Alumina. J. W. Kynaston, Liverpool. Eng. Pat. 962, January 20, 1891. 6d.

SULPHATE of alumina, after having been treated for the removal of iron and other impurities, has generally a yellow or greenish colour which is due to the presence of a minute quantity of chromium. This invention has for its object the removal or rather neutralisation of the colour by the addition of a complimentary one. Methyl orange and Tropaeolin OO are suitable colouring matters. The sulphate of alumina solution is concentrated to the required strength, and to the hot solution is added as much dilute solution of Methyl-orange as an experiment has shown to be necessary. The quality of the colouring matter varies, and one part of Methyl orange will produce a neutral grey tint with 600 to 1,200 parts of dissolved oxide of chromium. If the chromium be present as chromic acid it must be first reduced to a chromic salt by means of an alkaline sulphite or other reducing agent.—G. H. B.

An Improvement in the Process for the Simultaneous Production of Cellulose and Oxalic Acid from Vegetable Fibrous Substances. J. Läfschütz, Grünau, Germany. Eng. Pat. 1824, January 31, 1891. 6d.

See under XIX., page 176.

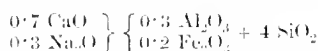
Improvements in Apparatus for the Automatic Control of Sulphuric Acid Supply to Carbonic Acid Generators Used in Aerated Water Manufacture and other Industries. H. C. Cox, Olton. Eng. Pat. 17,034, October 7, 1891. 6d.

THE supply of acid to the generator is regulated by the agency of a syphon with equal arms and turned-up ends which remains filled with acid when lifted out of the liquid. It hangs in suspension over the acid reservoir attached to the arm of a lever which is actuated by the movement of the gasholder. When the gasholder is being emptied the syphon sinks into the acid and delivers a stream of acid into the generator, but when the gasholder is full the syphon is raised from the acid and the flow of acid stops.—G. H. B.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Dark Brown Glaze for Roofing Tiles. E. Cramer. Thonind. Zeit. 1891, 15, 693.

It is advisable to glaze only well-burnt non-porous tiles, as otherwise water finding its way between the joints and at the unglazed edges, and afterwards freezing, will cause the glaze to crack off. A good dark-brown glaze which flows readily has the following composition per cent.: silica, 58.8; alumina, 8.15; ferric oxide, 7.98; lime, 936; alkalis, 6.30; loss on ignition, 8.39; corresponding to the formula—



A loam rich in lime and ferric oxide is best fitted for the production of a glaze of this description; it should be applied to the ware (the latter being in the air-dried condition) suspended in water.—B. B.

The Preparation of Gold Glaze for Stoneware. H. Hecht. Thonind. Zeit. 1891, 15, 694.

GOLD glazes made with purple of Cassius are not always satisfactory, as it is difficult to obtain a uniform admixture of the gold with the glaze by mechanical means. A process has been worked out by Müller, of Brunswick, which depends on the reduction of gold chloride by means of glucose in alkaline solution, which the author has found to give beautiful purple precipitates with such bodies as magnesia, lime, baryta, silica, and alumina. As applied to glazes, the process is carried out as follows:—A dilute solution of gold chloride is mixed with the liquid glaze, the mixture made alkaline with a few drops of sodium carbonate, and slightly warmed while being stirred with a glass rod. The addition of a small quantity of a solution of glucose colours the whole mass bright red after a few minutes. Leadless glazes gave the best results. For example, the following mixture was prepared:—

	Grms.
0.25 K ₂ O	31.50 calcined potash.
0.25 Na ₂ O	95.50 crystallised borax.
0.25 CaO	25.00 marble or chalk.
0.25 BaO	39.25 witherite.
	144.00 sand or quartz.
	12.40 boric anhydride.

80 grms. of this were mixed with 20 grms. of Zettlitzer kaolin and made into a "slip" and treated as described above. Glazes containing 0.01 per cent. of gold were a delicate rose colour after burning, while those containing 0.1 per cent. of gold were dark red, and a mixture with 0.0033 per cent. of gold, together with a little uranium, was yellowish-pink. The use of ammonia instead of sodium carbonate gives dirty bluish-red tones. The brilliancy of the glazes is very great.—B. B.

Change in Porcelain Paste by Storage. H. Seger. Thonind. Zeit. 1891, 15, 813.

WHEN stiff porcelain paste is rendered slightly alkaline with a few drops of sodium hydroxide, carbonate, or silicate, it becomes much thinner, a greater part of the agglutinating material is quickly precipitated and settles firmly at the bottom, whilst the supernatant liquid takes an extraordinarily long time to become clear. If, on the other hand, the porcelain paste is slightly acidified with hydrochloric or acetic acid, it gets so much stiffer that it does not fall out when the containing vessel is inverted. The author suggests that the improvement observed in porcelain paste by keeping may be due to similar molecular changes—probably to acid fermentation of organic matter in the water used—and he therefore proposes to obviate the necessity of long storage by slightly acidifying the paste.—D. A. L.

On a Colour Test of Kaolin and Sand. E. Nickel. Chem. Zeit. 1891, 15, 1125—1126.

THE presence of ferric oxide in kaolin, porous tiles, earthenware, sand, &c. may be demonstrated by the application of a solution of potassium ferrocyanide acidified with hydrochloric acid, the substance so treated becoming instantly coloured blue, of an intensity corresponding with the amount of iron present.

As the test solution soon decomposes, it must be prepared immediately before use. Care must be taken in preparing it that a precipitate of ferrocyanic acid is not produced.

—E. B.

Asbestos Porcelain (Porcelaine d'amiante). M. F. Garros. Compt. Rend. 1891, 113, 864—865.

THIS new material is employed for the filtration and sterilisation of water, wines, vinegar, and other liquids. It is prepared from the purer varieties of asbestos, the fibres of which are among the finest occurring in nature, whether in the animal, vegetable, or mineral kingdom. These fibres reduced to powder yield particles of extreme fineness, and on account of the chemical purity in which the mineral is often found, foreign particles of larger size are entirely absent. If the powder is not absolutely white but coloured with a yellowish tint it is washed with dilute acid to remove the oxide of iron. The powder forms a paste with water which can be moulded to any desired form. The articles are then dried very slowly by gentle heat, and subsequently fired for 17 or 18 hours at a temperature reaching 1,200° C.

The extreme fineness of the pores of this new species of porcelain is shown by the fact that micro-organisms will only penetrate the material to a certain depth, and are not able to traverse the substance as they do in the case of ordinary porcelain. Hence the use of the new material for sterilisation. Water containing 1,200 colonies per cubic centimetre was found to be absolutely sterilised after filtration. After being used for filtration, even for a prolonged period, the asbestos porcelain is restored to its original condition by wiping with a sponge moistened with hot water.—V. C.

PATENTS.

Improvements in the Manufacture of Leclanche Cells. D. Rylands, Stairfoot. Eng. Pat. 3170, February 21, 1891. 6d.

See under X1., page 169.

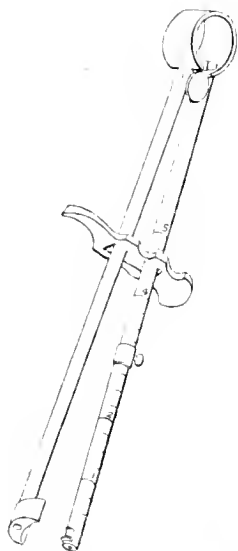
Improvements in Couplings for Glass Tubes or for Tubes lined with Glass. D. Rylands, Stairfoot, and R. Morant, Barnsley. Eng. Pat. 3172, February 21, 1891. 6d.

THE invention consists of a socket union made in two parts, the object achieved being the joining up of two tubes by turning either part of the socket instead of turning the

tubes, as when an ordinary sleeve socket is used. The tail part of the socket is furnished with a flange, the head part being provided with a circular chamber, large enough to admit the flange. A washer of gutta-percha coated with shellac renders the joint air-tight.—V. C.

An Improved Tool for Cutting Glass Tubes. A. W. Chesterton, Boston, U.S.A. Eng. Pat. 20,211, November 20, 1891. 6d.

In this tool there are two "spring tensioned arms," provided with a rotating cutter, and with a cutter block



TOOL FOR CUTTING GLASS TUBES.

respectively. There is a fulcrum block between the two arms. One arm is spaced out to measure the length of the tube. A clamping lever encircles both arms, and by changing its position the pressure on the cutting disc can be adjusted.—V. C.

Improvements in the Method of and Apparatus for Manufacturing Plate Glass. W. P. Thompson, Liverpool. From R. S. Pease, Minneapolis, U.S.A. Eng. Pat. 20,437, November 24, 1891. 8d.

In former attempts to improve the manufacture of plate glass, and to make the melting continuous, the plan has sometimes been tried of tipping the whole tank. This involves very costly appliances. Another plan has been to let the glass flow from an opening in the bottom or wall of the tank. The hole, however, becomes rapidly enlarged, and the flow cannot be properly regulated.

The present invention consists in special forms of oven, doors, pots, and so forth, all designed for the purpose of enabling the molten "metal" to be poured straight from the furnace on to the table. The pots, which are somewhat cut away on one side to facilitate tipping, stand in two rows on either side the centre of the furnace, the floor of which slopes so as to form a sort of trough, the bottom of which is closed by doors or gates of fire-brick, backed with iron. The best arrangement is to have one door for each pair of pots. This prevents waste of heat. The floor of the oven or chamber is mounted upon iron beams or girders carried upon columns, leaving a space below the chamber for the casting table, which is of the usual form. The table top is close below the floor of the oven. When the doors or gates are opened and the pots tipped, the metal flows out from the lip of a pot which is itself at a uniform high

temperature through an atmosphere of the same temperature. It encounters no cold body, as is the ordinary method, and consequently arrives on the table in a better condition. Furthermore, the life of the pot is greatly prolonged by this invention, since the alternate heating and cooling is avoided.—V. C.

New or Improved Method of and Apparatus for the Manufacture of Glass Plates, Cylinders, Pipes, and certain other Bodies. W. P. Thompson, Liverpool. From R. S. Pease, Minneapolis, U.S.A. Eng. Pat. 20,439, November 24, 1891. 8d.

It has formerly been proposed to produce a sheet of glass by dipping an iron bar into the molten metal and then raising the bar. Owing to the very different coefficients of expansion of iron and glass, the glass was apt to crack before it could be severed from the iron "bait."

In the present invention a glass "bait" is used, a plunger being allowed to descend until the lower edge of the "bait" dips so far into the molten metal as to cause a partial fusion of the edge. On reversing the motion of the plunger the molten metal follows the "bait." Sheets, hollow cylinders, or other hollow bodies are thus formed. The molten metal must be of the proper consistency, and not too fluid when the "bait" is introduced, otherwise the sheet is too thin. In order to regulate the thickness and maintain uniformity of the glass, the "bait" (which may have, for instance, the form of a hollow cylinder) is cooled inside by a spray of water and outside by a current of air. These arrangements secure a prompt cooling and hardening which enable the thickness to be nicely regulated.—V. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

The Manufacture and Properties of Slag Cement. G. R. Redgrave. Proc. Inst. Civil Eng., Session 1890—91, 105.

THE manufacture of slag cement (for details of which see this Journal, 1890, 863) can only be satisfactorily carried out when the composition and general character of the slag proposed to be used are accurately known. The following table shows the chief constituents of various blast-furnace slags, some well suited, and others wholly unsuited for the manufacture of cement:—

	Silica.	Alumina.	Iron.	Foreign Matter.
South Wales.....	42·84	28·84	23·13	2·11
Lancashire	37·49	10·12	45·97	8·54
Staffordshire	49·05	10·84	34·33	5·78
Scottish.....	32·10	24·28	35·43	8·10
Derbyshire	39·24	23·04	32·05	5·66
North Wales.....	31·28	12·41	46·10	10·21
Cleveland.....	32·15	17·53	45·50	4·82
Cleveland.....	35·45	21·55	33·70	9·30

The cement is made by pulverising granulated slag together with slaked "fat" lime (see this Journal, 1890, 863). In the following analyses the composition of a typical slag cement is contrasted with that of a typical Portland cement.

	Slag Cement.	Portland.
Lime	46.53	60.50
Silica	21.10	22.23
Alumina	16.30	7.22
Oxide of iron	0.93	4.32
Magnesia	2.08	1.10
Carbonic acid.....	0.65	0.80
Water (combined with lime)....	6.45	1.05
Sulphuric acid.....	2.05	1.68
Insoluble and other matters	0.94	1.01
	100.03	100.01

The chemical composition of a slag will not by itself serve to gauge its suitability for making cement, as is shown by the following two examples of slags of very similar composition, one of which had double the tensile strength of the other.

	A.	B.
Silica	21.10	21.22
Alumina.....	16.30	15.61
Lime	47.53	47.19
Oxide of iron	0.93	0.78
Soda, potash, &c.....	5.04	5.56
Carbonic acid.....	0.65	0.85
Moisture.....	6.45	6.88
Total	100.00	100.00

TENSILE STRENGTH—1 CEMENT TO 3 SAND.

A.		B.	
7 Days.	28 Days.	7 Days.	28 Days.
Lb. per Sq. In. 526	Lb. per Sq. In. 431	Lb. per Sq. In. 159	Lb. per Sq. In. 208

Slag cement has a tangible advantage over Portland cement inasmuch as it cannot from its mode of manufacture contain free lime, and therefore does not require "cooling" or aeration. In spite of the fact that it contains about 25 per cent. of slaked lime it keeps well in sacks, a sample thus kept for 15 months only showing a loss of tensile strength of about 5 per cent. When tested to determine its power of resisting attrition by the method used in Germany (this Journal, 1891, 165), slag cement does not give such good results when used neat as Portland cement, but is equal to the latter when a sand mixture is employed. The author considers that the property possessed by slag cement of giving higher results than Portland cement when mixed with large quantities of sand gives this material a value which has hitherto been somewhat overlooked in this country. The following are the results given by sundry slags from different ironworks:—

	1 Part Cement, 3 Parts Sand.		Neat.	
	7 Days.	28 Days.	7 Days.	28 Days.
	Lb. per Sq. In. 396	Lb. per Sq. In. 350	Lb. per Sq. In. 582	Lb. per Sq. In. 698
South Wales.....				
Lancashire	80	120	..	..
Staffordshire.....	117	180	230	250
North Wales.....	103	137	285	315
Scotland	227	340	340	415
Cleveland.....	280	398	415	507

The samples had approximately the same fineness, a residue of 10–15 per cent. being left on a 180 × 180 mesh sieve. The briquettes were hardened for 24 hours in air, and the rest of the time in water.

A sample was tested at the Government testing station at Berlin with the following results:—A residue of 14 per cent. was left on a sieve with 5,000 meshes per sq. cm. and of 5 per cent. on one with 900 meshes. All but 1 per cent. went through a 600-mesh sieve. The strength in tension and compression of the sample tested neat and with sand are given below:—

	Tensile Strength after		Compressive Strength after	
	7 Days.	28 Days.	7 Days.	28 Days.
Cement.....	647.0	692.0	..	..
Cement to sand = 1:3.	427.0	549.0	337.6	426.9

The results are the mean of a number of concordant tests, and are given in pounds per square inch.—B. B.

Hydraulic Cements. A. Busch. Dingl. Polyt. J. 1891, 232, 116–120.

The difference in tensile strength caused by measuring the quantity of sand and cement used in making standard briquettes by volume instead of by weight has been investigated at the Berlin testing station with the following result:—

		Strength in tension at 28 Days.	Strength in compression at 28 Days.
		Kilos. per sq. cm.	Kilos. per sq. cm.
Slag cement (1)....	By weight..	18.65	131.9
	By volume..	11.25	66.1
Slag cement (2)....	By weight..	22.90	237.4
	By volume..	15.65	161.7
Slag cement (3)....	By weight..	21.60	184.8
	By volume..	12.90	82.2
Portland cement (4)	By weight..	20.90	200.3
	By volume..	19.20	183.0
Portland cement (5)	By weight..	19.96	188.8
	By volume..	17.05	151.6
Portland cement (6)	By weight..	19.39	189.0
	By volume..	18.05	174.9
Roman cement (7)	By weight..	8.55	62.5
	By volume..	3.80	22.6

The briquettes were composed of one part of cement to three of normal sand by volume or by weight as given above, and were allowed to harden under water for the period mentioned in the table.

As might be expected from the comparative lightness of slag and Roman cement, the differences observed were greater in their case than in that of Portland cement, being about 40–60 per cent. as compared with 12 per cent. All the samples were finely ground and of normal specific gravity.

The lengthy time necessary for ascertaining the degree of soundness of hydraulic cements and the uncertainty of the judgments that can be pronounced upon them by the methods in common use, have lead to the device of more expeditious and reliable processes. Prominent among these is that of Deval (this Journal, 1891, 255).

The author has carried out some experiments upon the action of solutions of various sorts upon slag cement. The results are shown in the following table:—

Cement Composed of	Solution Containing	Behaviour after Seven Days.
Blast-furnace slag from Tees Bridge Iron Works, 75 per cent.	MgSO ₄ 1 per cent. + NaCl 1 per cent.	Test pieces "blown."
	NaCl 2 per cent.	Test pieces sound.
Slaked lime, 25 per cent.	MgSO ₄ 2 per cent.	Test pieces disintegrated.
	Sea water.	Test pieces sound.
Blast-furnace slag from Wilson and Pease, 75 per cent.	NaCl 2 per cent.	Test pieces sound.
	MgSO ₄ 2 per cent.	Test pieces disintegrated.
Slaked lime, 25 per cent.	NaCl 1 per cent. + MgSO ₄ 2 per cent.	Test pieces "blown."
	Sea water.	Test pieces sound.

The samples when hardened under fresh water behaved normally. After three months, the test pieces which had been hardened in all the solutions other than that of sodium chloride showed symptoms of failure, the corners being detachable with the finger nail. From these results it appears that magnesium sulphate has an active destructive effect upon slag cement. The author considers it debatable whether this action is due to the fact that magnesium sulphate is a salt of magnesium or to the circumstance that it is a sulphate, and adduces in favour of the former view the well known reaction of lime upon magnesium salts. Against this is the statement of Michaelis, who considers that solutions of calcium sulphate have the same effect as those of magnesium sulphate, while magnesium chloride has no such deleterious influence. He also believes that calcium sulphate combines with free lime to form a basic sulphate Ca_2SO_3 , the existence of which is confirmed by Schott. Whichever be the precise cause, it would appear from these data that slag cement cannot be relied upon for marine work.

The suitability of Sorel's magnesia cement for marine work and its general capabilities have been studied by Weber.—B. B.

Prevention of the Action of Frost on Portland Cement Concrete. Thonind. Zeit. 1891, 15, 754.

REINHOFER recommends the following mixture for concrete to resist the exfoliating action of exposure to very low temperatures:—one litre of Portland cement, one litre of lime and three litres of clean river sand are mixed with a solution of one kilo. of carbonate of soda in three litres of water. The test pieces were exposed to a temperature of about -31.5°C . for $14\frac{1}{2}$ hours and were afterwards heated for three hours without showing signs of injury. (Compare this Journal, 1890, 511.)—B. B.

Artificial Asphalt. E. Valenta. Cent. Org. f. Waarenkunde Tech. 1891, 1, 19; Chem. Zeit. Rep. 1891, 15, 211.

See under XIII., page 170.

PATENTS.

Method of Manufacturing Artificial Granite and Marble. C. George and C. Wernaer, Berlin, Germany. Eng. Pat. 20,948, December 23, 1890. 4d.

ONE to five parts of finely-ground blast-furnace slag are mixed with 10 to 15 parts of "argilliferous building sand," one part of granite or marble in small pieces, one part of fossil meal, "and a flux of from 3 to 6 per cent. of fluor-spar." A further addition of 3 to 6 per cent. of silicic acid is made if the granite or marble be very fine. The mixture is fused and mixed with a quantity of slag and sand also fused, and is coloured "by the addition of any suitable colouring matter." Small pieces of granite marble, &c. may be added so that they remain partially fused.—B. B.

An Improvement in Building Cements. F. J. Reynolds, Longport, and J. Brown, Hampstead. Eng. Pat. 12,429, July 22, 1891. 6d.

ONE quarter of a pound of pearlsh is dissolved in one gallon of water and freshly-burnt lime slaked with the solution. The slaked lime may be dried, if intended to be kept before being used in the manner described below. A mixture of equal quantities of nitrate of soda and pearlsh may be used instead of the pearlsh alone. The prepared lime is made into the stiffest possible paste with water and 0.5 per cent. of its weight of raw sugar or other saccharine matter added, together with sand, brickdust, blast-furnace slag or similar gritty materials. The mixture may be coloured with various metallic oxides, or salts such as black oxide of manganese or sulphate of copper. It is claimed that the use of the solutions of potash and of nitrate of soda is to effect a finer division of the lime, especially in the case of poor samples.—B. B.

An Improved Fireproof Material. C. H. Köpke, Hamburg, Germany. Eng. Pat. 13,491, August 10, 1891. 4d.

THE patent relates to the utilisation of "the waste products resulting from the manufacture of photogen (light hydrocarbon oils), the coke of bog-head coal, for the purpose of producing a valuable fireproof cement and other fireproof substances." The coke is first calcined, then ground either wet or dry, and moulded into the desired shape. The prepared coke may be used as a cement, alone or mixed with lime or gypsum, or may be mixed with cork, quartz, water-glass and other substances for the production of fireproof materials.—B. B.

X.—METALLURGY.

The Manufacture and Properties of Slag Cement. G. R. Redgrave. Proc. Inst. Civil Eng., Session 1890—1891, 105.

See under IX., pages 163–164.

Note on the Precipitation of Copper by Iron, and the Action of Metallic Iron on Solutions of the Salts of the Sesquioxide of Iron. J. C. Essner. Bull. Soc. Chim. 1891, 3, 147–148.

THE cinders of cupreous pyrites having been alternately moistened and dried by air, when extracted with water

gives a solution of sulphate of copper and salts of the sesquioxide of iron. This treated with metallic iron at 70–80° C. gives metallic copper mixed with a large quantity of the hydrate of the sesquioxide of iron. The copper exists in three forms: powder, grains, and fibres, the form depending on the structure of the iron employed. The cupreous solution contains a basic sulphate of the sesquioxide of iron which reacts with the metallic iron according to the equation—



In solutions of the normal sulphate of the sesquioxide part of the salt is reduced by the iron to the salt of the protoxide $2 \text{Fe}_2(\text{SO}_4)_3 + \text{Fe} = 6 \text{FeSO}_4$. In order to avoid the precipitation of the sesquioxide the cupreous solution was made acid with H_2SO_4 , and this when treated with iron gave a clean deposit of metallic copper.—J. C. C.

On the Determination of the Constants and the Coefficient of Elasticity of Nickel-Steel. E. Mercadier. *Compt. Rend.* 1891, 113, 33–36.

In 1887 and 1888 the author pointed out a method (founded on Kirchhoff's theory of vibration of circular discs) by which it was possible to determine the ratio $\frac{\lambda}{\mu}$ of Lamé's constants

for any sonorous body, and, consequently, the value of its coefficient of dynamic elasticity. The application of this method to various specimens of commercial steel showed that only slight variations existed between them in respect of their elastic properties (using the word in its usual sense as referring to vibratory motions without permanent

deformation). The ratio $\frac{\lambda}{\mu}$ of their constants varied only about 5 per cent. above or below the mean value, and their coefficient of dynamic elasticity varied barely 1 per cent. from its mean value (20,700 at 15°). The ratio of the coefficients of dynamic and static elasticity for these specimens was about 1.035. They contained, however, less than 1 per cent. of foreign substances (carbon, silicon, phosphorus, sulphur, and manganese).

Alloys of steel with chromium and nickel are now used for industrial purposes, and the proportion of nickel in these is sometimes as high as 25 per cent. The author has examined the elastic properties of specimens of nickel-steel from Crenson, the specimens being in the form of circular discs which were reheated to a red heat after being cast. Nos. 1 and 2 contained 5.55 per cent. of nickel; Nos. 3 and 4, 25.01 per cent. Discs 1 and 2 (although from the same melt) did not show the same degree of

homogeneity, for the ratio $\frac{\lambda}{\mu}$ had the value 2.29 for the first, and 1.60 for the second; the discs were far from being isotropic. On the other hand their coefficients of dynamic elasticity only differed by 2 per cent. from the mean value (19,922). The discs 3 and 4 were almost isotropic, their values for $\frac{\lambda}{\mu}$ being nearly equal to unity.

This remarkable result appears to indicate that the incorporation of nickel (in sufficient quantity) with steel tends to make it isotropic. At the same time it produces a considerable variation in the coefficient of dynamic elasticity, reducing it (for 3 and 4) to 18,600, whereas that of pure steel is 20,700 (a variation of 10 per cent.).

The ratio of the coefficients of dynamic and static elasticity is 1.035 for pure steel, 1.17 for steel containing 5.55 per cent. of nickel, and 1.51 for steel containing 25 per cent. of nickel. Tests of the latter made in the manufactory by the ordinary statical methods gave values of the coefficient varying from 12,000 to 6,000 according to the size of the specimen and the mode of treatment; the specimens yielded such very different results that under the circumstances it was impossible to regard the coefficient of static elasticity as having any real and determinate significance.

—D. E. J.

Refractory Bricks of Magnesite and Chrome Iron Ore.
Leo. Thonind. *Zeit.* 1891, 15, 700.

THE author ignited a sample of magnochromite from Tampadel in a Deville blast furnace to ascertain its capability of withstanding the temperature of an ordinary open-hearth steel furnace. The sample had the composition:—chromic oxide, 35–42 per cent.; ferric oxide and alumina, 19–22 per cent.; magnesite, 16–18 per cent.; and silica, 3–5 per cent. The lining of the Deville furnace was of magnesite, and a magnesite brick and a Dinas fire-brick were heated at the same time for the sake of comparison. The result of the experiment shows that the chrome iron ore and the Dinas brick were completely fused, while the magnesite lining and the magnesite brick were unaffected by the heat and unattacked by the fused sample.

—B. B.

Action of Sulphuric Acid and Nitric Acid on Aluminium.
G. A. Le Roy. *Bull. Soc. Ind. de Rouen*, 1891, 19 232.

THE author states that the commonly received view that aluminium is unattacked by sulphuric acid or nitric acid whether concentrated or, dilute is erroneous. Four samples of aluminium were examined by him, they had the following composition:—

	Aluminium.	Iron.	Silicon.
	Per Cent.		
A.	98.28	1.60	0.12
B.	98.45	1.39	0.25
C.	99.60	0.30	0.10
D.	99.47	0.43	0.13

The samples which were in the form of sheet were freed from traces of grease by means of caustic soda, washed with alcohol, dried and weighed and exposed to the action of acids of various strengths for 12 hours. The results which are given below correspond to the weight of the metal dissolved, calculated in grms. per square metre:—

Kind of Acid.	Sp. Gr.	Temp.	A.	B.	C.	D.
		° C.				
Pure sulphuric.....	1.842	..	18.40	18.10	16.40	14.50
Commercial sulphuric	1.842	..	21.00	21.30	17.50	16.40
Pure sulphuric.....	1.711	..	24.50	25.00	22.00	20.00
Commercial sulphuric	1.711	..	25.80	24.70	21.60	22.40
Pure sulphuric.....	1.580	15–20	19.00	18.00	17.90	16.30
Pure sulphuric.....	1.263	..	4.60	..	2.60	3.40
Pure nitric	1.383	..	17.00	16.00	15.50	14.50
Commercial nitric ...	1.383	..	20.50	19.60	18.00	16.60
Commercial nitric ...	1.382	..	16.30	16.50	14.00	13.40
Pure sulphuric.....	1.842	150	240	225	150	200
Commercial sulphuric	1.842	150	267	250	210	220
Pure nitric	1.383	100	..	..	..	..
Commercial nitric ...	1.383	100	..	..	..	..

From these figures it is apparent that even commercially pure aluminium is attacked in the cold by both nitric and sulphuric acids of whatever quality, and that, therefore, its proposed use for vessels for the preparation of these acids is ill-advised.—B. B.

The Manufacture of Cobalt. United States Consular Reports, September 1891.

THE large and important chemical works of the Maletra Company, at Rouen, finding that the manufacture of soda and its products had ceased to be profitable, determined to seek some better use for the large portion of their factory which had been used for this purpose. In searching for a substitute which would employ the workmen, utilise the machinery and buildings, and employ the capital and afford profit, the direction naturally sought for some production for which France relied upon other countries for its supply. They found that cobalt was almost a monopoly confined to four or five English and German houses, although the mineral is almost entirely brought from New Caledonia, which is a French colony.

The cobalt for trial was bought in the London market and experimented upon in the well equipped laboratories of their works. The results were conclusive. No doubt existed that this new departure was perfectly practicable. The only difficulty was to obtain the raw material.

The mineral cobalt abounds in New Caledonia and is inexhaustible and co-extensive with the island.

The working of the mines of the mineral is easy, as it is often found on the surface, and when it is below the trench does not exceed 20 ft. in depth. The cost is very little, and it requires to be, for the mineral contains only about 2 per cent. of cobalt.

The veins of cobalt are irregular impregnations of asbolane disseminated through large masses of clay tinted with iron.

This asbolane is found in several states. It is easily cut with a knife, and the section is of a characteristic blue-black lustre. It is mixed generally with silica, oxide of iron, and clay. Although the mineral varies in the different mines, the following analysis gives an approximate idea of its composition:—

Components.	Per Cent.	Components.	Per Cent.
Peroxide of manganese	18	Lime	1
Protoxide of cobalt ..	3	Magnesia	1
Protoxide of nickel ..	1.25	Lost by drying (water and oxygen in excess)	32.75
Silica	8	Total	100
Peroxide of iron ...	30		
Alumina	5		

The mineral thus obtained is sent directly to the London market, on account of the facilities of transportation afforded by English vessels. These ships, carrying wool from Australia, find it very convenient and profitable to take in for ballast the mineral cobalt, which enables them to carry more wool, as the fibres of the wool, like those of cotton, are liable to be broken under pressure. The freight of the mineral to London is about 15 to 18 francs per ton.

The London market has thus become the only centre of supply. In purchasing this article at London the tax imposed of 36 francs on entry into France upon articles from countries outside of Europe brought to European depôts prevented competition in their home market with their English and German rivals. The only remedy was to temporarily admit the mineral upon the express stipulation that the product should be all sold out of France, and thus avoid the payment of duties.

This deprivation of the entire French market interfered with the plans of the company. They undertook to import directly from Nouméa by a maritime transportation company richly subsidised by the French Government. This company offered to carry the freight at first at 28 francs per ton. This was an advance of 10 francs upon the London freight; but having no competition, soon raised their rates to 31 francs, and then to 51 francs, which was prohibitive. In the meantime the Maletra works sent a most competent and experienced metallurgist to New Caledonia. During a residence of 18 months he made a thorough examination, and on his return reported a new process for treating the minerals of cobalt. Soon after he

came back, about three years since, the company installed in the part of their establishment formerly devoted to the manufacture of soda the apparatus for treating the minerals of cobalt.

The following is a description of the method employed by the Maletra Company:—

The mineral in a state of powder is thrown into large vats filled with a solution of protosulphate of iron and thoroughly mixed up by a jet of steam. The manganese, the cobalt, and the nickel are taken up by the liquid in the form of sulphates. The iron that is in the mineral, as well as that in the solution, is precipitated in the form of peroxide and partly as persulphate, with the alumina and silica. The liquid, containing in solution the manganese, cobalt, and nickel, is drawn off, and the residue (containing iron and alumina) is passed through a filter-press and after calcination can be used as colcothar. The protosulphate of iron used in this operation is made in the establishment by attacking scrap iron by one of the residues rich in sulphuric acid known as bisulphate of soda. This bisulphate of soda forms, with the scrap iron, protosulphate of iron and also sulphate of soda, used subsequently. The sulphate of soda is separated by crystallisation. The liquid containing the manganese, cobalt, and nickel is run into stone basins, to which is added sulphide of sodium, which precipitates the whole of the cobalt and nickel, but leaves the greater part of the manganese in solution. The sulphide of sodium is produced in a corner of the establishment by boiling in a closed vessel one of the by-products of their establishment—black-ash waste from their carbonate of soda furnaces—and the sulphate of soda residue from making the protosulphate of iron already described.

The precipitate containing the cobalt, nickel and a small quantity of manganese is washed, passed through the filter-press and then treated with perchloride of iron (produced in one of the succeeding operations), which dissolves the manganese. This second operation gives (1) a black precipitate of comparatively pure sulphides of cobalt and nickel; (2) a liquid containing sulphate and chloride of manganese. To the liquid is added chloride of lime, obtained in one of the subsequent operations, and the manganese precipitated by the lime becomes a by-product used in the Weldon process.

The third operation consists of drying the sulphides of cobalt and nickel and then carefully roasting them in a reverberatory furnace, when, if carefully done, the sulphides become soluble sulphates of the two metals.

The fourth operation is the most difficult and remarkable one. The soluble sulphates are now washed with boiling water. The solution is treated with chloride of calcium. Of the solution (a) containing chloride of cobalt and nickel a certain quantity is taken, and the cobalt and nickel are precipitated by lime. This precipitate of oxide of nickel and cobalt is washed to remove any chloride of calcium that might remain, then placed in a suitable vessel, a sufficient quantity of water added, and submitted to a current of chlorine gas and air under pressure to produce a thorough mixing. To the peroxides so obtained is added a new portion (b) of the liquid a, and the two mixed up thoroughly by a jet of steam, and a curious change takes place. The peroxide of nickel, changing into protoxide, enters into solution and is displaced continuously by an equivalent proportion of cobalt from the first solution. The liquid then contains chloride of nickel, the cobalt being precipitated as peroxide of cobalt. The second portion (b) is calculated so as not to displace the whole of the nickel. This liquid is now run off and a fresh quantity of a added, and so on until on testing it is found that the precipitate contains nothing but peroxide of cobalt pure, when the operation is finished. The solutions containing nickel are treated with lime, and the nickel precipitated as oxide. The products of the operation are (1) protoxide of nickel, (2) peroxide of cobalt, (3) chloride of calcium. The chloride of calcium is required in one of the preceding operations. The separated oxides of nickel and cobalt are filter-pressed, dried and calcined.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Secondary Batteries. G. H. Robertson. Jour. Soc. Arts, 1891, 40, 44—61.

In the introduction the author traces briefly the history of the secondary or reversible battery from its first discovery by Gautherot in 1801, to the discovery of the peroxide of lead—lead couple—by Planté in 1859.

Passing on to 1880, the date of the introduction of the Faure cell, when the growth of electrical engineering led to a commercial demand for some means of storing electrical energy, the copper-zinc, lead-zinc, copper-lead, and alkaline copper forms of secondary cells are shortly described. Then the author deals with the improvements which have been effected in the Planté and Faure types of lead reversible batteries, and points out that since the characteristics of the original cell are common to all, it is important to discover whether they can be affected by mechanical alterations, or whether they are due to the chemical reactions involved in the working of the couple. The first part of the paper deals with the principal improvements in construction.

1. *Improvements in the Planté Type.*—The Planté type is defined as that in which the peroxide of lead and spongy lead are formed direct from metallic lead by electrolysis. In this type obtaining porosity has been the chief aim of inventors, since both the weight of the plate and the time required for formation can be shortened by making the plate porous, and thus exposing more surface to the action of the acid and charging current. The methods which have been suggested from time to time may be classified under three headings:—

A. *Chemical.*—The plates are subjected to some "pickling" process, or some special "forming" bath is used.

B. *Mechanical.*—The plates are made of granulated lead, wire, or some form of finely-divided lead.

C. *Electrolytic.*—(1.) The finely-divided lead is obtained by the electrolysis of some salt of lead; (2.) some salt of lead is formed into a plate by pressure, or otherwise, and then reduced to metallic lead.

II. *Improvements in the Faure Type.*—The Faure type is defined as that in which the peroxide of lead and spongy lead are formed by electrolysis from some oxide applied to the plates.

In this class of cell it is obviously desirable that the supporting part of the electrode should be light and not weakened by taking part in the chemical reactions. These requirements have been met in many instances by replacing the solid lead plate by a grid, usually made of an alloy of lead and antimony, since such an alloy is less acted on by the acid and is much stronger than pure lead.

The other improvements fall into two principal divisions:—

A. Those which have for their object the retention of the paste on the plate, and they may be classed under four headings:—

- (1.) The plate is not perforated, but grooves or recesses are made on the surface so as to afford a lodgment for the active material.
- (2.) The support is some form of "grid."
- (3.) The active material is enclosed in a perforated conducting retaining vessel.
- (4.) The enclosing vessel or plates are made of some non-conducting material, or some inactive substance is packed between the plates to prevent short-circuiting and retain the active material.

B. Those intended to provide better connection between the support and the active material.

Instances under each heading are given from cells and processes of formation in commercial use. The cells described are the "Reynier," "E.P.S.," "Oerlikon," Messrs. Drake and Gorham's "D.P.," "Tommasi," "Julien," "Gadot," "Crompton-Howell," "Atlas," "Roberts,"

"Legay," "Tudor," and all the information which could be obtained in respect to these cells is given in a tabulated form.

In the second part of the paper the author deals with the chemistry of the acid, and points out that although so many different modes of manufacture and preliminary treatment have been resorted to, all the batteries which depend for their action on the couple formed between lead and lead-peroxide in dilute sulphuric acid, exhibit the characteristic peculiarities noticed by Planté in his cell, namely:—The high initial E.M.F. of a freshly-charged cell; the fall of E.M.F. on breaking the charging circuit, with corresponding rise on breaking the discharging circuit; the very rapid fall towards the end of discharge which occurs earlier the more rapid the discharge is, and is not due to the exhaustion of the active material, as after a rest a fresh discharge can be obtained. As the defects, namely, sulphating and buckling, which have retarded the introduction of reversible lead batteries, are also common to the two types, it appeared possible that they were due to the same causes which produced the variations in E.M.F., and which Planté has ascribed to the formation of peroxides in the acid. Berthelot, in 1878, discovered persulphuric acid ($\text{H}_2\text{S}_2\text{O}_8$), and showed that it is the primary product of the electrolysis of sulphuric acid solutions, and that its decomposition is attended with the formation of hydrogen dioxide.

As there was evidence to show that the addition of sodium sulphate, as recommended by Barber Starkey, affected the E.M.F. of the cell, it seemed possible that the different behaviour of cells containing this substance was due to its catalytic action on hydrogen dioxide, and furnished a clue to the reactions normally occurring.

The investigation was aided by Mr. Preece, who allowed experiments to be carried out at the General Post Office, where one half of the secondary cells contain 1 per cent. of sodium sulphate and the other half ordinary dilute acid, density 1.180. The Post Office records showed that the sulphating was much less in the case of cells containing sodium sulphate than in those without. As an instance of this, in the case of two short-circuited cells with badly broken plates, the density of the electrolyte had fallen from 1.170 and 1.180 respectively to 1.100, while in two sodium sulphate cells under similar conditions the density had only fallen from 1.200 to 1.180. This was strong evidence in favour of the hydrogen dioxide formed in the working of the cell being appreciable in quantity, since if sulphating were only due to local action between the support and the paste, there does not appear any reason why the addition of sodium sulphate should affect it.

In the sodium sulphate cells the amount of the oxidising agent was usually less than in the plain cells. Whenever the cells were tested they were always found to contain "active oxygen," which was due to the presence of persulphuric acid and peroxide of hydrogen in varying proportions. It was also found that electrolysed acid was able to reduce pure peroxide of lead in a flask where the reduction could not be due to local action.

The cause of the pink colour of the acid, sometimes noticed, was found to be manganese. This result is important, for it is well known that the pink colour disappears from the acid in a short time if it is taken from the cell, and as persulphuric acid has no action on permanganate, but hydrogen dioxide decolorises it, this disappearance of the colour shows that the latter is formed.

The presence of hydrogen dioxide having been proved, both directly and indirectly, its effect on the E.M.F. of the cell was tested, and it was found to increase the E.M.F. when present at the peroxide plate, but to lower it when present at the lead plate.

In conclusion, the author points out that from the same faults appearing in cells of such different construction, and judging also from the results of the experiments recorded in the paper, it would appear that the troubles occurring in batteries are due rather to causes arising in the working than in the manufacture. What is required is some substance which can be added to the acid to check the formation of the oxidised bodies in it, which cause sulphating, without at the same time injuring the plates in other ways.

In discussion, Mr. James Swinburne said that he had tried a number of experiments on forming processes, and thought the best results were obtained by the use of a solution which first dissolved the lead and then precipitated it. Nitric, sulphuric, and acetic acids, various chlorides, and a large number of other solutions were tried, but the great trouble was that traces of the material were left in the cell which would eventually eat through the plate and destroy it. The least trace of chloride was fatal. The best results were obtained with a mixture of acetic and sulphuric acids. By increasing the strength of the acid a higher E.M.F. could be got, but there was a limit to the strength which could be used, as at a certain strength the spongy lead began to decompose the solution. He regretted more information had not been given about copper and other cells, and believed the tendency now was to turn to copper for the cell of the future.

Mr. M. Immisch said the cells now made would be very satisfactory if manufacturers would give them more output in proportion to their weight. He had tried solid peroxide plates, but though at first the results were marvellous they did not last.

Mr. Bernard Drake said if excessive sulphating could be avoided there would be no buckling; but if batteries were allowed to run out, and were left under conditions which would produce excessive sulphating, nothing would save them. The specific gravity of the acid should be varied according to the work required. With regard to copper cells the return in proportion to weight was certainly greater than from lead, but the invariable difficulty was that the zinc appeared to be soluble in the solution.

Mr. Robertson, in reply, said diminution of weight was, of course, the great point, and he hoped when they knew more about what happened in a cell they would be able to construct them better. Mr. Drake had confirmed his view that the strength of the acid should depend on the work to be done.

The Chairman (Mr. W. H. Preece) thought that the cause of buckling was one of the great troubles chemists ought to attack. He also gave an instance of the practical use of soda. In May last it was reported to him that there were 28 E.P.S. 13 L cells terribly sulphated, which had resisted various attempts to get them into order. About half a pint of a saturated solution of carbonate of soda was added to each cell, and at once the whole difficulty disappeared.—G. H. R.

Artificial Asphalt. E. Valenta. Centr. Org. f. Waarenkunde. Tech. 1891, 1, 19; Chem. Zeit. Rep. 1891, 15, 211.

See under XIII., page 170.

PATENT.

Improvements in the Manufacture of Leclanche Cells. D. Rylands. Stairfoot. Eng. Pat. 3170, February 21, 1891. 6d.

THE object of the invention is to keep the porous pot in the centre of the glass cell, and so that it shall not touch the inside of the mouth of the glass cell. This is accomplished in one of three ways: first, while the bottom of the glass is in a plastic state a plunger is introduced, forming a depression in the thickness of the glass bottom. Into this depression the porous pot fits; or secondly, a shallow glass cell is introduced into such depression, and the porous pot stands inside the shallow glass cell; or, thirdly, the bottom of the glass cell is indented from the outside, and the bottom of the porous pot is indented also from the outside in such a way that the pot fits over the raised portion of the bottom of the glass cell, and is retained in this manner in a vertical position in the middle of the glass cell.—V. C.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

A Rapid Method of Determining the Composition of Lubricating Oils. H. Gripper. Chem. News, 1892, 65, 27—28.

See under XXII., page 182.

PATENTS.

Improvements in the Separation or Treatment of Fatty or Greasy Matters from the Wash-Waters of Wool-Washing or Scouring Establishments. C. W. Kimmins, Cambridge, and T. Craig, Bradford. Eng. Pat. 92, January 2, 1891. 6d.

IN the processes now generally in vogue for separating fatty matters from wash-waters, the sulphuric acid used acts injuriously on the fatty materials as well as on the apparatus used for their mechanical separation. To minimise the objectionable action of the acid the patentees precipitate the fatty matter from wash-waters by means of either suitable neutral salts, such as chloride of calcium or these in conjunction with lime or bleaching powder. From the separated fatty matters a better cake may be obtained by the addition of a small quantity of a soluble sulphate. The cake is decomposed with sulphuric acid, and the colour of the resulting product may be improved by passing through it air, gas, or steam, at a comparative low temperature.

—K. E. M.

Improved Filter for Oils, Lubricants, and other Fluids. W. H. Willeox, London. Eng. Pat. 101, January 2, 1891. 6d.

THIS oil filter consists of two concentric cylinders, the inner cylinder communicating with the annular space, through grids at the bottom, and between which a suitable filtering medium is placed. The oil to be filtered being placed in the annular space between the two cylinders, rises up through the grids and filtering medium into the inner cylinder, whence the filtered oil is removed through a suitable pipe.—O. H.

An Improved Oil Filter. C. E. Masterman and "Woodhouse and Rawson, United Limited," London. Eng. Pat. 1976, February 3, 1891. 8d.

AN air-tight vessel of metal or other suitable substance preferably cylindrical, is divided by a horizontal diaphragm into two chambers, the upper for the reception of dirty oil to be filtered, and the lower for the collection of the clean filtered oil. The diaphragm consists of a disc of perforated metal or wire gauze, upon which is laid fine cotton waste and one or more discs of perforated metal, with corresponding layers of cotton waste, the whole being kept in place by a perforated plate on the top, pressed down by a heavy iron ring. The lower chamber is fitted with an inlet and an outlet cock at the top, and an outlet cock at the bottom, by means of which it may be filled with clean oil to start with, the out-flow of which will tend to aspirate the dirty oil through the filter-plate. A separate vessel may be connected with the upper chamber as a settling tank for the dirty oil, and to allow any water it may contain to separate before passing to the filter.—B. B.

Improvement relating to Candles. G. E. Farrow, London. Eng. Pat. 16,986, October 6, 1891. 6d.

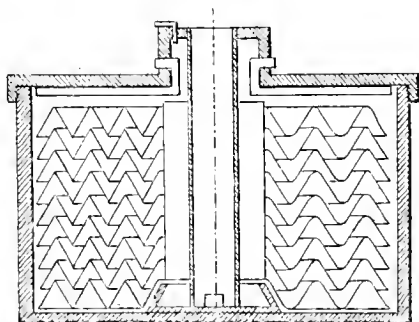
IN order to extinguish candles automatically and at the same time prevent waste, the patentee secures an obstruction of suitable non-combustible material upon the wick. When the candle burns down to the obstruction this will cause extinction. The remaining small piece of candle may now be inverted and relighted by the projecting part of the wick at the lower end.—K. E. M.

An Improved Lubricating Compound for the Chains and Bearings of Cycles and for other Purposes. H. H. Lake, London. From J. Ketchum, Brooklyn, U.S.A. Eng. Pat. 17,553, October 14, 1891. 4d.

METALLIC chromites, preferably chromite of iron, in the condition of an impalpable powder, mixed with glycerin or other suitable "suspending or binding material" is said to be an efficient lubricating compound for bearings of all kinds.—K. E. M.

Improved Method of and Apparatus for Extracting Fatty Particles from Emulsions. C. D. Hellström, Sala, Sweden. Eng. Pat. 17,654, October 15, 1891. 6d.

WITH a view to increase the rapidity and completeness of separation of fats from emulsions such as milk, the patentee makes use of a centrifugal separator in which the emulsion on its passage from the centre to the casing has to take an undulatory path between discs or rings consisting of con-



APPARATUS FOR EXTRACTING FATTY PARTICLES FROM EMULSIONS.

centric corrugations. Annexed Figure shows the arrangement used by patentee.—K. E. M.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Pigments and Vehicles of the Old Masters. A. P. Laurie. J. Soc. Arts, 1892, 125, 133, 150—164, and 171—178.

Of the great variety of pigments used by the old masters many are only suitable for miniature painting or under conditions where they are protected from the action of sunlight and moisture. A few only were used in fresco painting. Other pigments which were admissible in the purer air of ancient cities or in dry climates such as that of Italy, are unsuitable in the atmosphere of modern towns and in moister climates. In reviewing the list of the pigments generally employed for oil painting by the old masters one is struck by the fact that many are of such a character as to act injuriously upon other pigments unless carefully isolated. Yet such pigments are frequently found to have preserved their brilliancy for centuries. Others again are affected by air in the presence of moisture. The author shows that the oils and varnishes usually employed at the present time are far from furnishing a perfect protection from the access of air and moisture. In these experiments dehydrated copper sulphate was coated with the varnish, placed in a desiccator and subsequently exposed, when the more or less rapid colouration of the copper sulphate proved the incomplete character of the protection afforded by the varnish. Similar experiments are considered by the author to disprove Eastlake's theory that the preservation of the colour in such

paintings as those of Van Eyck is due to the use of an *oleoresinous* vehicle, i.e., one in which a resin dissolved in oil is mixed with oil. The author is rather inclined to attribute the preservation of these colours to the use of *balsams* such as Venice turpentine (the balsam of the larch) which he finds to afford a fairly complete protection from moisture. He points out, however, that these balsams are unsuited for modern work, owing to their stickiness, which does not admit of rapidity of execution. Much might be done, however, for the permanence of modern paintings by the exclusion of dangerous pigments, the careful preparation of the pigments used, and particularly by paying more attention to the purity and mode of preparation of the oils.

The author deals at some length with the properties of white lead. The old masters appear to have uniformly employed that made by the Dutch process which contains hydrate. The presence of the hydrate results in the formation of a lead soap with the oil, thus forming a leathery substance of great durability. The precipitated white lead preferred by modern artists on account of its greater purity of colour has not this property. A mixture of the two is believed to be fairly satisfactory. The author considers that too much importance is attached to the fact that a sulphurous atmosphere discolours this pigment, as the colour is restored by exposure to sunlight.—V. C.

Artificial Asphalt. E. Valenta. Centr. Org. f. Waarenkunde u. Tech. 1891 1, 19; Chem. Zeit. Rep. 1891, 15, 211.

By adding sulphur to molten rosin a clear mass is obtained which on heating turns brown, froths up and gives off hydrogen sulphide; at 250° this evolution of gas is regular until it ceases, when the mass becomes brownish-black. The product contains sulphur, is pitchy, and closely resembles Syrian asphalt in properties. It is insoluble in alcohol, but dissolves readily in chloroform and benzene; a thin layer of the latter solution when allowed to dry on glass, deposits a solid varnish which is extremely sensitive to light.—D. A. L.

PATENTS.

The Manufacture of an Improved Preparation of Dryers or Siccative Material for Mixing with Paints. W. N. Hartley, Dublin, and W. E. Hlenkinsop, London. Eng. Pat. 1267, January 23, 1891. 4d.

This preparation is a mixture of manganese linoleate with a finely-powdered metallic oxide or salt, which can have no injurious action on the paint, such, for example, as zinc oxide, carbonate or sulphate, china clay, silica, or kieselguhr. The mixing may be made by beating the materials to steam heat and triturating in a mortar or by rubbing with turpentine.

Good results are said to be obtained by using 40 parts by weight of manganese linoleate dissolved in 120 parts of turpentine and afterwards mixing with 1,000 parts of zinc oxide. This powder may be used for mixing with paints. To prepare a liquid dryer an oil containing 1 per cent. manganese linoleate is treated as described in Eng. Pat. 11,629, of 1890 (this Journal, 1891, 263), and prolonged till the oil becomes thickened, when it is diluted with a suitable solution of the linoleate till it contains about 10 per cent. This dryer will then mix completely with oils or oil paints.—D. A. S.

Improved Polishing Composition. H. E. Hickox, London. Eng. Pat. 12,951, July 30, 1891. 4d.

This composition is intended as a substitute for black-lead, and consists of either size, water, plumbago, and ammonia, or of size, vinegar, water, plumbago, camphor and ammonia, in suitable admixture.—D. A. S.

Apparatus for the Manufacture of Lamp-black Carbon-black. E. Binney, New York, U.S.A. Eng. Pat. 17,221, October 9, 1891. By Internat. Conv., March 9, 1891. 8d.

This is an improved method of making lamp-black from oil, and carbon-black from gas, more economically.

The general practice hitherto in making lamp-black has been to draw the oil flame into a special chamber for a time, and subsequently, when the building is cooled, workmen are sent in to scrape down and remove the lamp-black. It is claimed the new process by saving labour is more economical.

Hitherto carbon-black has been made by allowing a gas flame to impinge directly on a metal surface, from which the deposited black is subsequently scraped. This method of manufacture tends to give the carbon-black a granular form on account of the high temperature, and so in the manufacture of ink, in spite of its superior colour, it has to be mixed with lamp-black to give it flaky texture. It is claimed that by this process the product, while retaining the superior colour of carbon-black, has also the soft flaky texture of lamp-black.

The apparatus is simple, and practically consists in the suitable combination of an oil or gas burner or furnace, with a depositing chamber, the walls of which are out of contact with the flame. The chamber has a revolving scraper to remove the black from the walls, and a conveyor to carry it continuously out.—D. A. S.

Improvements in or relating to the Manufacture of Resinous Paint. W. P. Thompson, Liverpool. From A. F. von Pereira, Stuttgart, Germany. Eng. Pat. 18,072, October 21, 1891. 4d.

This preparation consists of a mixture of 325 parts of copaiba balsam, 25 parts of lavender essence, and 15 parts each of mastic and of dammara resin, which can be rubbed up with the desired colours.

It is claimed that when this resinous paint is used the paintings will not become dark, nor their surface crack, nor will their transparency and durability be interfered with, a drawback which has hitherto attended all such resin colours used without the addition of fatty oils.

These colours dry completely in about 24 hours, and are excellent for painting on glass and metal, even when employed by themselves. When used in distemper painting they can be painted on again with distemper if desired.

—D. A. S.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

The Role of Arsenic in Tanning. S. Sadlon. Der Gerber, 1891, 17, 284.

THE addition of sulphide of arsenic to limes is known to effect a more complete unhairing and to prevent too much plumping of the hides or skins. The condition of the hides from such limes is sounder and of better quality, this improvement manifesting itself in tawed leather by the greater softness and gloss of the grain, and in tanned leather by a better quality of the grain. It has heretofore been accepted that the sulphide of arsenic merely acts in the limes as a carrier of sulphur, converting a portion of the lime into calcium sulphide, the arsenic being itself of no service. The author's observations show that while it is true that the sulphide of arsenic converts a portion of the lime or alkalis into sulphides, the arsenic is by no means unserviceable, for it prevents putrefaction and fermentation, and thus greatly aids the improvement in the leather. Although alkaline sulphides alone will not effect the same improvement as sulphide of arsenic, an addition of common salt, together with an alkaline sulphide, is attended by much the same results as those obtained by the use of sulphide of arsenic.—A. G. B.

PATENT.

A New or Improved Process for Tanning all kinds of Hides or Skins. W. Bolt, Glasgow. Eng. Pat. 3176, February 21, 1891. 4d.

THE inventor mixes with the solution of catechu or other tanning material a solution of chloride of sodium or sulphate of magnesium, or both.—E. J. B.

XV.—MANURES, Etc.

PATENTS.

Improved Method for Precipitating Solid Matter in Sewage, Purifying and Disinfecting the Effluent Water, and Solidifying and Preparing the Sludge for use as a Manure. J. Hardwick and L. A. Newton, London. Eng. Pat. 15,405, September 29, 1890. 6d.

See under XVIII.—B., page 173.

Improvements in and Relating to the Treatment of Sewage and Sewage Deposits. H. Tatham, Burnley. Eng. Pat. 1225, January 23, 1891. 6d.

See under XVIII.—B., page 174.

XVII.—BREWING, WINES, SPIRITS, Etc.

On Wine Yeast. A. Rommier. Compt. Rend. 1891, 113, 386—387.

A VINEYARD in the Dordogne was planted with vines of the best kind from the Médoc, grafted on American vines. After three years, a good crop of grapes was obtained which yielded a good wine, but of no different character from wines of that part of the country generally. If, however, before fermentation, uncrushed grapes from the Médoc or fresh must therefrom be added to the must from the grapes above mentioned, a wine is obtained having absolutely the same character as the Médoc wine.—A. L. S.

Iso-maltose in Beer and Wort. C. J. Lintner. Zeits. ges. Brauw. 1891, 14, 281.

LEAD acetate is added to one and a half litres of beer, the filtrate neutralised with soda and concentrated to a syrup. The concentrated solution is poured into one litre of absolute alcohol; the precipitate consists chiefly of dextrin; the clear alcoholic solution is concentrated and again treated with alcohol; a precipitate is thrown out which, with phenylhydrazine acetate, yields a yellow precipitate, and when purified by several recrystallisations forms aggregations of yellow needles which begin to run at 138°—140° C. and finally melt at 150°—153° C. They have the same composition and properties as iso-maltosazone described by Fischer. This body was also obtained from wort.—A. L. S.

The Application of Aluminium for Vessels for containing Foods, &c. G. Rupp. Dingl. Polyt. J. 1891, 283, 19—21.

See under XVIII.—A., pages 172—173.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A).—CHEMISTRY OF FOODS.

The Artificial Colouration of Articles of Food. A. Tschireh. Schweiz. Wochenschr. Pharm. 1891, 29, 344.

THE green colouring matter of leaves is extremely sensitive to light and to acids of all kinds. To prevent its decolourisation, sodium carbonate is commonly added to vegetables before cooking, while preserved vegetables were formerly boiled in copper vessels but are now treated directly with copper sulphate, well washed, sterilised, and soldered down. The author explains the reactions taking place in the following way. By treatment with sodium carbonate the free fatty, and vegetable acids are neutralised, the fats saponified, and acid salts such as potassium binoxalate converted into the neutral compounds. Not only is the action of the vegetable acids upon the chlorophyll, which results in the conversion of the latter into phyllocyanic acid (a brownish-green body), prevented by the addition of alkaline carbonate, but there is formed the sodium salt of the acid in question which is a fairly stable green substance soluble in water and insoluble in ether. The corresponding copper salt which the author has obtained in the form of black plates with a steel blue reflection is, however, still more stable; the copper it contains does not give the usual reactions until the salt has been destroyed by ignition; it is always formed when the green parts of plants are treated with copper sulphate solution; it contains about 9 per cent. of copper. Seeing that the quantity of chlorophyll in such vegetables as are commonly preserved in this manner, as for example, peas and cucumbers, is very small, the amount of copper solution necessary to preserve the colour is correspondingly minute. The author considers that it is impossible to procure preserved vegetables of brilliant colour which have not been coppered, and is disposed to fix a maximum limit for the quantity of copper, believing that the traces usually present are innocuous.—B. B.

Fruit of the Wax Palm (Corypha cerifera L.) as a Coffee Substitute. J. König. Centr. Org. f. Waarenkunde u. Tech. 1891, 1; Chem. Zeit. Rep. 1891, 15, 208.

THE fruit of *Corypha cerifera* is of stony consistency, and in Brazil is made into a substitute for coffee by roasting in the ordinary manner. Chemical analysis of the Brazilian fruit gave the following numbers per cent. :—

	Crude.	Roasted.
Water.....	Per Cent. 9.37	Per Cent. 3.76
Albuminoids.....	5.82	6.14
Fat.....	10.57	11.06
Sugar and dextrin.....	1.67	1.25
Starch.....	2.47	5.46
Other non-nitrogenous extract substances.....	23.01	27.79
Woody fibre.....	41.31	38.45
Ash.....	2.06	2.24
Ash containing :—		
potash.....	0.63	0.69
lime.....	0.12	0.45
phosphoric acid.....	0.41	0.43
Substances soluble in water.....	12.17	13.50

The fat from the fruit differs in composition from that obtained from the leaves.—D. A. L.

The Adulteration of Foods in Various Countries. Rev. Inter. des falsificat. 1891, 4.

Milk.—Of 214 samples of London milk 44 had been deprived of their cream, boracic acid had been added to 21, and 26 were poor; 6 had an abnormal composition containing 6.7—14.25 per cent. of fat. Of 959 samples of Amsterdam milk 13.7 per cent. were unsatisfactory as they contained less than 11.25 per cent. of dry substances, 15.7 per cent. were poor as they contained between 11.25 and 11.50 per cent. of dry substance, 209 samples contained 12—13 per cent. of dry substance, 36 samples over 13 per cent. dry substance, and 2 samples contained 15.80 and 16.39 per cent. dry substance. In Bremen the following results were obtained :—

Number of Samples.	Specific Gravity at 15° C.	Volume Per Cent. Cream.	Per Cent. Fat.	Per Cent. Dry Substance.
1887.	Per Cent.			
99 market milk .	1.0314	7.54	2.84	11.54
6 stall milk	1.0316	6.14	2.53	11.08
1888.				
87 market milk .	1.0318	8.23	2.98	11.62
23 stall milk	1.0310	7.59	2.98	11.48
1889.				
94 market milk .	1.0319	8.31	2.94	11.52
18 stall milk	1.0312	6.24	2.36	10.80

Butter.—In Bremen, of 109 samples examined, 49 contained foreign fats, 3 were pure margarine, many were rancid, and one contained casein, water, salt, and a little butter. Of 30 London butters one contained 35 per cent. and another 90 per cent. of foreign fats. Much butter is imported into England from Normandy as pure French butter which contains 70—80 per cent. margarine.

Lard.—Of 92 samples taken in Bremen 69 were adulterated with tallow and cotton-seed oil. Lard adulteration also goes on very largely in the United States.

Flour and Bread.—The per cent. of water contained in Amsterdam samples were, wheat flour, 11.3; barley flour, 12.1; rye flour, 13.2; rice flour, 11.4; potato flour, 19. Wheaten bread contained 32—40 per cent. moisture and 1.4—1.7 per cent. ash; rye bread, 2.5 per cent. ash.

Soda Water.—A Bucharest sample contained alum, which had been used to clarify the water, and another sample contained lead.

Beer.—Two Bremen samples contained salicylic acid. It has been enacted in Belgium that lead pipes shall not be used for beer machines.

Spices.—Of 8 samples of mace 3 were adulterated. The samples of pure mace contained about 11 per cent. water, 42 per cent. alcoholic extract, and 2 per cent. ash, whilst the adulterated samples contained about 5 per cent. water, 63 per cent. alcoholic extract, and 1.8 per cent. ash. Black pepper contains 5—5½ per cent. ash, and samples containing over 7 per cent. are adulterated with sand; this last spice is a very favourite one for adulterating.—A. L. S.

The Application of Aluminium for Vessels for containing Foods, &c. G. Rupp. Dingl. Polyt. J. 1891, 293, 19—21.

THE author has subjected aluminium in various forms, such as cups, canteens for the troops, and foil, to the action of different foods and liquids for a length of time varying from 4 to 28 days at the ordinary temperature. An analysis of the metal employed gave Al, 99.66; Si, 0.08; and Fe, 0.30. Besides observing the loss of weight after treatment he also estimated the aluminium in the food, &c. before and after treatment; the results are given in the table. The author also mentions that whereas aluminium in a finely-divided state is perceptibly oxidised by boiling water, the metal in bulk, with the same treatment, is practically unaltered. In conclusion he advocates the re-establishment of aluminium for containing vessels for foods, &c.

	Kind of Treatment.	Duration of Test.	Weight of Aluminium.		Difference in Weight.	Alumina in Solution.	Character of the Solution after Treatment.
			Before.	After.			
1. Aluminium flasks	White wine with 0.7 per cent. acid.	8 days	126.031	126.0302	0.0008	0.0	Clear.
2. " " "	Red wine	"	126.0302	126.0291	0.0011	0.0	"
3. " " "	White wine	28 days	126.0291	126.0256	0.0035	Slight trace	"
4. " " "	Red wine	"	126.0256	126.0218	0.0038	" "	"
5. " " "	Beer	4 days	126.0218	126.0216	0.0002	0.0	Faintly clouded.
6. " " "	Brandy	8 days	108.210	108.2099	0.0001	0.0	Clear.
7. " " "	Cognac	"	108.2099	108.2097	0.0002	0.0	"
8. " " "	20 grms. coffee to 200 cc. water	"	126.0216	126.0210	0.0006	Slight trace	Faintly clouded.
9. " " "	Tea	"	126.0210	126.0204	0.0004	" "	" "
10. Aluminium cups.	Milk	4 days	55.798	55.7977	0.0003	0.0	Curdled and sour.
11. " " "	Butter	8 days	55.7977	55.7975	0.0002	0.0	Rancid.
12. Aluminium foil.	Honey	"	3.8715	3.8714	0.0001	0.0	Unaltered.
13. " " "	Preserved fruits	"	3.170	3.170	0.0	0.0	"
14. " " "	Drinking water, 14° hardness	"	1.879	1.879	0.0	0.0	Clear.
15. " " "	Drinking water (boiling)	$\frac{1}{2}$ hour	1.879	1.8789	0.0001	0.0	"
16. " " "	1 per cent. citric acid	8 days	3.872	3.8715	0.0005	Slight trace	"
17. " " "	1 per cent. tannic acid	"	3.170	3.170	0.0	0.0	"
18. " " "	1 per cent. acetic acid	"	3.789	3.789	0.0	0.0	"
19. " " "	4 per cent. acetic acid	"	3.790	3.786	0.0004	Slight trace	"
20. " " "	10 per cent. acetic acid	"	1.8788	1.8787	0.0001	" "	"
21. Aluminium foil finely divided.	10 per cent. acetic acid, 100 parts...	"	1.001	0.9982	0.0028	0.0021 Al	"
22. Aluminium foil.	5 per cent. boric acid	4 days	3.170	3.1699	0.0001	0.0	"
23. " " "	5 per cent. carbolic acid	days	2.518	2.518	0.0	0.0	"
24. " " "	5 per cent. salicylic acid	"	3.7886	3.7885	0.0001	0.0	"
25. " " "	1 per cent. soda solution	"	2.172	2.157	0.0150	0.0138 Al	Faintly clouded.

—J. C. C.

PATENTS.

Method and Apparatus for Drawing off and Transporting Sterilised Liquids without being Contaminated with Germs. O. Imray, London. From "Calhera Fitz und Consorten," Berlin, Germany. Eng. Pat. 1191, January 22, 1891. 1s. 1d.

This invention has for its object the transport of sterilised fluids, e.g., milk in large quantities. The vessel is spherical and smooth on the inside to render cleaning easy, and is provided with protected orifices at the ends, to one of which may be attached a complex air filter for the removal of germs from the air admitted to replace the fluid drawn off. (For description of the filter we refer to the original.) Among the filtering materials are cellulose, wadding, and charcoal, the former two being regenerated by hot air. A cylinder of a compressed gas such as carbonic acid may be used instead of the air filter.—L. de K.

(B.)—SANITARY CHEMISTRY.

PATENTS.

Improved Method for Precipitating Solid Matter in Sewage, Purifying and Disinfecting the Effluent Water, and Solidifying and Preparing the Sludge for Use as Manure. J. Hardwick and L. A. Newton, London. Eng. Pat. 15,405, September 29, 1890. 6d.

The invention consists in first mixing the sewage with a sufficiency (to be determined if necessary by experiment) of a mixture of gypsum, salt, nitrate of lead, borax, alum,

and nitre, and in some cases also salicylic acid, hydrochloric acid, and caustic potash.

The deposit is finally made into a manure by mixing it with a compound of sulphate of lime, carbonate of lime, salt, sulphur, borax, and magnesite.

Besides yielding a highly purified effluent water, the inventors claim to produce a manure which, whilst possessing valuable fertilising properties, will destroy all insect life.

—L. de K.

Improvement in Apparatus for the Filtration, Aëration, and Purification of Water for Household or Drinking Purposes and the Like. B. L. Ray, London. Eng. Pat. 19,512, December 1, 1890. 6d.

The invention consists in the use of an outer filter case which may be of stone, glass, china, wood, or metal, a filtering pan which fits into the outer case by a broad rim. At the bottom of the filtering pan and descending from it, is a tube or square or oblong; and round the sides of this receptacle are a few fine holes for straining. This receptacle is for receiving a sterilised filtering medium. Inside the filtering pan is a ledge, and on this is placed a flat aërating strainer which fits the filtering pan and from the centre of strainer rises a funnel or pipe for the purpose of aërating the water. Air is admitted through holes in the rim of filtering pan and slight grooves on the rim of the outer case.

—L. de K.

Improvements in and Relating to the Treatment of Sewage and Sewage Deposits. H. Tatham, Burnley. Eng. Pat. 1225, January 23, 1891. 6d.

THE invention relates to the purification of sewage and the manufacture of manure.

The chief feature of the invention is a disintegrator, consisting of two rollers, one of which is spiked and the other plain, the former running the faster, which enables the blocks or cakes of the manure from the filter-press to be reduced to fine particles with rapidity and a very little cost.

—L. de K.

(C).—DISINFECTANTS.

PATENTS.

Improvements in Apparatus for Vaporising Oils and other Liquids for Medicinal and Disinfecting Purposes.

W. H. Spencer, St. Leonards-on-Sea. Eng. Pat. 8629, May 20, 1891. 8d.

THE invention "consists in improved apparatus for vaporising eucalyptus and other oils or materials possessing allied qualities, at such temperatures as have been found from experience to produce the highest remedial effects under varying conditions of disease, by charging the air with the vapour evolved to any desired degree of saturation over extended periods of time, without any further adjustment of apparatus after preliminary setting." For details the specification must be consulted.—L. de K.

Improvements in Sulphur Candles. S. B. Morss, New Jersey, and T. F. Bourne, New York, U.S.A. Eng. Pat. 18,434, October 27, 1891. 6d.

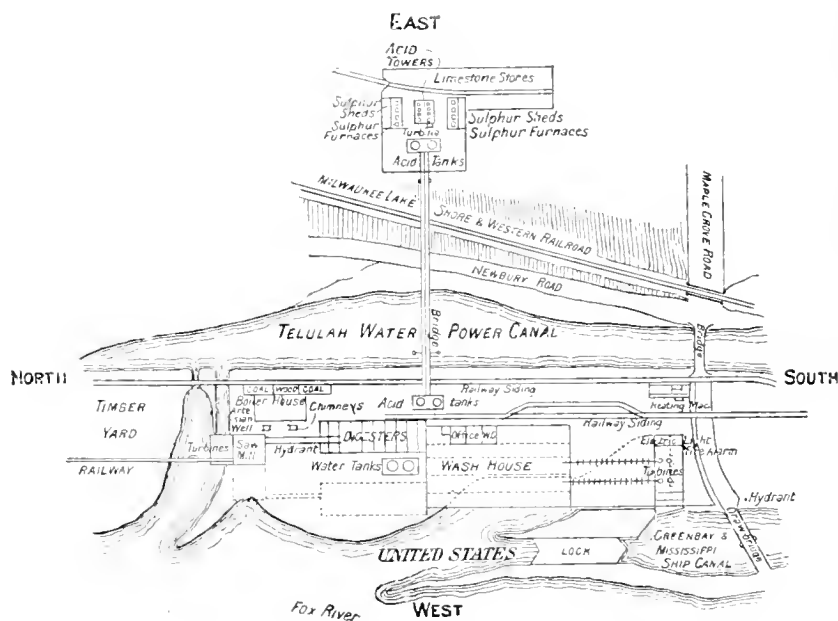
WHEN sulphur is moulded into a block or mass it becomes very hard and difficult to ignite when a flame is applied to its upper surface. Further, on account of the fumes that arise, a person cannot long remain in proximity to the candle.

The invention consists chiefly in undermining the surface of the candle so that a flame will attack and ignite the sulphur quickly and positively.—L. de K.

XIX.—PAPER, PASTEBOARD, Etc.

Description of an American Sulphite Cellulose Paper Mill. H. Wildhagen. Papier Zeit. 1891, 16, 2122—2124.

AN account is given of a large paper mill recently erected at Appleton, on the Fox river (Wisconsin), on the plan known as the Mitscherlich system. The water-power resources of the country are very large, due to the fact that in this section of the river, between Lake Winnebago and Greenbay (Lake Michigan) extending for about 30 miles, there are no less than 18 locks, the fall of which varies from 7 to 12 ft., the river all along its course being used to supply power to mills and factories. Lake Winnebago forms the natural reservoir for this supply, extending for about 40 miles in length and varying from 15 to 20 miles in breadth. At Appleton a weir 8 ft. high and about 750 ft. long gives power on the west bank of the river to various works. On the eastern bank, situate on an island formed by the Fox river, the Greenbay, and the Mississippi Navigation Canal and the Telulah Water Power Canal, lies the paper mill in question. The river is about 750 ft. wide at this point and is bridged by a wooden structure for vehicular and passenger traffic. Across this bridge is the Greenbay and Mississippi Canal, and thence communication is obtained across a swing-bridge with the island, which is about 250 ft. in breadth. Another bridge crosses the Telulah Water Power Canal on the east and affords communication with the mainland. Alongside the roadway thus formed lies the building containing the principal turbines; it is 100·5 ft. by 53, and contains one story only. The plant consists of four turbines of 100 horse-power each and one smaller one of 75 horse-power. In sets of two the former supply power to the wash-house by means of shafting, whereas the latter turbine drives the dynamos for electrically lighting the whole of the mill. The water for these turbines is drawn from the navigation canal. Between the turbine-house and the wash-house lies an open space, measuring 135 ft., upon which there is room for five paper machines. The wash-house, 142·5 by 263 ft., consists of one large hall subdivided into five sections merely by the columns supporting the roof. The centre section is 34 ft. high, the others being 20 ft. only, and a row of windows gives light to the centre of the building. Along this section is arranged the large machine for drying cellulose,



PLAN OF PAPER MILL, &c.

built up of 37 drying cylinders of 3.5 ft. diameter and two sieve cylinders. The two sections of the west side of the building are occupied by washing machines, pumps, troughs, depositing tanks, and other machinery, whereas the sections on the opposite side are taken up by offices, and will only be used for machinery in case of extensions. The three first-named sections have concrete floors, but the eastern portion of the building has only wooden flooring. Situate at the north-east corner of this building lies that containing the digesters, of which there are at present eight; this building has three storeys, and is 156.7 by 60.7 ft.: reference to the plan will, however, show that provision has been made for the addition of 12 further digesters. Here also the floor is concreted so that the pulp after being dropped from the digesters is simply flooded into the wash-house. On the third floor there is accommodation for sufficient wood for each digester, and as soon as one boiling is completed no time is lost in recharging with the wood from above. The wood is conveyed to the store just mentioned from the saw mills, which are about 100 ft. off, by means of a belt. The saw mills consist of a building 58 by 60 ft., containing on the ground floor the shafting for the bark-removing, sawing, grinding, and various other machinery placed in the upper floor. The refuse of shavings and sawdust, &c., is conveyed by a blower through an iron tube 24 in. in diameter to the boiler-house. In the saw mill there is, among others, one machine capable of working over 70 cords of wood into discs of 1.25 in. in thickness in 10 hours. The saw mills are driven by two 100-horse-power turbines mounted in an adjoining building facing north, here there is also a 25-horse-power turbine for driving a pump for the supply to the tower of water required for the preparation of the acid. Beyond the outlet from the Telulah Water Power Canal supplying power to this part of the mill lies the timber yard, with a capacity of several thousand cords of wood, and bounded in the east by a siding of the Milwaukee Lake Shore and Western railroad. The extensive narrow gauge lines of rail in this yard end in the upper storey of the saw mills, running up an inclined bridge. The boiler-house for supplying steam to the digesters and for heating the drying cylinders and buildings lying east of the saw mills, contains two batteries of water-tube boilers, each with a chimney of 125 ft. in height. The towers and sulphur furnaces lie to the east of the Telulah canal on a small hill about 65 ft. high. An iron bridge 420 ft. long gives access to this part of the mill, and carries the conduits for acid, water, steam, waste gases, and the electric current for lighting the bridge and tower. The nine towers are each 115 ft. high and are braced together by a staging 32 ft. wide and 44 ft. long; a building on the top, 32 by 44 ft. and 8 ft. high, bounded by a 8-ft. gallery, contains the water cisterns and systems of piping for each tower; it is heated so that this part of the plant is not liable to become frozen in the cold season. The lift for limestone is placed centrally in the tower and is driven by a small turbine 3 ft. in diameter, placed at the foot of the tower. The water for feeding this turbine is obtained from the turbine of 25-horse-power already mentioned in connexion with the saw mill; it is pumped to the top of the tower and is always kept running, because it is of great importance that the water required here should be as cold as possible. For this purpose it draws from an artesian well. North and south of the tower are the sheds for the sulphur furnaces and sulphur stores, and to the east lies the siding of the Milwaukee Lake Shore and Western railroad, conveying limestone and sulphur. Two tanks for the acid are placed by the canal side close to the bridge, and the liquid is conveyed through an 8-in. pipe across the bridge to two similar tanks placed on high stagings. From here it is conveyed direct to the digesters. The two water tanks are similarly placed on the other side of the digester, or boiling-house, and are supplied by two large double-acting pumps. These six tanks measure 24 ft. diameter by 12 ft. high each. The whole of the foundations and canal walls are in quarry stone and Portland cement, and the buildings in yellow brick and mortar. The mill has a daily output of 25,000 kilos. of dry cellulose.—H. S.

The Paper Industry of Lower Austria. Papier Zeit. 1891, 16, 2142.

THE following is an extract from the report of the Vienna Chamber of Commerce on the paper industry of Austria in 1890:—

The condition of this industry has not experienced any improvement in 1890 as compared with the previous year. The productive capabilities of the Lower Austrian paper mills, which are on the whole favourably situated, remained unaltered, but the concerns did not pay as good a dividend as in the previous year. The over-production, which had in years gone by sought the export markets and had thus relieved the home market, has now to be provided for elsewhere, as many countries, formerly customers, are now large manufacturers themselves. Thus Roumania, the United States, and on account of the disturbances, South America also, were lost in rapid succession.

The export business is represented as being reduced to a mere matter of calculating freights, and owing to the high railway rates in Austria and the equally unfavourable freights charged by the Austro-Hungarian Lloyd, such calculations were rarely favourable to Austrian industry.

As compared to the development of the manufacturing establishments of this trade and the number of mills employed therein, the home demands appear very modest. Although intended to be assisted by extensive printing, newspaper, and publishing combinations, these do not exist on a sufficient scale to be of real value. In fact the few newspapers sold, the small number of publishing offices and the various public demands, are only sufficient to absorb a portion of the output.

Repeatedly the mill-owners have pointed out that Germany imports large quantities of printed paper into Austria, and that by her publishing monopoly, she not only does immense damage to the Austrian paper industry but moreover ruins the printing and bookbinding trades. But still more opposed to the interests of the industry than Germany, with her duty-free importations, is the antiquated press-law, with its fiscal measures, such as newspaper-stamps, securities, &c., which make it impossible for a printing and publishing industry of any value to the country, to exist.—H. S.

PATENTS.

Improvements in Apparatus for Straining or Screening Paper Pulp. W. P. Thompson, Liverpool. From P. R. Thorn, Appleton, U.S.A. Eng. Pat. 18,169, November 11, 1890. 8d.

In the ordinary method of agitating pulp screens, one end only is moved. According to the present invention both ends are agitated and the horizontal motion which is usually given is dispensed with as being unnecessary and injurious.

—E. J. B.

Improvements in Self-registering Apparatus for Measuring the Tensibility and Breaking Strain of Paper and other Light and Flexible Material. F. Leunig, London. Eng. Pat. 18,431, November 15, 1890. 6d.

THIS invention cannot be suitably described without reference to the drawings.—E. J. B.

Improvements in the Manufacture of Paper for Cheques and like Documents. R. C. Menzies, Musselburgh, and E. J. Bevan, London. Eng. Pat. 748, January 15, 1891. 4d.

FERROCYANIDE of manganese, starch, iodide, and iodate of potassium or sodium, and sulphate of manganese are incorporated with the paper.—E. J. B.

An Improvement in the Manufacture of Pulp for Paper Making and other Purposes. R. N. Redmayne, Newcastle-on-Tyne. Eng. Pat. 927, January 19, 1891. 8d.

INSTEAD of discharging the contents of a pulp boiler into a blow-off pit situated below the boiler, the inventor utilises the pressure of steam inside the boiler and causes it to force the pulp to a higher level so as to be ready for the subsequent operations, and thus save the cost of handling.

—E. J. B.

An Improvement in the Process for the Simultaneous Production of Cellulose and Oxalic Acid from Vegetable Fibrous Substances. J. Lifschütz, Grünau, Germany. Eng. Pat. 1824, January 31, 1891. 6d.

ACCORDING to this process, wood, jute, straw, and similar materials are treated with a mixture of dilute nitric and sulphuric acids. The brown vapours evolved, which consist of N_2O , NO and NO_2 , are reconverted into nitric acid. No N_2O is evolved. The acid liquid is used for other operations, the temperature being gradually increased as the nitric acid becomes exhausted. When this occurs the oxalic acid is crystallised out by cooling.

The ligneous material after the action of the nitric acid is converted into pure cellulose by treatment with a weak alkaline solution.—E. J. B.

Improvements in the Treatment of Fibrous Plants for the Manufacture of Paper Pulp. J. Beveridge, Gravesend. Eng. Pat. 2872, February 17, 1891. 6d.

STRAW, esparto, and similar fibrous plants contain considerable quantities of silica, which is not removed by treatment with acid sulphite solutions. The inventor proposes an additional treatment with an alkali which may be applied either before or after the acid sulphite treatment.

—E. J. B.

Improved Machine for Making Parchmentised Fibre and the like. C. N. Robinson, Wilmington, U.S.A. Eng. Pat. 15,222, September 8, 1891. 6d.

THE object of this invention is to prevent the "buckling" of sheets of parchment paper which occurs in the ordinary method of manufacture. It is obtained by the use of special mechanical appliances which cannot be well understood without reference to the drawings accompanying the specification.—E. J. B.

New Manufacture of Composition for Blotting or Absorbing Liquids. A. Bürkel and C. Osterwald, Bremen, Germany. Eng. Pat. 16,921, October 5, 1891. 4d.

925 PARTS by weight of gypsum, 50 parts of wool fibre, 10 of lime, 10 of sodium bicarbonate, and 5 parts of sulphuric acid are mixed together with an equal quantity of water. The paste is moulded in the form of a block, which, when dried, is said to be an efficient absorbent of liquids.

—G. H. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Sulphonic Acids of some of the Cinchona Alkaloids. O. Hesse. *Annalen*, 1891, 267, 138—142.

FUMING sulphuric acid converts the four chief cinchona alkaloids into sulphonic acids, but since the action of strong sulphuric acid is to form the iso-bases iso-quinine, iso-conquinine, iso-cinchonidine, and iso-cinchonine, the sulphonic acids are to be regarded as derived from these iso-bases. To prepare the sulphonic acids, the alkaloids, either as dehydrated mono- or tri-sulphates, are dissolved in the fuming sulphuric acid, colourless solutions being obtained, which are neutralised by baryta, and the barium salt of the sulphonic acid decomposed by sulphuric acid. The resulting solution is evaporated at 50° — 60° C., when a light-brown residue is obtained, which after drying can be ground to a light-brown or flesh-coloured powder.

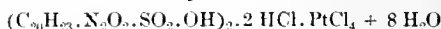
Isoquinine Sulphonic Acid, $C_{20}H_{23}N_2O_2 \cdot SO_3 \cdot OH$, is readily soluble in water. The solution is only slightly acid, it has a blue fluorescence, and is strongly levo-rotatory. It gives an intense dark-green colouration with ammonia and chlorine water. Platinic chloride forms a readily soluble double chloride, whilst auric chloride yields a yellow flocculent precipitate which, when dried at 100° C., has the composition $C_{20}H_{23}N_2O_2 \cdot SO_3 \cdot OH \cdot HCl \cdot AuCl_3$.

Isoconquinine Sulphonic Acid is isomeric with the above and closely resembles it in its properties. It is slightly dextro-rotatory in aqueous solution.

Iso-cinchonidine Sulphonic Acid, $C_{19}H_{22}N_2OSO_3 \cdot OH$, gives no precipitate with platinic chloride, but a yellow flocculent precipitate with auric chloride. It is dextro-rotatory in aqueous solution.

Iso-cinchonine Sulphonic Acid resembles the preceding. It is slightly soluble in water, has an acid reaction, and gives precipitates both with platinic and with auric chlorides. The sulphonic acids of quinine and of cinchonidine are obtained by treating the well-dried tetrasulphates of these bases with acetic anhydride. The sulphates of the sulphonic acids which result when dissolved in hot water and neutralised by ammonia yield the free sulphonic acids, which may be purified by recrystallisation from hot dilute alcohol.

Quinine Sulphonic Acid, $C_{20}H_{23}N_2O_2 \cdot SO_3 \cdot OH + H_2O$, forms small white prisms, difficultly soluble in hot water, which lose their water of crystallisation at 120° C., and then melt with decomposition at 209° C. The hydrochloric acid solution of the sulphonic acid is levo-rotatory— $[\alpha]_D = -182.2^{\circ}$ at 15° C. The platinum double chloride—



crystallises in needles.

Cinchonidine Sulphonic Acid, $C_{19}H_{21}N_2O \cdot SO_3 \cdot OH + H_2O$, also forms small white needles difficultly soluble in water, which melt at 225° C. The platinum double chloride forms orange-coloured needles which contain 3 molecules of water of crystallisation. It is levo-rotatory in hydrochloric acid solution $[\alpha]_D = -140^{\circ}$ at 15° C.—C. A. K.

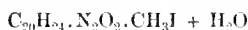
Compounds of Quinine with Hydrochloric Acid. O. Hesse. *Annalen*, 1891, 267, 142—144.

QUININE hydrochloride crystallises in white needles with two molecules of water of crystallisation, which it loses at 120° C., without previously melting. The requirement of the German Pharmacopœia that this salt should melt at 75° C. is therefore not fulfilled by the pure hydrochloride. The dehydrated salt melts at 158° — 160° C. without change, and is not converted into quinine, as stated by Pasteur. If an aqueous solution of the hydrochloride saturated at 15° C. be allowed to stand for some time at a low temperature (about 0° C.), large octahedral crystals belonging to the monoclinic system separate out. These differ from the usual long asbestos-like needles of the salt in containing 3 instead of 2 molecules of water of crystallisation. Acid

quinine hydrochloride, the salt specially applicable for subcutaneous injection, is formed by treating the bisulphate with the equivalent quantity of barium chloride or by evaporating a solution of the normal hydrochloride to which a molecule of hydrochloric acid has been added. It forms groups of concentric needles having the composition $C_{20}H_{24}N_2O_2 \cdot 2HCl$, which can be dried without change at $110^\circ C$. It also separates as a gelatinous mass, which becomes crystalline on gentle warming. The salt corresponds therefore in composition to the hydrochloride of iso-quinine, whence the composition of the latter cannot serve to distinguish the two bases, quinine and iso-quinine, as has been suggested by Lippmann and Heissner (this Journal, 1891, 945—946).—C. A. K.

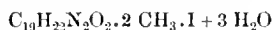
The Action of Methyl Iodide on Cupreine and on Quinine.
O. Hesse. *Annalen*, 1891, **266**, 240—245.

QUININE, when boiled with methyl iodide in methyl alcohol solution, is converted into quinine-monomethyl iodide—



whilst when the mixture is heated in a closed vessel to 80° — $100^\circ C$, the dimethyl iodide is formed. The same product results when the reaction is allowed to take place at the boiling point of the mixture in presence of caustic soda or of sodium methylate. It forms yellow tables having the composition $C_{20}H_{24}N_2O_2 \cdot 2CH_3I + 3H_2O$, which lose their water of crystallisation completely in the exsiccator. The dehydrated dimethyl iodide melts at 158° — 160° , which agrees with the melting point determined by previous investigators. Silver chloride converts this dimethyl iodide into the corresponding chloride, from which both platonic and auric double chlorides can be prepared, both of which are difficultly soluble in water.

Cupreine, when heated with an excess of methyl iodide in methyl alcohol solution, yields the monomethyl iodide, whilst the dimethyl iodide results by prolonged heating in a closed vessel to 80° — $100^\circ C$. The latter forms prismatic crystals having the composition—



corresponding, therefore, in composition to the quinine dimethyl iodide. It loses its water of crystallisation in the exsiccator and melts with decomposition at $210^\circ C$. When treated with silver chloride the corresponding dimethyl chloride is formed, which yields an orange-coloured, granular, difficultly soluble platinum double chloride.

Cupreine dissolved in methyl alcohol is converted into quinine dimethyl iodide when treated with 1 part by weight of sodium (in the form of concentrated caustic soda or of sodium methylate) and 6 parts by weight of methyl iodide. (Compare this Journal, 1891, 723 and 770).—C. A. K.

Iso-cinchonine. O. Hesse. *Annalen*, 1891, **266**, 245—248.

THE author has shown that the alkaloid *cinchonigine* obtained by Jungfleisch and Léger (this Journal, 1891, 724) is identical with *iso-cinchonine*, which is formed by the action of strong sulphuric acid on cinchonine. Jungfleisch and Léger have expressed the opinion that this *iso-cinchonine* contains *cinchoniline* (Compt. Rend. **112**, 942) which is, however, not the case. Nevertheless *cinchoniline* is formed in small quantity, together with *iso-cinchonine*, when cinchonine sulphate is treated with sulphuric acid. *Iso-cinchonine* is not converted into *cinchoniline* by further treatment with sulphuric acid, and the author is of opinion that the formation of this second alkaloid is due to the presence of a second isomeric alkaloid in the so-called "pure" cinchonine sulphate.

Other points referring to the probable presence of a second cinchonine are discussed in the paper.—C. A. K.

A New Alkaloid from Javanese Coca Leaves. F. Giesel. *Pharm. Zeit.* 1891, **36**, 419.

A SMALL-leaved Javanese coca plant contains about 2 per cent. of alkaloid but very little cocaine.

The chief alkaloid present appears to be one closely resembling dextro-cocaine obtained by Einhorn from dextro-ecgonine. The base is not markedly optically active; concentrated hydrochloric acid converts it into benzoic acid and the hydrochloride of an ecgonine. The new base is most probably an isomer or homologue of cocaine.—A. L. S.

Fatty Matter and Ethereal Oil of Sabadilla Seed.

E. Opitz. *Arch. Pharm.* 1891, **229**, 265.

By exhausting ground sabadilla seeds with light petroleum and distilling the extract in vacuo, the crude fat is obtained as a brownish-green liquid readily soluble in alcohol, ether, and benzene. When submitted to steam distillation this product yields about 3.2 per cent. of ethereal oil and the residual fat then has the following percentage composition:—oleic acid, 50; palmitic acid, 36.30; cholesterol, 4.12; glycerol, 9.55; whilst the ethereal oil, on fractionation, distils mainly between 220° — 250° , the distillate having a specific gravity of 0.907, a slightly greenish colour, and an odour resembling turpentine; it consists of ethyl and methyl salts of hydroxymyristic and veratric acids, aldehydes of the lower fatty acids and of high-boiling polyterpenes.—D. A. L.

Larch Turpentine. E. Valenta. *Centr. Org. f. Waarenkunde u. Tech.* 1891, **1**, 141.

On distillation with superheated steam, pure Tyrolean larch turpentine yields 15 per cent. of crude ethereal oil. The residue, after freeing from water and remaining oil in vacuo, is an amber-yellow coloured resin, and when dissolved in acetone is dextro-rotatory. The greater part of it dissolves in 95 per cent. alcohol the insoluble residue—a brown resin—does not apparently exist in the original larch turpentine, but is produced during the heating in vacuo. The alcoholic solution contains, in addition to a colloidal resin, abietic acid. After fractional distillation, the principal portion of the ethereal oil obtained boils at 158° , is a clear colourless laevo-rotatory oil with pleasant odour, has a specific gravity of 0.8604 at 15° and an iodine number=201. The portion boiling between 159° — 165° appears to be a mixture of many turpentine oils.—D. A. L.

On the Production of Sulphate of Quinine. E. Jungfleisch. *Bull. Soc. d'Encouragement Ind. Nat.* 1891, **6**, 604—610.

No other important chemical has diminished in price during the last 10 years so much as sulphate of quinine. The Jahresbericht, published by Zimmer and Co. of Frankfort-on-the-Main, gives the following limits for the prices per kilogram, for the last few years:—

	Francs.
1880	454—443
1881	531—306
1882	444—319
1883	322—262
1884	322—155
1885	190—105
1886	134—88
1887	106—65
1888	88—56
1889	60—38

The introduction of other antipyretics has been suggested as a reason for this decrease in price, but the fact that the total consumption of sulphate of quinine increases by about one-tenth each year negatives this supposition. Speculation is equally incapable of producing a regular diminution in the price, nor is it due to improvements in manufacturing processes. The true explanation lies in the reduction of

the cost of the raw material. Improved methods of culture have yielded far better results than were expected, both in the quantity of the bark and the percentage of alkaloid it contains, which far surpasses the percentage in the best forest barks of South America. Ceylon is the country which yields the largest quantity of cultivated bark. The following figures are taken from *The Ceylon Handbook and Directory* :—

CINCHONA BARK EXPORTED FROM CEYLON TO EUROPE.

	Lb.
1875-1876*	16,812
1876-1877	56,589
1877-1878	178,497
1878-1879	373,511
1879-1880	1,208,518
1880-1881	1,207,720
1881-1882	3,069,895
1882-1883	6,925,538
1883-1884	11,402,947
1884-1885	11,678,390
1885-1886	15,361,912
1886-1887	14,438,260
1887-1888	11,704,932
1888-1889	11,798,465

The diminution of the yield during the last few years is attributed to parasitic diseases. In India, on the plantations begun in 1862, Government has now more than six million cinchona trees under cultivation, and private individuals possess about the same number. The exports of bark from these two sources (from October 1st to September 30th of each year) have been as follows :—

	Lb.
1880-1881	639,258
1881-1882	428,497
1882-1883	641,608
1883-1884	306,419
1884-1885	745,730
1885-1886	857,040
1886-1887	1,285,900
1887-1888	1,449,315
1888-1889	3,074,098

These numbers do not represent the total production of sulphate of quinine, as there are factories in Bengal which work up a portion of the bark on the spot. In 1889 these factories produced 2,191 lb. of sulphate of quinine and 6,384 lb. of a febrifuge consisting of a mixture of alkaloids.

In Java, where the area of the Government plantations forms a much smaller proportion of the whole, the exports of bark (from July 1st to June 30th of each year) have been as follows :—

	Dutch Pounds.
1883-1884	1,104,534
1884-1885	1,195,479
1885-1886	1,531,156
1886-1887	2,230,275
1887-1888	3,742,025
1888-1889	4,415,031

Thus the colonies in Asia export to Europe a total of nearly eight million kilos. of cinchona bark. They will in all probability soon manufacture all the sulphate of quinine they need for their home consumption. In South America, as the forests, which for a long time were the only source of cinchona bark, have become impoverished, cultivation has also been commenced and will probably soon attain large proportions. It is impossible to obtain complete statistics on the subject, but the exports of cultivated bark rich in alkaloids from Bolivia to the London market may be quoted :—

	Bales.
1885	2,530
1886	3,370
1887	7,190
1888	7,810
1889	9,552

* From October 1st to September 30th.

In many other countries, Jamaica, Réunion, St. Thomas, the Fiji islands, &c., the plantations are too young to yield, but they will soon be productive and export to Europe.

There are of course many varieties of cinchona of unequal value, and the number has been increased by hybridisation. In the same species the *natural bark*, *mossed bark*, and *renewed bark* (*écorce renouvelée*) contain very different percentages of quinine, the last being the richest. But there can be no doubt of the general increase in the percentage of quinine contained in the bark; of late years it has not been unusual to meet with lots yielding 10 per cent. and more of sulphate of quinine. It seems probable that the market value of this product will not again increase to a figure which will put it beyond the reach of the poor.

The methods for the extraction of quinine sulphate have not changed since 1878, but the product has been more carefully purified. When manufacturers employed, almost exclusively the bark of *Cinchona calissaya*, which contains but a small percentage of the other alkaloids and notably of cinchonidine, the methods of Pelletier and Caventou sufficed to give a fairly pure product. But the use of cultivated bark, which contains a large percentage of the other alkaloids, introduced into the commercial sulphate a considerable amount of sulphate of cinchonidine, which crystallises with sulphate of quinine, and indeed, causes it to crystallise in silky needles and gives it the characteristic appearance of "light" quinine sulphate. One per cent. of sulphate of cinchonidine suffices to produce this silky appearance, and this is not changed by the addition of an excess. A few years ago, when the bark of *Remigia*, which contains no cinchonidine, was first treated, the latter alkaloid was added, as the pure solutions yielded large brilliant needles unfamiliar in commerce; for the same reason the bark of *Cuprea* was never treated without being previously mixed with other barks. These circumstances led European manufacturers, when the cultivated barks were first employed, to produce samples of sulphate of quinine far too largely admixed with sulphate of cinchonidine, a state of things which led to new regulations for the pharmacopœia in different countries. The French Code in 1884, making use of Kerner's method of analysis, prescribes that 5 cc. of a mother liquor obtained at 15° C. after treatment of 1 gm. of the official salt with 10 cc. of luke-warm water, shall remain perfectly limpid for 24 hours after the addition of 7 cc. of a solution of ammonia of density 0.96. The manufacturers considered these regulations severe. However, the new Austrian pharmacopœia prescribed the use of 7.5 cc. of ammonia, which is only slightly less severe a test; and the pharmacopœias of Russia, Finland, Sweden, the United States, and Japan adopted nearly the same test; the Dutch pharmacopœia has reduced the amount of ammonia to 5 cc. and the German pharmacopœia of 1890 to 4 cc. It seems probable, therefore, that before long only pure ("heavy") sulphate of quinine will be used; and this salt may be recognised by its crystalline appearance which resembles that of zinc sulphate. The only objection of any weight to the employment of the pure salt is that the expense necessary in transforming a nearly pure into an absolutely pure product may be disproportionate to the advantage gained. The author thinks, however, that this expense cannot be very great.

4. Sulphate of quinine manufacturers produce at least four qualities of substance. (1.) The pure salt or "heavy sulphate" of which the use has been hitherto extremely limited chiefly on account of its unfamiliarity to the members of the medical profession; (2.) and (3.) Products satisfying the requirements of the German and Dutch pharmacopœias; and (4.) Products for the others of the above-mentioned pharmacopœias, and containing four to six per cent. of sulphate of cinchonidine. Other products may have a certain commercial importance but have no "legal status" in civilised countries.

5. It is evidently a waste of energy to ship bark to Europe of which only a small percentage by weight is utilised. However, the inferiority of native labour and the dearth of acids in the countries where the bark is grown are an obstacle to the establishment of factories on the spot. Nevertheless, the English in India are developing an industry which seems likely to compete with that of Europe. In

South America less progress has been made, but the first step has been taken. M. Manuel Jijon has set up a factory at Quito which supplies the whole of Ecuador, and has begun to export a product which has a very good appearance. The sulphuric acid necessary is manufactured on the spot from native sulphur.—P. J. H.

PATENTS.

Improvements in Coatings for Therapeutical Purposes. H. Lake, London. From "Ichthyol Gesellschaft Cordes, Hermann, and Co.," Hamburg, Germany. Eng. Pat. 588, January 12, 1891. 6d.

This invention relates to an improved coating for therapeutical purposes into which the remedy is incorporated.

The remedy, either solid or dissolved, is mixed with pure dry starch, and if this should fail to keep the mass homogeneous, certain portions of albumen, casein, or other similarly acting substances should be added. The inventors give a few instances.

An ichthyol coating may be obtained by sprinkling wheat-starch with half its weight of water and mixing with an equal weight of ichthyol; 1 to 1.5 per cent. of a strong solution of albumen is then added, and the mixture triturated until fit for use.

A glycerin coating is obtained by mixing in the same manner 30 per cent. of glycerin with 30 per cent. of starch meal, 15 per cent. of water and 25 per cent. of gum arabic; or 40 per cent. of glycerin, 40 per cent. of starch, and 20 per cent. of a strong solution of casein.

A chloride of calcium coating is prepared by mixing about 40 per cent. of its 50 per cent. solution with 40 per cent. of starch meal, 10 per cent. of water, and 10 per cent. of a concentrated solution of albumen.—L. de K.

A New or Improved Manufacture of Eucalyptus Products for Various Useful Purposes. E. Dean, Epsom. Eng. Pat. 16,910, October 5, 1891. 4d.

THE leaves are dried in the sun or by artificial heat, and after selection cut or wrapped to be used as a substitute for tobacco, for smoking in pipes or in the form of cigars. The leaves and fibres may also be used for the stuffing of beds, mattresses, bolsters, pillows, and the cushions of chairs and sofas. The leaves, whether alone or combined with tea leaves, may be used for fumigating rooms, or, when ground, used as a snuff, for tooth powder, or combined with the fats employed in making soap and candles. The gum it is proposed to make into lozenges for the throat and chest, also for plasters and poultices. The seed is to be ground and used with or without ground gum and leaves in making bread.—L. de K.

Action of Light on Silver Chloride. W. Guntz. Bull. Soc. Chem. 1891, 3, 140—145.

AFTER reviewing former work on the subject, the author states that he has obtained by boiling with a reversed condenser for some hours a modification of AgCl , which is reduced by ferrous oxalate in the dark. He has proved that in vacuo it is coloured by light, and that in air chlorine is given off, there being loss of weight. In these cases some Ag_2Cl is formed which was identical in colour and properties with that obtained by the double decomposition of Ag_2F . He also states that with the formation of Ag_2Cl by light there is an absorption of heat of 28 cal., and that this explains why the action is facilitated by the addition of organic or mineral substances capable of absorbing chlorine with evolution of heat. Ag_2Cl is further decomposed by light into $\text{Ag} + \text{Cl}$. The author also mentions that Ag_2Cl is very opaque to light, a film of silver chloride being exposed for some days being only decomposed to the depth of $\frac{1}{10000}$ mm. Applying his results to photographic matters, he states that a very slight exposure is sufficient to start the process of reduction in the developing solution, and the chlorine then liberated supplies sufficient heat by its action on the developer to continue the decomposition of the AgCl , and this explains the fogging of plates by over-development; also that this unequal state of equilibrium explains how electricity, mechanical, or electro-chemical action may produce complete reduction in the developer.—J. C. C.

PATENT.

Means of Enlarging Photographic Gelatine Films by the Aid of Chemical Means and without the Aid of Enlarging Apparatus. A. J. E. Hill, Norbiton. Eng. Pat. 16,125, September 23, 1891. 6d.

THE film mounted on glass or other support after developing, fixing, and washing, is immersed in a bath composed of hydrofluoric acid 1 part, citric (or other vegetable acid) 4 parts, glacial acetic acid 1 part, glycerin 1 part, and water 32 parts by weight. In this the film separates from its support enlarging at the same time; it is then washed, and allowed to dry spontaneously on its final support. If further enlargement is required, it is treated again in the same manner. The inventor also claims the addition of sulphate of copper or iron to the bath to prevent loss of density by the action of the acids on the silver.—J. C. C.

XXII.—EXPLOSIVES, MATCHES, Etc.

Further Experiments on the Behaviour of Explosives in Fiery Mines. H. Lotmann. Zeits. f. Berg-Hütten u. Salinenwesen, 1891, 39, 183. (Compare this Journal, 1889, 419.)

THE author's observations have confirmed the decision of the Prussian Fire-damp Commission as to the danger of "black powder," but have proved their theory that the safety of an explosive in the presence of fire-damp or coal-dust is nearly proportional to the amount of gas evolved on explosion, to be untenable.

Ammonium oxalate was substituted for the charcoal in ordinary black powder with a view of lessening the hot gases evolved by its explosion, but the explosive force was thereby very seriously diminished without an accompanying increase in safety. Further experiments were made with Seidler's explosives (D. R. Pat. 46,205), diazonaphthalene-monosulphonic acid and diazobenzenesulphonic acid being employed. Their behaviour to fire-damp and coal-dust was favourable, but they are put beyond the pale by the dense and intolerable smoke which they yield.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Drawings from Photographs. Papier Zeit. 1892, 17, 92.

THE drawing is made in ink on a silver print which has been fixed but not toned. The print is first washed in a weak solution of soda in alcohol, and is then bleached by flooding several times with an alcoholic solution of potassium cyanide, made by mixing a saturated solution of the cyanide with 95 per cent. alcohol; finally the print is washed several times with alcohol.—J. C. C.

Experiments with the ordinary dynamites—kieselguhr dynamite, blasting gelatin, and gelatin dynamite—confirmed the former results, and showed in addition that immediate contact of the explosive with coal-dust increases the necessity for priming, and that tamped explosives are in general more dangerous than free cartridges.

"Moist dynamites" (*Wetter-dynamite*) were first prepared by Müller by the addition of salts containing water of crystallisation to dynamite; such are "crystal-soda-kieselguhr-moist-dynamite," "ammonium-oxalate-moist-dynamite" (45 per cent. ammonium oxalate, 15 per cent. sodium nitrate, 40 per cent. nitroglycerol with kieselguhr), and "bicarbonate-moist-dynamite" (kieselguhr-moist-dynamite with 35 per cent. of sodium bicarbonate). Ammonium-oxalate-moist-dynamite proved safe, and bicarbonate-moist-dynamite is so safe that it can be used even in hot, fiery mines. Such explosives, however, should only be regarded as expedients, being uneconomical, because a large portion of the energy of the explosive is consumed in vaporising the added substances; much of the heat being thus employed, the products of the explosion are cooler. A "magnesium-sulphate-moist-dynamite" is marketed in Belgium and England.

The "carbonite" adapted for fiery mines is essentially a dynamite containing organic substances rich in carbon, such as sugar, starch, and cellulose. Such a one, analysed in 1888, gave the following percentage composition:—Nitroglycerol, 17.76; nitrobenzene, &c., 1.70; soda, 0.42; potassium nitrate, 34.22; barium nitrate, 9.71; cellulose, 1.55; cane-sugar, 34.27; moisture, 0.36. Carbonite is safe, but the quantity of carbon monoxide in its after-damp is very objectionable.

Explosives of the Sprengel class are objectionable by reason of their fluidity and their requiring a stronger detonator than dynamite explosives. "Securite" has given good results; its composition has undergone considerable change, and now consists of dinitrotoluene, ammonium nitrate, and potassium nitrate. Roburite is an explosive of the securite type and is safe. Three sorts of Favier's explosives were used. "Explosiv Favier" consists of 88 per cent. ammonium nitrate and 12 per cent. of dinitro-naphthalene; "Antigrison (anti-fire-damp) Favier" consists of 90 per cent. of "Explosiv Favier" and 10 per cent. of ammonium chloride; the third sort is for blasting in the absence of fire-damp, and contains in its compressed portion 79 per cent. of sodium nitrate and 21 per cent. of dinitro-naphthalene, while its mealy portion consists of "Explosiv Favier." The first two sorts proved favourable.

Hellhoffite is not widely applicable because of its concentrated nitric acid; but by substituting nitrates for the nitric acid, and nitrated animal products for the organic substances, after the manner of Sprengel, a safe and practicable explosive was obtained.—A. G. B.

On an Explosive Compound formed by the Action of Baryta-Water upon Chromic Acid in presence of Oxygenated Water. E. Pechard. *Compt. Rend.* 1891, 113, 39—41.

BARYTA-WATER exercises a curious action upon chromic acid to which oxygenated water has been added; a buff-coloured precipitate is produced which when dried detonates violently on percussion, or when heated. When heated at the bottom of a test-tube it detonates sharply and leaves a residue of neutral barium chromate mixed with a small excess of barium oxide. The dried precipitate is not decomposed by contact with water; after being treated with water and again dried it detonates as before. In contact with dilute sulphuric acid a blue colouration is produced which disappears rapidly with evolution of oxygen. In order to analyse the substance, it is mixed with a large excess of sand (previously washed with hydrochloric acid and carefully dried) and is deflagrated in vacuo. The amount of oxygen is measured by volume, and after treatment with dilute hydrochloric acid, the barium is estimated as barium sulphate, and the chromium as Cr_2O_3 . The analyses

appear to show that the dried precipitate consists mainly of a substance having a composition corresponding to the formula BaCrO_5 or $\text{BaO}_5 \cdot \text{CrO}_3$.—D. E. J.

PATENTS.

Improvements relating to the Manufacture of Explosives and to Apparatus therefor. E. J. Ryves, Crayford. Eng. Pat. 298, January 7, 1891. 6d.

THE object of this invention is to overcome a difficulty stated to arise when smokeless powders are used. According to the inventor, when powders are used in rifles, the products of which are entirely gaseous, the barrel is left so clean that the succeeding bullets experience great and varying degrees of friction. He proposes to obviate this by using an explosive compound of the following ingredients, which may be in the proportions given:—

Trinitro cellulose	50	50	75
Nitroglycerin.....	48	48	24
Castor oil.....	2	2	1
Magnesium carbonate	2	2	1
Cotton paper pulp	5	8	5

—W. M.

The Treatment of Cellulose for the Manufacture of Cellulose Nitrates or Gun-Cotton. J. Y. Johnson, London. From "Zellstoff-fabrik Waldhof," Mannheim. Eng. Pat. 336, January 7, 1891. 8d.

THE main feature in this invention is the disintegration of wood pulp, which has been freed from incrusting matters and soluble constituents, in a suitable machine, it being found that the degree of nitration and stability of the product depends greatly on the fineness of division of the cellulose before treatment with the nitrating acid mixtures for the preparation of gun-cotton.—W. M.

Improvements in the Manufacture of Gunpowder and in Apparatus therefor. G. G. André, Dorking, and C. H. Curtis, London. Eng. Pat. 843, January 15, 1891. 6d.

THE apparatus "consists essentially of a stationary cylinder with slot in the bottom, a perforated ring rotated thereon," and a roller which is rotated against the ring. The plastic mass as it comes from the kneading machine is fed in between the rotating cylinder and roller, and in this manner the perforations become filled with the plastic mass. The interior cylinder is supplied with water under pressure, and on the filled perforations coming opposite the slot in the bottom the water forces the pellets out into any suitable receiver.—W. M.

A New Manufacture of Explosives. M. Reuland, Dortmund, Germany. Eng. Pat. 11,713, July 9, 1891. 6d.

MELTED naphthalene has the property of penetrating anhydrous nitrate of ammonia so that the resulting mixture remains unaltered even in air saturated with moisture. The new explosive is prepared by intimately mixing nitrate or "humate of ammonia" with melted naphthalene. Such a mixture is not hygroscopic, nor is it affected in any way by moist air. "These explosives can be exploded only by means of a very intense thin flame. They are therefore unaffected by falling shock and change of temperature."

—E. J. B.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

A New Siphon. F. Konther. Chem. Zeit. 1891, 15, 1126.

The author has devised the form of siphon shown in the Figure.



A NEW SIPHON.

It consists of a wide glass tube which is sufficiently drawn out at one end to allow an india-rubber tube to slip over it, a cork provided with two holes for the insertion of glass tubes being fitted in the other end. To use the apparatus the bent glass tube is closed with the finger, the pinch-cock on the rubber tube opened, and the liquid drawn up the straight glass tube until the upper vessel is two-thirds full. The finger is then removed and air admitted into the upper vessel until the liquid commences to run out of the bent tube, the pinch-cock being thereupon closed.

The wide tube must obviously be of greater capacity than the two smaller tubes combined.—E. B.

Simple Method of Preventing Tumultuous Boiling.

E. Pieszczyk. Chem. Zeit. 1891, 15, 1126.

IRREGULAR ebullition of alcohol, petroleum, benzene, &c., may be prevented by placing a glass tube 5–8 cm. long and 5–10 mm. wide in a vertical or nearly vertical position at the bottom of the distilling vessel. The tube is kept in position by a platinum wire—terminating preferably in a loop—fused into its upper end, which is closed.—E. B.

Behaviour of Glass Surfaces towards Water, and Selection of Glass Vessels for Chemical Purposes. F. Mylius and F. Foerster. Zeits. f. Instrumentenkunde, 1891, 11, 311.

FOR the investigation of the action of water on glass surfaces the authors use millinormal sulphuric acid for solution containing more than 0.1 mgrm. of alkali (reckoned as sodium), but for quantities below this:—the colourless alkaline solution is shaken with some concentrated ethereal solution of iodo-eosine and the amount of alkali is estimated from the reduction in tint observed by comparison with a standard. Neutral water obtained by distilling ordinary distilled water to which a little sulphuric acid had been added to retain ammonia, was employed in the author's experiments on the action of water and atmospheric agencies on glass, and the action of glass on water. Useful comparisons may be made by exposing neutral water for similar periods in glass vessels from different manufacturers, and then examining the solutions.

From their various experiments the authors have observed:—1. That the action of cold water on glass is at first very rapid, but soon becomes much slower; the slackening is attributed to the formation of an exhausted and difficultly permeable layer. 2. That the intensity of the attack of water upon glass is influenced by atmospheric conditions. 3. The relative intensity of the attack by hot or by cold water varies with different kinds of glass. 4. That treating glass vessels of medium quality with water to increase their superficial power of resistance is of great utility; this is not the case by a long way with inferior

kinds of glass. 5. Glass surfaces have the property of absorbing alkali from solutions, and of retaining it when rinsed with water, so that prolonged contact with water is necessary to remove the alkali from the glass again.

—D. A. L.

A Porcelain Water-Bath. W. Dittmar. Chem. Zeit. 1891, 15, 1467.

ON account of the ease with which copper water-baths are attacked by acid vapours, and also on account of the difficulty of keeping such water-baths in a presentable condition, porcelain has been tried as a substitute for copper, but the water-baths have now disappeared by reason, it is said, of great liability to breakage. The author has, however, successfully used for some time water-baths of porcelain, to which is fitted an apparatus for keeping the water in the bath at constant height; by such means liability to cracking is overcome to a very considerable extent.

As a considerable improvement the author suggests the attachment of a ledge to the bath; on this ledge a thin glass globe may be placed fitting into a groove; on the globe is placed a circular piece of thick filter paper; the globe is cooled by the aid of a stream of cold water. By this means evaporation is performed in absence of air and dust.

—T. L. B.

PATENT.

An Improved Tool for Cutting Glass Tubes. A. W. Chisterton, Boston, U.S.A. Eng. Pat. 20,211, November 20, 1891. 6d.

See under VIII., page 163.

INORGANIC CHEMISTRY.—
QUANTITATIVE.

Electrolytic Separation of Mercury from Copper. E. F. Smith and A. W. McCauley. Ber. 1891, 24, 2936–2938.

This separation was attempted previously (J. Franklin Inst. April 1889) but was not complete unless the amount of copper present in solution did not amount to more than 20 per cent. of the mercury present in solution. It has now been ascertained that, by careful regulation of current, it is not only possible to separate the two metals, when present in equal quantities, but also even when there is twice as much copper present as mercury.

A table given shows the results obtained.—T. L. B.

On a Colour Test of Kaolin and Sand. E. Nickel. Chem. Zeit. 1891, 15, 1125–1126.

See under VIII., page 162.

Analysis of Galena and Lead Sulphate. R. Benedikt. Chem. Zeit. 1891, 16, 43–44.

THE author converts the galena into the nitrate with the help of hydriodic acid. The galena, very finely powdered, is weighed into a basin and covered with water; a few cc. of commercial hydriodic acid, sp. gr. 1.7, are then added. If the water is omitted the action may easily become too violent. The dish is warmed on a water-bath till solution is complete, when it is evaporated to dryness. The residue is treated with nitric acid diluted 5–7 times, and again warmed. When oxidation is complete, the solution is evaporated to dryness, moistened with dilute nitric acid and filtered, when the whole of the lead will be in solution as nitrate. With lead sulphate a great quantity of iodine becomes free and, owing to the action of this iodine on the sulphuric acid, sulphur is deposited on the sides of the glass. Should any iodine be seen in the residue after moistening

with nitric acid, all the acid must be driven off and a few cc. of alcohol added, and the mixture evaporated to dryness and again moistened with nitric acid, diluted and filtered. In order to prevent the separation of iodine and sulphur, the author recommends the use of water containing a small quantity of red phosphorus, which will reduce the iodine to hydriodic acid, and be itself oxidised to phosphoric acid.

A complicated ore containing other metallic sulphides in addition to that of lead was analysed first in the usual way, and then by the method above described; in the former case 51.41 per cent. of lead was obtained, and in the latter 51.39.—E. C. C. B.

On the Determination of Small Quantities of Boric Acid.
F. Parmentier. *Compt. Rend.* 1891, **113**, 41–43.

The presence of small quantities of boric acid in mineral waters can easily be detected by means of the spectroscope. A drop of such water, rendered acid and placed in the non-luminous flame of a Bunsen burner, generally shows distinctly the characteristic bands of boron. The amount of boric acid present can be estimated roughly by the intensity of these bands.

The author has endeavoured to determine the quantity of boric acid present in such waters by a method depending on the two following facts:—(1.) Boric acid has no action upon helianthine which has been turned yellow by alkalis. (2.) Boric acid produces a characteristic change in the colour of tincture of sunflowers; this change occurs just when the acid forms a borate with the base present.

In carrying out the method it is essential that the solution should only contain salts which are without action upon tincture of sunflowers, such, for example, as salts of the alkalis or alkaline earths. Most of the mineral waters examined by the author contain calcium bicarbonate and often bicarbonate of iron. When evaporated down they produce precipitates which are insoluble in water and contain all the boric acid (as well as silica, arsenic, and phosphoric acid). The precipitate is treated with hydrochloric acid and evaporated down at a low temperature; it is then heated to 100° (to render the silica insoluble), and afterwards treated with a slightly alkaline solution of ammonium nitrate. The boric acid remains in solution; the residue contains the iron, manganese, arsenic, alumina, and phosphoric acid. The solution is acidified with sulphuric or hydrochloric acid and divided into two parts. In one of these the acidity is determined by means of a titrated solution of soda, using helianthine as an indicator; in the other the acidity is determined with tincture of sunflowers as an indicator. From the difference between the results the quantity of boric acid present can be deduced.

The author has made up artificial mineral waters with salts free from boric acid, and has then added known quantities of boric acid to them. By applying the above method to these he has convinced himself that it is accurate and reliable.—D. E. J.

A New Method of Determining Nitric Nitrogen, and also Total Nitrogen. E. Boyer. *Compt. Rend.* 1891, **113**, 503–505.

This method is based on the fact that when a nitrate is heated with a mixture of sulphur (1 part), calcium oxalate (2 parts), and soda-lime (6 parts), the whole of its nitrogen becomes eliminated in the form of ammonia. Nitrogen, if present in the form of ammoniacal or of organic compounds, is also liberated in the form of ammonia. A combustion tube, closed at one end, is charged as follows:—(1) with 2 grms. of calcium oxalate, (2) 10 grms. of soda-lime, (3) 10 grms. of above reducing mixture, (4) the substance, 0.5 grms. to be tested, intimately mixed with 50 grms. of the reducing mixture, (5) 10 grms. of the reducing mixture, (6) 10 grms. of soda-lime held in position by a plug of asbestos. The tube is heated in the usual way and the ammonia collected in standardised sulphuric acid.

—A. K. M.

Analysis of Chrome Iron Ore. C. Häussermann. *Chem. Zeit.* 1891, **15**, 1601.

The moisture is determined by heating the finely-powdered substance at 100° C., and then 0.5 gm. is mixed with 4 grms. of a mixture consisting of three parts of potassium carbonate to one part of caustic soda. The whole is first heated in a covered platinum crucible over a small Bunsen flame for two hours, after which the fusion is completed over the blow-pipe, the lid of the crucible being removed. After cooling, crucible and contents are boiled with water in a deep porcelain dish; the solution so obtained is acidified with sulphuric acid, and made up to a litre. Should a sandy powder remain in the dish, it is evident that the material has been insufficiently powdered, and a fresh start is necessary. The solution having been satisfactorily obtained, titration with ferrous ammonium sulphate is performed, the strength of the ferrous ammonium sulphate solution having been previously standardised against pure potassium bichromate.—T. L. B.

ORGANIC CHEMISTRY.—QUALITATIVE.

The Use of Ammonium Sulpho-Selenite as a Test for Alkaloids. A. J. Ferreira da Silva. *Jour. Pharm. Chim.* 1891, **24**, 102.

LAFFON, in 1885, described the use of a solution of 1 part of ammonium selenite in 20 parts concentrated sulphuric acid as a reagent for morphia and iodine. The reagent is also useful with the following:—

- Aconitine. After 20 minutes a light rose colour.
- Berberine. Greenish yellow, afterwards brown; the edges of the solution appear red, the middle violet; after half an hour a wine-red colour appears which remains after three hours.
- Brucine. A red changing to orange.
- Caffeine and cocaine. After three hours the solution is reddish.
- Curarine. Light violet changing to red.
- Delphine. Light red changing to violet.
- Digitaline. Yellow changing to a red precipitate.
- Eserine. Citron yellow changing to orange.
- Morphine. Greenish blue changing through violet to red.
- Narcein. First yellowish green, then brown and then red.
- Narcotine. Blue changing through violet into red.
- Papaverine. Blue changing through bottle green, greenish yellow, and bluish violet to red.
- Solanine. Green, afterwards brown.
- Senegine. Dirty yellow changing to red.
- Veratrine. Yellowish colour; after three hours a red precipitate settles.
- Atropine, cinchonidine, cinchonine, and pilocarpine give no reaction.—A. L. S.

ORGANIC CHEMISTRY.—QUANTITATIVE

A Rapid Method of Determining the Composition of Lubricating Oils. H. Gripper. *Chem. News*, 1892, **65**, 27–28.

The author describes a method for ascertaining the composition of lubricating oils containing both fatty and mineral oils, which is stated to be quicker than the usual process of saponifying the fatty oils, and shaking out the unsaponifiable matter with an immiscible volatile solvent. 2.5 grms. of the sample are saponified with 25 cc. of alcoholic potash of one-third or one-half normal strength, according to the amount of fatty oil supposed to be present, and the excess of alkali titrated with seminormal hydrochloric acid, using phenolphthalein as an indicator, a blank experiment for the determination of the strength of the alkali being performed at the same time. The oils most used for mixing with mineral oils for making lubricants are blown cotton-seed oil with a saponification equivalent

of 252, blown rape oil 280, neatsfoot 300, lard oil and tallow oil 290, and castor oil 313. The amount of potash, therefore, required for the saponification of these oils varies from 17.90—22.27 per cent. Taking the mean of these figures (20.08 per cent.) it may be assumed that one part of caustic potash will saponify 4.98 parts of the oil, from which the percentage of saponifiable oil may be readily calculated. The method is simply an application of the Koettstorfer process, and its degree of exactitude depends on the saponification equivalent of the saponifiable oil present in the sample being approximately equal to the mean value taken. The analysis is completed by filtering off the mineral oil from the neutralised soap solution, and taking its specific gravity by Hager's method, which consists in ascertaining the specific gravity of a mixture of alcohol and water in which a globule of the oil will float or sink indifferently. From the specific gravity of the mineral oil and that of the original mixture, the specific gravity of the fatty oil can be calculated. The method, without pretending to be exact, is adapted for technical purposes where great rapidity is important.

The following table shows how the results compare with those obtained by the usual method:—

	By Titration.		By Separation and Weighing.	
	Per Cent.	Specific Gravity.	Per Cent.	Specific Gravity.
I. { Hydrocarbon oil	78.3	0.891		
Saponifiable oil	21.7	0.950		
II. { Hydrocarbon oil	79.4	0.891	79.3	0.890
Saponifiable oil	20.6	0.955	20.7	0.957
III. { Hydrocarbon oil	78.3	0.891		
Saponifiable oil	21.7	0.950		
IV. { Hydrocarbon oil	72.7	0.900	74.4	0.900
Saponifiable oil	27.3	0.973	25.6	0.979
V. { Hydrocarbon oil	76.6	0.882	76.7	0.883
Saponifiable oil	23.4	0.956	23.3	0.953
VI. { Hydrocarbon oil	65.4	0.887	61.1	0.886
Saponifiable oil	34.6	0.966	35.9	0.964
VII. { Hydrocarbon oil	79.9	0.885		
Saponifiable oil	20.1	0.963		
VIII. { Hydrocarbon oil	79.6	0.885	79.8	0.886
Saponifiable oil	20.4	0.962	20.2	0.959
IX. { Hydrocarbon oil	79.9	0.885		
Saponifiable oil	20.1	0.963		
X. { Hydrocarbon oil	56.5	0.906	41.9	0.965
Saponifiable oil	43.5	0.966	58.1	0.908

—B. B.

Hüb's Iodine Test for Fats. W. Fahrion. Chem. Zeit. 1891, 15, 1791—1792.

RESULTS obtained by Hüb's method or even by Holde's (this Journal, 1891, 954) are unsatisfactory, owing to the instability of the iodine-mercury solution. The author has been in the habit of retaining the mercuric chloride and the iodine solutions separate, adding first the former and then the latter to the chloroform solutions of the fat, but even then alterations take place, as the results tabulated below show; in these tests 25 grms. of iodine and 30 grms. of mercuric chloride were each dissolved in 500 cc. of strong alcohol, 250 cc. of each of these solutions were kept separate, whilst the other two halves were mixed. After the

periods noted 20 cc. of the latter and mixtures of 10 cc. of each of the former solutions were treated with potassium iodide and water and titrated with thiosulphate.

	20 cc.		10 + 10 cc.	
	Active Iodine.	Decrease.	Active Iodine.	Decrease.
Series I.: Immediately after preparation.	Grms. 0.4944	Per Cent. ..	Grms. 0.5068	Per Cent. ..
After eight days	0.3776	23.6	0.4882	3.7
After fourteen days	0.3404	31.2	0.4782	5.6
After five weeks	0.2500	49.6	0.4307	15.0
Series II.: Immediately after preparation.	0.4806	..	0.4987	..
After eight days	0.3961	17.6	0.4819	3.4
After fourteen days	0.3541	26.3	0.4733	4.3
After seven weeks	0.2397	50.1	0.4397	11.8

The irregularity is probably due chiefly to variations of temperature, hence it is advisable to keep such solutions at as low and as constant a temperature as possible. The author agrees with E. Pfleger in regarding the use of starch as an indicator not alone as superfluous but even as pernicious, and applies this method in the following manner both to drying and non-drying oils. The solutions he employs are—(1.) 65 grms. of mercuric chloride in 1 litre of 95 per cent. alcohol. (2.) 50 grms. of iodine in 1 litre of 95 per cent. alcohol. (3.) 25 grms. of crystalline sodium thiosulphate in 1 litre of water. (4.) 3.874 grms. of purest dry potassium dichromate in 1 litre of water. (5.) 100 grms. potassium iodide in 1 litre of water. (6.) Chloroform. The strength of the thiosulphate is first ascertained by mixing in a stoppered bottle 10 cc. of the potassium iodide, 5 cc. of ordinary dilute hydrochloric acid, 20 cc. of potassium dichromate, and 150 cc. of water, and titrating to a pale blue-green colouration with the thiosulphate, the number obtained = 0.2 grm. of iodine; the solution will remain constant for a long time if kept in a well stoppered bottle. The strength of the iodine solution is then tested by mixing, in a stoppered bottle, 10 cc. of mercuric chloride, 10 cc. of iodine solution, then 20 cc. of potassium iodide and 150 cc. of water, and titration with the thiosulphate to colourlessness, agitating vigorously. For the actual test, 0.2 to 0.3 grm. of the oil dissolved in 20 cc. chloroform is mixed with an amount of iodine solution corresponding to four times the quantity of iodine actually required for the absorption, and with an equal volume of the mercuric chloride solution, then after two hours for each grm. of iodine taken, about 4 grms. of potassium iodide, in the above solution, and 50 to 100 cc. of water are added, and the titration with thiosulphate to colourlessness proceeded with. A blank experiment should be carried out at the same time.—D. A. L.

Estimation of Cholesterolin. K. Obermüller. Zeit. f. physiol. Chem. 1891, 16, 143.

THE author has applied A. Kossel's method of saponification to the estimation of cholesterolin in the following manner:—1 grm. of fat containing the cholesterolin is dissolved in ether (using sufficient quantity to keep the soap magma subsequently formed thin enough, generally about 80 cc.), sodium ethylate (prepared by dissolving, with the aid of heat, 0.15 grm. of sodium in as little 90 per cent. alcohol as possible—1 to 1½ cc.) is added, and on shaking energetic saponification ensues and is complete in three hours at the ordinary temperature. The soap is filtered off and washed with ether; the latter, as well as any alcohol and water, are expelled from the filtrate, the dry residue redissolved in a minimum quantity of absolute alcohol, and the cholesterolin obtained from this solution by evaporation is dried at 120° and weighed. Solid fats yield granular soaps, fats rich in

oleic acid give stringy soaps. The method only answers for the former; for the latter the first part of the method is the same, but the treatment of the residue is different. It is dissolved in carbon bisulphide and is treated with a solution of bromine in carbon bisulphide of known strength, until a yellowish-red colouration is obtained.

The action of bromine on substances analogous to cholesterol is not known, but the author finds that isocholesterin absorbs 2 mols. of bromine.—D. A. L.

The Optical Determination of Albumen in Urine. H. O. G. Ellinger. *Jour. prakt. Chem.* 1891, **44**, 256.

THE oleorefractometer of Amagat and Jean is used for this purpose. The albumen is removed from one portion of the urine by boiling with a little acetic acid; the filtrate is made up to its original volume and placed in the outer spaces of the prism. The untreated urine is placed in the interior prism of the instrument. The displacement of the sought point is proportional to the amount of albumen present. Five determinations gave readings of $2\frac{1}{2}$, 4, $4\frac{1}{2}$, 5, 5. By weighing the albumen the absolute amounts were found to be respectively 2.71, 4.36, 4.94, 5.10, 5.22 parts per thousand.

—A. L. S.

Choline as a Constituent of Beer. J. Kjedahl. *Meddelelser fra Carlsberg Laboratoriet*, 1891, **3**, 79.

IF a large excess of a solution of iodine in potassium iodide be added to beer or wort, tinct, beetle-green needles appear after a short time; these are a polyiodide of choline. To obtain choline from wort, the latter is evaporated to one-half and treated with excess of milk of lime and one or two volumes of alcohol. The filtrate is acidified with sulphuric acid, evaporated on the water-bath with excess of barium carbonate, until all the alcohol is volatilised and then after distillation the polyiodide of choline is precipitated by iodide solution. The polyiodide is decomposed by sulphurous acid, the solution filtered, the iodine replaced by chlorine by shaking with silver chloride and the solution evaporated; by treatment with platinum chloride the platinum double salt is prepared.

Several determinations of the amount of choline in beer and wort showed that the amount was the same before and after fermentation.

Besides free choline, beer also contains a choline compound, perhaps lecithin.—A. L. S.

Testing Paper for Wood Fibre. F. v. Hühnel. *Centr. Org. f. Waarenkunde u. Techn.* 1891, **1**, 219.

IT is pointed out that various carbohydrates, such as cane-sugar, dextrins, &c., give reactions resembling the lignin reactions, for instance:—Swedish filter paper, prepared from pure cellulose, impregnated with cane-sugar solution and tested with phloroglucol and hydrochloric acid at first gave no reaction, but when dry it becomes distinctly red just as if wood fibre were present. Again wood cellulose, which tested in the ordinary way with phloroglucol and hydrochloric acid, showed only traces of lignin, became intensely red when, after treatment with the reagents, it was washed slightly and then quickly dried at 100° – 110° . The author, therefore, considers it advisable, whenever drying or heating has taken place during a test of this kind, to supplement the observation by a careful microscopical examination for the sake of confirmation.—D. A. L.

ANALYTICAL AND SCIENTIFIC NOTES.

On an Explosive Compound formed by the Action of Baryta-Water upon Chromic Acid in presence of Oxygenated Water.

See under XXII., page 180.

New Books.

MANUAL OF CHEMICAL TECHNOLOGY. By RUDOLF VON WAGNER. Translated and edited by WILLIAM CROOKES, F.R.S. From the 13th enlarged German edition as remodelled by Dr. Ferdinand Fischer; with 596 Illustrations. 1892. London: J. and A. Churchill, 11, New Burlington Street.

LARGE octavo volume, bound in cloth. Contains Preface by F. Fischer (translated), Preface to the English Edition by William Crookes, Table of Contents, subject-matter covering 948 pages, an Appendix of 4 pages, and an Alphabetical Index. The subjects treated of in the volume are as follows:—

Section I. Technology of Fuel. *Section II.* Metallurgy. *Section III.* CHEMICAL MANUFACTURING INDUSTRY, including the following branches:—Water and Ice. Artificial Mineral Waters. Sulphur. Sulphuric Acid. Potassium Salts, Common Salt, and Salt Works. Soda. Chlorine, Chloride of Lime and Chlorates. Bromine. Iodine. Nitric Acid and Nitrates. Explosives. Ammonia. Phosphorus. Matches. Phosphates, Manure. Boric Acid and Borax. Salts of Aluminium. Ultramarine. Compounds of Tin and Antimony, of Arsenic, of Gold, Silver, and Mercury, of Copper, of Zinc and Cadmium, of Lead, of Manganese and Chromium, Iron Compounds including Ferrocyanogen. Inorganic Pigments, Thermo-chemistry. *Section IV.* THE ORGANIC CHEMICAL MANUFACTURES. Alcohols and Ethers. Organic Acids. Treatment of Coal-tar. Organic Colouring Matters. Tar Colours. Benzene Colours. *Section V.* Glass, Earthenware, Cement and Mortar. *Section VI.* Articles of Food and Consumption. *Section VII.* Chemical Technology of Fibres. *Section VIII.* Miscellaneous Organic-Chemical Arts and Manufactures. Appendix containing a set of useful Tables. The price of the volume is 1*l.* 12*s.*

THE PHOSPHATES OF AMERICA. Where and How they Occur; How they are Mined; and What they Cost. With Practical Treatises on the Manufacture of Sulphuric Acid, Acid Phosphate, Phosphoric Acid, and Concentrated Superphosphates. Also, Selected Methods of Chemical Analysis. By FRANCIS WYATT, Ph.D. Second Edition. 1891. New York: The Scientific Publishing Co., 27, Park Street. London: H. Grevel and Co., 33, King Street, Covent Garden.

THIS work is dedicated to R. P. Rothwell, the editor of the *Engineering and Mining Journal*, by the author, and is an 8vo volume, bound in cloth, and containing Prefaces to first and second editions, 178 pages of subject-matter, and an Alphabetical Index.

CHAP. I. Introductory. II. Phosphates and their Assimilability. III. The Phosphates of North America. IV. The Phosphate Deposits of South Carolina. V. The Phosphate Deposits of Florida. VI. Sulphuric Acid Manufacture. Under this heading occurs the following sentence on the subject of chamber construction:—"The subject of chamber construction is well worn, if not exhausted; their form and size have long been bones of contention over which certain viscerates, with plenty of time for useless discussion, have growled *ad nauseam*." As to thickness of lead to be employed, the author says, "A happy medium may be attained by adopting seven-pound lead for the first chamber and six-pound lead for the second." On the dimensions, he says, "The amount of chamber room should in no case be less than 20 cubic feet for every pound of sulphur consumed." Speaking of the Glover Tower, the author says, "This remarkably ingenious and valuable addition to the sulphuric acid plant is named after its disinterested inventor, Mr. John Glover, an English chemist." VII. Manufacture of Superphosphate, Phosphoric Acid, and High-Grade Supers. VIII. Selected Methods of Phosphate Analysis and Generally Useful Laboratory Details. On the subject of divergent analyses, &c., the author asks, "Why should there be any material difference between the shippers' and buyers' samples, if both are faithfully taken according to prescribed rules and

with proper regard for the true interests of each party to the contract?" There follows later a short chapter on SAMPLING, and minute details are given. This very properly precedes any details given as to Analysis. After a full description of the Analytical Methods, the work concludes with a "Table showing the principal Apparatus and Chemicals comprising the Outfit required in Phosphate Mining or Fertiliser Factory Laboratories." The work is illustrated by means of 20 well executed wood engravings, two maps, and 20 photographs. The price of the book is 4 dols., or, approximately, 18s. in English money.

SYSTEMATIC MINERALOGY, based on a natural classification, with a General Introduction. By THOMAS STERRY HUNT, M.A., LL.D. 1891. New York: The Scientific Publishing Co., 27, Park Place. London: H. Grevel and Co., 33, King Street, Covent Garden.

This work is dedicated to his friend James Douglas, the metallurgist. It is a large 8vo. volume, bound in cloth, and containing Table of Contents, Preface, 376 pages of subject-matter, and the Alphabetical Index. The text is subdivided into Chapters, as follows:—Chapter I. The Relations of Mineralogy. II. Mineralogical Systems. These are divided as involving the Natural History and Chemical Methods, and the possibility is considered of reconciling the two. III. First Principles in Chemistry. IV. Chemical Elements and Notation. V. Specific Gravity. VI. The Coefficient of Mineral Condensation. The views on this problem of Gibbs, Roscoe, Victor Meyer, Louis Henry, &c. are given. VII. The Theory of Solution. VIII. The Relations of Condensation to Hardness and Insolubility. IX. Crystallisation and its Relations. X. The Constitution of Mineral Species. XI. A New Mineralogical Classification. XII. Mineralogical Nomenclature. XIII. Synopsis of Mineral Species. XIV. The Metallaceous Class. XV. The Itallidaceous Class. XVI. The Oxydaceous Class. XVII. The Pericaustaceous Class. XVIII. Mineral History of Waters. XIX. There then follows:—(1.) A General Alphabetical Index, and (2.) An Alphabetical Index of Mineral Names. The price of the book is 5 dollars, or approximately 11. 2s. 6d.

CHEMISTRY OF THE CARBON COMPOUNDS OR ORGANIC CHEMISTRY. By Professor V. VON RICHTER. Authorised Translation by Edgar F. Smith, Professor of Chemistry, University of Pennsylvania. Second American Edition from the Sixth German Edition. 1891. London: Kegan, Paul, Trench, Trübner & Co., Limited.

This well-known work on Organic Chemistry, according to the preface of the translator, is as well received in America as it is in England. The present volume is an 8vo., bound in cloth, and after Prefaces and Table of Contents, commencing with an Introductory Chapter on General Theory, Methods of Analysis, Vapour Density Determination, &c. The special part of the work with Introductory included, occupies 1016 pages, and an Alphabetical Index completes the work. The eight or nine illustrations are exceedingly well executed wood engravings.

The special part is subdivided as follows:—

Class I.—FATTY BODIES OF METHANE DERIVATIVES.

Hydrocarbons. Alcohols, Acids and their Derivatives.

Monovalent Compounds. Alcohols. Unsaturated Alcohols. Ethers. Mercaptans and Thio-ethers. Esters of Mineral Acids. Amines. Hydrazines. Phosphines. Arsenic Bases. Metallo-organic Compounds. Aldehydes and Ketones. Monobasic Acids. Cyanogen Compounds. *Divalent Compounds.* *Trivalent Compounds.* *Tetravalent Compounds.* *Pentavalent Compounds.* *Hexavalent Compounds.* Carbohydrates. Tetramethylene Derivatives, &c. Furfuran Group. Thiophene Group. Pyrrol Group.

Class II.—BENZENE DERIVATIVES. Hydrocarbons, &c. *Diazo-Compounds.* *Azo-Compounds.* *Hydrazine Compounds.* Sulpho-compounds of the Hydrocarbons. Phenols. Dihydric Phenols. Trihydric Phenols. Quinones. Alcohols. Divalent Alcohols. Aldehydes. Ketones. Ketone-aldehydes. Di-ketones. Nitriles. AROMATIC ACIDS. Ketonic Acids. Dibasic Acids. Tribasic Acids. Tetrabasic Acids. Hexabasic Acids. Unsaturated Compounds.

Derivatives with Closed Side Chains. (1.) *Derivatives of Directly Combined Nuclei.* (2.) *Derivatives of Benzene Nuclei joined by one Carbon Atom.* (3.) *Derivatives of Benzene Nuclei joined by two Carbon Atoms.* (4.) *With Condensed Benzene Nuclei.*

Derivatives of Nuclei Containing Nitrogen. (1.) Derivatives of five-membered Nuclei. (2.) Quinoline Group. Isoquinoline Group. Benzodiazines. Cinnolines. Quinazolines. Quinoxalines. Acridine Group. Phenazine Group. Safranines. Alkaloids. Terpenes. Camphor. Resins.

The price of the work is 20s.

THE CHEMISTRY OF PAINTS AND PAINTING. By A. H. CHURCH, M.A., F.R.S., Professor of Chemistry in the Royal Academy of Arts, London. Second Edition. Revised and enlarged. 1892. London: Seeley and Co., Limited, Essex Street, Strand.

This book is dedicated to Sir Frederick Leighton by the author. It is of 8vo. size and handsomely bound in green cloth, and gilt. There are Prefaces to First and Second Editions, a Table of Bibliographical Notes of Works consulted or recommended for consultation. Then follow Table of Contents, 320 pages of subject-matter, and the Alphabetical Index. The text is subdivided as follows:—Introduction. PART I. PAINTING GROUNDS. Paper, Vellum, Ivory, Plaster or Intonaco, Stone, Panel, Canvas. PART II. VEHICLES AND VARNISHES. Oils, Resins, Waxes, Paraffin Wax. Yolk and White of Egg, Size, Glue. Gums, Glycerin, Honey. Water-glass, Lime- and Baryta-water. Solvents and Diluents. Siccatives or Dryers. Varnishes and Oleo-resinous Vehicles. PART III. PIGMENTS. White, Yellow, Red, Green, Blue, Brown, Black Pigments. Classification of Pigments. Tables of Permanent and Fugitive Pigments. Selected and Restricted Palettes. PART IV. PAINTING. Methods. Study of Old Paintings. Conservation of Pictures and Drawings. Trials of Pigments. The price of the book is 5s.

TECHNISCH-CHEMISCHES JAHRBUCH, 1890—1891. Ein Bericht über die Fortschritte auf dem Gebiete der chemischen Technologie vom April 1890 bis April 1891. Herausgegeben von Dr. RUDOLF BIEDERMANN. Dreizehnter Jahrgang. Mit 263 in den Text gedruckten Illustrationen. 1892. Berlin: Carl Heymann's Verlag. London: H. Grevel and Co., 33, King Street, Covent Garden.

OCTAVO volume, strongly bound in cloth and gilt-lettered. It commences with a brief Preface, followed by Tables of Contents and Errata, and List of Works consulted and referred to in the text, with the Abbreviations used. The subject-matter covers 573 pages, and the work contains 263 well-executed wood engravings. The classified list of New Books published during the year is an interesting feature, and it immediately precedes the Alphabetical Index, which comprises an index of authors and one of subject-matter.

The matters treated of in the text are as follows:—I. Patent Laws. II. Iron and Steel. III. The Alkali Metals, Magnesium, Aluminium. IV. Gold and Silver. V. Copper. VI. Lead. VII. Zinc. VIII. Tin. IX. Nickel and Cobalt. X. Chromium and Manganese. XI. Bismuth, Arsenic, Antimony, Mercury. XII. Chlorine, Hydrochloric Acid. XIII. Sulphur, Sulphurous Acid, Sulphuric Acid. XIV. Hydrogen, Oxygen, Carbonic Acid. XV. Soda. XVI. Potash Salts. XVII. Ammonia. XVIII. Alkaline Earths. XIX. Aluminium Compounds. XX. Glass. XXI. Earthenware. XXII. Cement. XXIII. Artificial Stone. XXIV. Explosives. XXV. Illuminants. XXVI. Fuel. XXVII. Sugar. XXVIII. Starch and Starch Sugar. XXIX. Wine. XXX. Beer. XXXI. Spirits. XXXII. Fats, Soaps, &c. XXXIII. Water. XXXIV. Foodstuffs. XXXV. Mannes. XXXVI. Tanning. XXXVII. Organic Acids. XXXVIII. Alkaloids. XXXIX. Colouring Matters. XL. Textile Fibres and their Treatment. XLI. Paper. XLII. Photography. XLIII. Apparatus and Machinery. The price of the book is 12s.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

(From the Board of Trade and other Journals.)

RUSSIA.

Classification of Articles in Customs Tariff.

Note.—Pond = 36 lb. avoirdupois. Rouble = 100 copecks = 3s. 2d.

The following decisions affecting the classification of articles in the Russian Customs tariff have recently been given by the Russian Customs authorities:—

Ethers or fruit essences employed for flavouring sweets and in medicine though with an admixture of spirits and with not less than 75 per cent. of ether, under sect. 115. Duty, 10 roubles gold per pound; the same ethers mixed with spirits containing less than 65 per cent. of ether under sect. 27, as spirits with flavouring admixtures. Duty, 12 r. gold per pond, gross; when imported in casks and barrels and when imported in bottles of $\frac{1}{2}$ of a vedro, 1 r. gold per bottle.

NEW CUSTOMS TARIFF OF MEXICO.

Note.—Kilog. = 2·204 lb. avoirdupois. Peso = 4s. 2d.

The following is a statement of the rates of import duty on chemicals now levied under the new Customs tariff of Mexico, which came into operation on the 1st November last:—

Note.—By "net weight" must be understood the actual weight of the merchandise; by "legal weight," that which includes besides the "net weight" that of the interior bottles, boxes, winders, wrappers, &c. in which the articles are imported, and by "gross weight" the total weight of the packages. When merchandise which pays according to the "legal weight" has no other covering besides the one which forms the outside package, the actual weight of the merchandise will be considered to be its legal weight.

No. in Tariff	Articles, &c.	Rates of Duty now levied.
CHEMICAL AND PHARMACEUTICAL PRODUCTS.		
		Pesos, Cs.
651	Aniline oil.....	Kilo. (gross) 0·07
652	Acetates of aluminium, ammonia, lime, iron, and lead.....	" (legal) 0·08
653	Arsenical acid.....	Free.
654	Carbonic, chlorhydric, sulphuric, and sulphurous acids.....	Kilo. (gross) 0·03
655	Acetic, nitric, oxalic, and pyroligneous acids.....	" (legal) 0·05
656	Phenic acid.....	Free.
657	Liquid acids not specified.....	Kilo. (legal) 0·20
658	Acids in crystals or in powder, not specified.....	" " 1·00
659	Gum for cloth.....	" " 0·08
660	Aromatic distilled waters, not spirituous.....	" " 0·50
661	Natural alkaloids, not specified, and their salts.....	" " 8·00
662	Alcohol and spirits of wine.....	" (net) 0·70
663	Amylic and methylic alcohol or spirits of wood.....	" (legal) 0·20
664	Alizarine, natural or artificial.....	" (gross) 0·05
665	Antiseptic cotton.....	" (legal) 0·25

NEW CUSTOMS TARIFF OF MEXICO—cont.

No. in Tariff	Articles, &c.	Rates of Duty now levied.
		Pesos, Cs.
666	Ammonia, liquid or solid.....	Kilo. (gross) 0·01
667	Anthracene.....	" " 0·07
668	Sugar of milk.....	" (legal) 0·40
669	Sugar, medicinal and aromatised.....	" " 0·50
670	Varnishes, white and coloured.....	" " 0·20
671	Benzene.....	" " 0·10
672	Bitumen and jappanning in paste or varnish for boots and shoes.....	" " 0·20
673	Medicine chests.....	" " 0·75
674	Cases with medical reagents.....	" " 1·00
675	Capsules, drops, globules, grains, pills, confections, medicinal, and empty gelatine capsules and wafers.....	" " 0·75
676	Carbonates and bicarbonates of potash and of soda.....	" " 0·03
677	Cyanide of potassium.....	" " 0·08
678	Collodion, common and photographic, of whatever formula.....	" " 1·00
679	Colours, in powder, in crystals, or prepared.....	" (gross) 0·08
680	Chloral.....	" (legal) 1·00
681	Chlorate of potash or of soda.....	" " 0·06
682	Chloroform.....	" " 1·00
683	Chlorides of calcium, sodium, or potassium.....	Free.
684	Chlorides of gold and of platinum.....	Kilo. (legal) 16·00
685	Chloride of zinc and protochloride of tin.....	" (gross) 0·01
686	Cream of tartar.....	" (legal) 0·10
687	Creoline.....	" " 0·03
688	Diastase.....	" " 1·00
689	Medicinal drugs and chemical and pharmaceutical products not specified.....	" " 0·75
690	Antiseptic soap.....	" " 0·03
691	Fruit ether.....	" " 0·75
692	Ether, not specified.....	" " 0·20
693	Extracts of dyewoods.....	" (gross) 0·05
694	Phosphorus, white or red.....	" (legal) 0·50
695	Phosphorus and wax of all kinds.....	" " 1·50
696	Glue (mucilage) for offices.....	" " 0·30
697	Hyposulphite of soda.....	Free.
698	Medicinal soaps.....	Kilo. (legal) 0·40
699	Concentrated lyes.....	" (gross) 0·03
700	Yeast of all kinds.....	" (legal) 0·03
701	Morphia and its salts.....	" " 6·00
702	Nitrate of silver.....	" " 8·00
703	Orcinol.....	" (gross) 0·05
704	Plasters, &c.....	" (legal) 0·50
705	Pastes, lozenges, and jellies, medicinal... ..	" " 0·75
706	Pepsine.....	" " 1·00
707	Potassium permanganate.....	Free.
708	Photographic dry plates.....	Kilo. (legal) 0·30
709	Powders, medicinal.....	" " 0·30

NEW CUSTOMS TARIFF OF MEXICO—*cont.*

No. in Tariff.	Articles, &c.	Rates of Duty now levied.
		Pesos. Cs. Free.
710	"Potea" of tin	Free.
711	Quinine and other alkaloids of bark.....	Kilo. (nett) 1'00
712	Common or table salt	" (gross) 0'03
713	Aniline salt	" " 0'07
714	Salts of strontium and barytes	" (legal) 0'08
715	Salts and oxides of all substances not specified	" " 0'15
716	Nitrate of potash or of soda.....	Free.
717	Silicates of soda and of potash.....	Kilo. (gross) 0'03
718	Caustic soda and potash	" " 0'03
719	Sulphates of copper, iron, and antimony.	Free.
720	Sulphates of soda and of magnesia	Kilo. (legal) 0'03
721	Sulphite, bisulphite, and trisulphite of lime and of soda.....	Free.
722	Sulpho-oleine.....	Kilo. (gross) 0'07
723	Bisulphide of carbon	" (legal) 0'10
724	Hypodermic tablets of pastilles of alka- loids	" " 8'00
725	Raw tartar	" (gross) 0'08
726	Writing ink	" " 0'08
727	Poison for hides	Free.
728	Medicated wines	Kilo. (net) 0'25
729	Iodine	" (legal) 1'00
730	Iodoform	" " 1'50
ARMS AND EXPLOSIVES.		
843	Cartridges, loaded or empty, for fire- arms.....	Kilo. (gross) 0'50
844	Percussion caps for fire-arms	" " 0'50
845	Detonators of all kinds for mines.....	Free.
846	Dynamite and other explosives for mines.....	Free.
847	Fireworks	Kilo. (gross) 0'30
848	Matches for mines	Free.
849	Gunpowder for mines.....	Free.
850	Gunpowder, not for mines.....	Kilo. (gross) 0'50
851	Gun cotton.....	Free.
852	Pistols and carbines.....	Kilo. (legal) 0'50
MISCELLANEOUS ARTICLES.		
854	Lubricating oils	Kilo. (legal) 0'05
857	Articles of gutta-perch and celluloid....	" " 0'40
899	Soap, not perfumed	" (gross) 0'25
900	Sealing wax	" (legal) 0'50
901	Sheets of asbestos card, and tarred felt..	" (gross) 0'04
908	Perfumery of all kinds.....	" (legal) 1'00
919	Oilcloth for clothing.....	" " 2'00
920	Oilcloth for tables, floors, &c.....	" (gross) 0'30

EXTRACTS FROM DIPLOMATIC AND
CONSULAR REPORTS.

SPANISH COLONIES.

Perfumery Imports.

THE imports of perfumery articles and soaps into Cuba are very large; but this country does not appear to possess any appreciable share in them. Florida water comes from the United States, some very common perfumes from Germany, and low grades of soap are manufactured locally. But all these sources are as nothing compared with the enormous import of French goods, especially of the finer qualities. Fine French toilet-soap, oils, scents, powders, &c., are exceedingly popular. Certain Paris perfumery houses are said to export 500,000 francs' worth of perfumery to Cuba every year. Against this trade English and American houses have hitherto tried to compete in vain. But there are now some German firms who send travellers through Cuba every year, and, it appears, have met with some success.

Drugs for Porto Rico.

In his review of the trade of the Spanish West Indian colony of Porto Rico in 1890, Consul Latimer observes that drugs and chemicals to the amount of 71 tons, valued at 15,320*l.*, have come from the United States, France, Spain, England, and Germany. Not embraced in the foregoing heading, there has been a supply of 2,311 tons of nitric, muriatic, and sulphuric acid, of the value of 32,397*l.*, 2,128 tons of which come from Spain, while England sends but 38 tons. Of the total import of soap of 2,250 tons, valued at 58,565*l.*, Spain furnished 2,228 tons, and England and Cuba the remainder.—*Chemist and Druggist.*

GENERAL TRADE NOTES.

MANCHESTER CHAMBER OF COMMERCE.

The Chemical Sectional Committee of the Manchester Chamber of Commerce has had under its consideration a communication received from Her Majesty's Consul-General at Christiania with reference to coloured cotton goods shipped from this country to Norway. These goods were alleged to contain arsenic, and in consequence of this it was stated that injury was done to British traders, as the Government of Norway did not permit the import of goods containing arsenical compounds. The secretary of the Chamber was requested to procure samples of the goods complained of. Fifteen samples were in due time received, and a special committee, appointed to examine them, report that in at least 12 samples an excessive quantity of arsenic was found, and that three contained only traces of it. The opinion was also expressed that the employment of arsenic or arsenical compounds could be dispensed with by dyers and printers. The attention of the committee was also called to the prosecution, on the part of the Corporation, of certain chemical manufacturers for the emission of black smoke. The committee are of opinion that there are a number of bye-laws now in existence which, if enforced, would injuriously affect a large number of manufacturers, without in the least degree benefiting the general public. These bye-laws (they say) may be admirable for most purposes, but some at least are impracticable when applied to the chemical and allied trades. The difficulties which British manufacturers of fine chemicals, chemical and medicinal preparations, colours, dyes, &c., experience in competing with foreign nations—especially Germany and Switzerland—are already serious enough without being unnecessarily increased. In the opinion of the committee, too little importance is yet attached by traders and manufacturers generally to the development of our chemical industries, and the result of this apathy is clearly shown by comparing the progress by leaps and bounds made yearly by

Germany and other countries with the almost stationary condition of these industries in this country. This want of progressiveness is due to inferior technical education of the highest grade, to the unfairness of our Patent Laws in regard to foreign patentees, and to the needless exactions of some of the bye-laws of the local authorities. These tend seriously to increase the expenditure on plant without reason, and without advantage to the public at large.—*Ibid.*

THE METRIC SYSTEM IN CHINA AND JAPAN.

The Secretary of the Decimal Association writes, with reference to the recent adoption of metric weights and measures in Japan, that the military authorities of that country now prefer to place their orders in France or Germany rather than in England, because the metric measures are followed in those countries. The secretary further states that a recommendation is about to go forward from a high authority in China, to whose views attention is usually paid, that China should adopt, as Japan has already done, the metric system of weights and measures. Unless the importance of this statement is fully realised, there may be a loss of valuable business to English firms; for, in countries where the metric system is used, the Government naturally prefer to buy the foreign goods required from countries where the same weights and measures are followed.—*Ibid.*

PHOSPHATES IN 1891.

Report by the Anglo-Continental (late Ohlendorff's) Guano Works.

We beg to append table giving the quantities and origin of the phosphates imported into the United Kingdom during the last five years.

There has been a serious falling off in the quantities imported, amounting to 86,729 tons, as compared with 1890, and to 48,181 tons as compared with 1889.

Already during the first half-year we reported a reduction in the importations, and the decrease has continued to the end of the year, and seems to have been spread over all the important ports alike.

The deficiency is probably due not only to a smaller demand for phosphatic manures, but also to the heavy stocks left over from the previous year, when importations were evidently in excess of requirements.

In consequence of the interruption of production on the Coosaw river the quantities received from South Carolina were only 97,000 tons, but the shortage was partly made good by the supply from Peace river and other Florida phosphate mines. This pebble phosphate from Peace river has found ready buyers as it is even preferred to Bull river phosphate.

A considerable change has taken place in our supply of high-class phosphates containing 70 per cent. of phosphate of lime and over. Only about 16,000 tons of phosphates arrived from Aruba and Sombreno last year, against respectively 16,000 and 19,000 tons in 1889 and 1890.

The supply from Florida was 35,203 tons, of which about 16,000 tons were river phosphates from Peace river and one cargo from Alafia river. Part of the high-grade phosphate from Florida was reshipped to the Continent, like most of the Canadian phosphate which arrives in this country.

The consumption of high-grade phosphates in the United Kingdom will therefore not have exceeded about 50,000 tons last year.

Considerably less Somme and Belgian phosphates have been used, especially if we consider that in the quantity of phosphates from Belgium, a large quantity of Osso phosphate from the new mines near Liège is included.

Although the production on the Coosaw river was interrupted last year it appears that South Carolina produced more phosphate than ever, the consumption in the United States evidently increasing rapidly.

The following are the figures of the last three years :—

	Tons.
1889.....	462,101
1890.....	537,149
1891 (about).....	600,000

During 1889-90, from September 1 to August 31 —

Tons.
219,812 were shipped to Europe from Charleston and Beaufort.
250,936 were sent inland by rail and coastwise.
116,000 were consumed locally.
<u>586,758</u>

showing that whilst about 220,000 tons, mostly river phosphates, are sent from South Carolina to Europe, the remainder is consumed in the United States.

The production in Florida last year began to assume large proportions.

Calculated at the present rate of production Florida would furnish about 100,000 tons of river (pebble) phosphates and about 100,000 tons of high-class land rock with perhaps some low-class phosphates for home consumption.

It is, however, impossible to estimate future production with any degree of certainty, because the mines inland are only partially developed, and some are still waiting the completion of railway connexions, whilst other large mines work at reduced speed, or not at all, on account of the present low prices of phosphates in Europe.

The sanguine hopes of the many miners in Florida are not likely to be realised, because it costs more to raise saleable phosphates than they expected, and there is no possible sale for large quantities of high-class phosphates in Europe.

In the Somme district in France raisers of phosphates have suffered under the serious fall in prices, caused by the new discoveries in Florida, and the production last year was probably on a somewhat smaller scale than the previous year. As regards cost of raising, preparing for and bringing into the market, the Somme raisers are much better placed than any other miners; but many properties in the Somme were acquired at such a high cost that the present reduced prices must be very unremunerative to them.

We have not yet received exact figures of last year's production in France, but give the following figures for previous years :—

In 1889 the quantity of phosphates produced in the Somme was stated to have been about 260 000 tons, of which about 100,000 tons were of high grade, say 65—80 per cent.

In 1890 the production in the Somme has been stated as 250,000 tons, of which about 120,000 tons were exported.

The export of phosphates from France was—

	Tons.
1887.....	50,898
1888.....	99,673
1889.....	150,963
1890.....	122,002

During the past year (1891) the quantity of Somme phosphates exported from France must have been much smaller, as is evident from the quantities landed in the United Kingdom and Germany; but the home consumption in France seems to be increasing, and a large quantity of low-class ground phosphates is used by the French farmers direct without manufacture into superphosphate.

We have not yet been able to obtain particulars of the quantity of phosphate raised last year in Belgium, but it seems clear that the production of calcareous phosphate near Mons is not much increasing, whilst the old mines near Mons are about worked out. The new mines near Liège are in full activity, and although the quantity raised will be much less than expected, still the production will be important for some years to come.

Germany has always been the best market for high-class phosphates, and consequently the new Florida phosphate has been most extensively used in that country. We have particulars of imports during last year only from two ports, which of course are no indication of the total quantity used

in Germany, but are characteristic as to the origin of the material, and may be summarised as follows :—

	Tons.
South Carolina.....	13,022
Pence River (Florida).....	7,540
Florida land rock.....	20,455
Somme phosphates.....	5,803
Canadian.....	4,210
Aruba Curaçoa.....	870
	<u>52,000</u>

IMPORTATION OF PHOSPHATES INTO THE UNITED KINGDOM, INDICATING COUNTRIES OF PRODUCTION.

Country whence imported.	1887.	1888.	1889.	1890.	1891.
	Tons.	Tons.	Tons.	Tons.	Tons.
U.S. of America.....	165,275	111,369	122,554	177,283	..
Florida.....	..	..	..	..	35,203
S. Carolina.....	..	..	..	..	96,881
British West Indies....	6,451	11,010	1,880	3,970	1,960
Dutch West Indies....	9,505	10,736	14,730	14,763	8,851
Haiti and San Domingo	3,044	6,238	1,094	992	1,639
Venezuela and Guiana.	405	..	..	..	540
Brazil.....	1,200	..	..	..	..
Australia.....	350	..	1,250	..	..
British North America.	19,194	12,423	23,297	21,089	15,918
Portugal.....	15,612	6,978	1,326	..	320
France.....	11,140	39,059	65,490	35,659	18,325
Belgium.....	45,322	54,261	61,043	82,096	70,723
Holland.....	4,778	4,137	2,270	2,428	3,434
Other countries.....	1,139	1,675	390	1,070	1,483
Norway.....	..	..	..	4,151	1,495
Total.....	283,415	257,886	304,953	343,501	256,772

EXPORTS OF PHOSPHATES.

Country whence exported.	1887.	1888.	1889.	1890.
	Tons.	Tons.	Tons.	Tons.
Sweden.....	..	..	1,305	1,587
Germany.....	7,034	3,747	9,716	6,235
Holland.....	1,443	985	1,335	..
Other countries.....	1,609	891	4,510	489
Total export ...	10,086	5,623	14,066	8,311
Remaining for U.K.	273,329	252,263	290,887	335,190

THE PRODUCTION OF QUICKSILVER IN CALIFORNIA.

The report of the Quicksilver Mining Company, of New Almaden, Cal., for the year ending December 31st, 1891, is the most unfavourable statement made by that company during the past 21 years. The production of quicksilver was smaller than in any preceding year, being but 68 per cent. as great as in 1890, while in value there was a still more important decline, the average price of quicksilver having been 12·06 dols. per flask lower in 1891 than in 1890.

In 1890, 22,649 tons of ore were roasted, and in 1891, 25,548 tons, but the average yield of the ore during the latter year was only 1·22 per cent., against 2·02 per cent.

in 1890. On the other hand the expenses in 1891 were very nearly as heavy as in 1890; the yield of quicksilver being so much less the cost of production rose from 33·87 dols. per flask to 48·62 dols., and for the first time in 21 years the mines were operated at a loss. The deficit amounted to 57,523·96 dols., which was 6·97 dols. per flask.

There seems no doubt that the New Almaden mines are now upon the verge of exhaustion, and that within a few years the quicksilver mining industry of California will be a thing of the past, notwithstanding the remarkably able and economical management of the mines. The production of the California mines reached its maximum in 1879, when 79,396 flasks were produced. Since that time the output has diminished steadily. In 1881 the yield was 60,851 flasks; in 1891 it had fallen to 22,904 flasks.

The quicksilver mines of California have had a glorious past and have returned large profits to their owners. From 1850 to 1891, both years inclusive, they produced 1,590,674 flasks, or 121,696,561 lb. of quicksilver valued at 71,508,021 dols. Of this amount the New Almaden mines, owned by the Quicksilver Mining Company, produced 924,659 flasks, or over 58 per cent. In 1881 the product of this company was 42·8 per cent. of the total, and in 1891, 36 per cent. With the approaching exhaustion of the California mines it would seem that we are likely to see higher prices of quicksilver this year. No figures have yet been compiled showing the world's production of quicksilver in 1891, but the output of the Almaden mines of Spain was probably about 47,500 flasks, against 50,035 flasks in 1890. The mines of Spain and California are the largest producers and turn out about 70 per cent. of the total amount of the world's quicksilver.—*Engineering and Mining Journal*.

BRITISH ALKALI IN THE STATES.

The American market for heavy chemicals has been brisk lately, owing, says the *O. P. and D. Reporter*, to the equalisation of freight rates from New York with those of Boston, and the probability of an early advance in ocean freights. The first reason has caused the divergence of some trade from Boston to New York, and the second has influenced buyers to place larger orders for early forward shipment than they probably would have done otherwise. So far as caustic soda is concerned the effect of the present conditions is likely to be transitory, and will not increase the figures representing the total volume of trade for the twelve months if the experiences of the past year are to be taken as a criterion. The statistics of exports of the heavy chemicals to the United States during 1891 are just to hand, and afford some interesting comparisons with those of the two preceding years. The shipments of bleaching powder are considerably larger than those of the previous year. On the other hand, the exports of caustic soda, sal soda, and salt cake show a decided falling off, which may be attributed in a large part to the increasing consumption of the domestic products.

The figures showing the shipments to the United States from England are as follows :—

	Tons.	1891.	1890.	1889.
Soda ash.....	68,684	67,168	62,769	
Bleach.....	49,303	45,781	42,608	
Caustic soda.....	31,355	37,423	32,875	
Sal soda.....	5,900	9,845	6,337	
Salt cake.....	8,059	8,535	7,343	

— *Chemist and Druggist*.

THE GLASS-BOTTLE TRADE IN GERMANY.

The German glass-bottle industry, says the annual report of one of the biggest bottle-making firms in the world (the Gerresheimer glassworks), has been in a rather bad way in 1891. Instead of a profit of 608,841 marks, such as

these works made in 1890, when they paid their shareholders 9 per cent., the net profit in 1891 has only been 295,512 marks, admitting of no larger dividend than 5 per cent. The output of bottles, however, increased from 47,660,000 in 1890 to 50,920,000 in 1891. Of the last-named number 29½ millions were sold to the German home trade, and 21½ millions for export. The prices realised declined considerably, the smaller output of 1890 selling for 3,510,000 marks and the larger one of 1891 for 3,460,000 marks. — *Ibid.*

DISCOVERY OF CALCIUM TUNGSTATE.

A discovery of economic importance has just been made by Mr. W. F. Ferrier, B.A. Sc., of the Canadian Geological Survey, in specimens collected some years ago. The specimens were procured from an opening made for gold on a quartz vein in the township of Marlow, Beauce county, province of Quebec, near the State of Maine boundary line. They are found to hold scheelite or calcium tungstate, of a yellowish-white colour, resembling blende so much as to be mistaken for the latter. It is the intention of the owners to develop the property. — *Engineering and Mining Journal.*

PAPERS OF INTEREST TO TECHNOLOGISTS.

The following articles in the *Board of Trade Journal* for February will repay perusal :—

“Prussian Mining and Metallurgical Industries,” p. 135.

“Regulations for the Carriage of Petroleum through the Suez Canal,” p. 163.

“New Customs Tariff of Argentina,” p. 177.

“The Industries of Orenbourg,” p. 198.

“German Sugar Industry, 1890—91,” p. 199.

“Fibre Industry in Queensland,” p. 219.

BOARD OF TRADE RETURNS

SUMMARY OF IMPORTS.

	Month ending 31st January	
	1891.	1892.
	£	£
Metals.....	1,715,867	1,822,503
Chemicals and dyestuffs.....	852,787	827,086
Oils.....	636,134	566,628
Raw materials for non-textile industries.	2,378,863	2,423,044
Total value of all imports	33,741,082	38,485,244

SUMMARY OF EXPORTS.

	Month ending 31st January	
	1891.	1892.
	£	£
Metals (other than machinery)	3,148,601	2,551,466
Chemicals and medicines	710,457	707,184
Miscellaneous articles.....	2,348,858	2,219,264
Total value of all exports.....	19,854,315	19,469,704

IMPORTS OF METALS FOR MONTH ENDING 31ST JANUARY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Copper:—			£	£
Ore..... Tons	6,139	6,200	39,483	38,821
Regulus..... "	9,964	9,189	313,040	228,572
Unwrought "	3,120	3,969	172,539	190,294
Iron:—				
Ore..... "	317,331	281,679	245,393	214,150
Bolt, bar, &c.... "	2,976	4,206	30,905	35,855
Steel, unwrought.. "	294	366	9,822	2,575
Lead, pig and sheet .. "	13,257	14,342	173,747	165,204
Pyrites..... "	70,685	56,028	126,094	98,758
Quicksilver..... Lb.	82,675	464,349	8,819	49,041
Tin..... Cwt.	33,353	42,291	153,718	190,114
Zinc..... Tons	2,360	3,911	53,158	85,242
Other articles...Value £	..	..	395,999	523,877
Total value of metals	..	..	1,715,867	1,822,503

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST JANUARY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Bark, Peruvian .. Cwt.	7,786	6,897	£ 22,784	£ 18,292
Bristles..... Lb.	171,686	170,486	25,655	20,350
Caoutchouc..... Cwt.	29,771	32,556	365,263	398,788
Gum:—				
Arabic..... "	5,036	5,305	14,081	15,374
Lac, &c..... "	8,580	10,824	35,772	47,985
Gutta-percha "	6,286	2,284	70,308	30,924
Hides, raw:—				
Dry..... "	32,987	28,761	89,092	73,056
Wet..... "	20,873	41,622	42,934	86,803
Ivory..... "	736	1,095	36,174	56,262
Manure:—				
Guano..... Tons	967	1,456	5,870	10,685
Bones..... "	7,048	7,056	36,897	36,266
Paraffin..... Cwt.	37,550	53,231	47,515	77,648
Linen rags..... Tons	1,749	2,214	15,505	20,142
Esparto..... "	24,634	19,170	117,492	91,857
Palp of wood "	8,622	13,475	50,114	66,686
Rosin..... Cwt.	119,356	72,067	26,878	18,870
Tallow and stearin .. "	111,525	85,118	140,746	106,980
Tar.....Barrels	2,503	2,427	1,101	1,630
Wood:—				
Hewn..... Loads	110,153	99,608	227,788	184,940
Sawn..... "	69,650	95,491	176,175	205,135
Staves..... "	6,471	3,672	45,870	26,110
Mahogany..... Tons	4,897	3,164	45,216	30,715
Other articles....Value £	..	..	739,723	797,546
Total value .....	..	..	2,378,863	2,423,044

Besides the above, drugs to the value of 67,623*l.* were imported as against 51,829*l.* in January 1891.

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH
ENDING 31ST JANUARY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Alkali..... Cwt.	1,872	3,505	£ 1,797	£ 2,707
Bark (tanners, &c.) "	12,398	36,616	4,911	16,514
Brimstone..... "	30,075	60,563	8,615	18,783
Chemicals..... Value £	..	..	90,807	97,861
Cochineal Cwt.	858	580	5,342	3,420
Cutch and gambier Tons	2,160	1,346	51,539	31,057
Dyes:—				
Aniline..... Value £	..	..	21,517	18,959
Alizarine..... "	..	..	23,460	18,694
Other..... "	..	..	1,774	1,187
Indigo Cwt.	13,738	21,596	332,773	443,224
Nitrate of soda.... "	263,980	52,628	106,356	23,682
Nitrate of potash. "	26,065	20,735	23,441	18,554
Valonia Tons	1,806	2,707	40,683	11,131
Other articles... Value £	..	..	189,769	91,313
Total value of chemicals	..	..	852,787	827,086

IMPORTS OF OILS FOR MONTH ENDING 31ST JANUARY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Cocoa-nut..... Cwt.	6,143	6,850	£ 8,909	£ 8,754
Olive Tons	1,285	1,510	51,740	57,427
Palm Cwt.	85,979	87,773	98,659	101,730
Petroleum Gall.	12,946,134	10,048,117	282,685	205,483
Seed Tons	2,342	1,511	57,345	41,249
Train, &c..... Tons	1,142	1,299	22,065	26,156
Turpentine Cwt.	39,867	33,091	55,729	43,190
Other articles .. Value £	..	..	59,392	82,639
Total value of oils ...	..	..	636,434	566,628

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING
31ST JANUARY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Alkali..... Cwt.	467,992	398,382	£ 169,007	£ 152,515
Bleaching materials "	110,631	85,320	35,379	33,066
Chemical manures. Tons	21,437	26,369	178,004	217,422
Medicines..... Value £	..	..	73,867	75,781
Other articles ... "	..	..	254,200	228,460
Total value ..... "	..	..	710,457	767,184

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR
MONTH ENDING 31ST JANUARY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Brass..... Cwt.	8,249	6,814	£ 40,814	£ 31,481
Copper:—				
Unwrought..... "	48,048	43,895	144,227	107,359
Wrought..... "	29,585	27,237	72,603	84,056
Mixed metal "	10,566	22,841	53,551	59,506
Hardware Value £	..	..	214,242	179,892
Implements..... "	..	..	110,787	99,565
Iron and steel.... Tons	219,419	196,678	2,112,622	1,736,404
Lead "	2,545	5,149	38,797	68,312
Plated wares... Value £	..	..	247,46	29,547
Telegraph wires, &c. "	..	..	238,223	46,243
Tin Cwt.	7,178	7,764	34,460	36,889
Zinc "	10,327	14,685	11,196	14,161
Other articles .. Value £	..	..	72,633	67,188
Total value ..... "	..	..	3,418,601	2,551,466

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH
ENDING 31ST JANUARY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Gunpowder..... Lb.	1,178,500	653,800	£ 29,314	£ 15,657
Military stores.. Value £	..	..	82,591	78,658
Candles..... Lb.	1,094,500	1,379,900	21,840	26,793
Caoutchouc Value £	..	..	88,333	111,159
Cement..... Tons	36,113	25,626	73,878	46,597
Products of coal Value £	..	..	98,707	130,822
Earthenware ... "	..	..	130,031	121,760
Stoneware ..... "	..	..	12,253	11,239
Glass:—				
Plate..... Sq. Ft.	369,873	177,985	18,247	10,581
Flint..... Cwt.	7,522	6,914	17,115	17,242
Bottles..... "	58,629	59,941	27,159	28,347
Other kinds.... "	15,917	14,882	15,203	12,856
Leather:—				
Unwrought "	9,656	11,175	9,664	116,479
Wrought Value £	..	..	26,701	25,053
Seed oil..... Tons	4,211	5,461	93,013	111,943
Flooreloth Sq. Yds.	1,366,200	1,975,400	58,847	85,967
Painters' materials Val. £	..	..	106,318	139,366
Paper Cwt.	68,446	74,896	117,992	132,235
Rags..... Tons	3,797	3,266	30,438	24,311
Soap..... Cwt.	33,816	47,946	39,583	46,095
Total value ..... "	..	..	2,348,858	2,219,264

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

538. J. Arnold. Improvements in or connected with thermometers. January 11.

541. L. Ronmien. Improved filtering receptacle for substances from which oil or other liquid is to be expressed by hydraulic and other presses. January 11.

765. S. Fox. Improvements in furnaces for the application of water-gas for heating and welding purposes. January 14.

801. J. Pelat. Improvements in apparatus for use in filtering and purifying oils, glucose, or other like matters. January 14.

829. J. W. Hall. An improvement connected with gas-producer and other furnaces. January 15.

836. A. M. Strathern and A. G. Strathern. Improvements in and relating to apparatus for governing or regulating the pressure or flow of illuminating gas or other fluids. January 15.

845. H. E. Newton.—From R. N. Oakman, jun., United States. Improvements in gas furnaces. January 15.

1054. J. H. Bovenkerk, jun., and A. C. Kuyt. Improvements relating to softening water. January 19.

1172. A. T. Rapkin and F. Cossor. Improvements in or connected with thermometers. January 21.

1181. W. J. Lomax and C. J. Lomax. A combined refuse furnace and gas apparatus. January 21.

1210. B. Zeitschel. Improvements in apparatus for rapidly heating liquids. Complete Specification. January 21.

1738. W. P. Thompson.—From J. W. Meens, Belgium. See Class XVII.

1777. B. Bolton. Improved non-conducting composition or paint for steam-heated surfaces. January 29.

1858. W. L. Wise.—From C. d'Abbadie de Barran, Island of Mauritius. See Class XVI.

1863. J. G. Hall. See Class XVII.

1991. J. Wright. Improvements in apparatus for heating water and fluids of all kinds; also applicable to ammoniacal and other liquors for distillation for steam boilers or any other purpose. February 2.

2117. C. F. Betting. Improvements in assay or chemical balances. Complete Specification. February 3.

2363. W. P. Ingham and E. Crowe. Improvements in gas-fired recuperative kilns. February 8.

2516. J. A. Mays. A process and apparatus for effecting the concentration or separation of solids. February 9.

2790. J. W. Bowley. Apparatus for producing cold in or freezing liquids. February 12.

2895. F. M. Robertson, H. S. Fearon, and W. S. Miller. Improvements in the process of, and apparatus for, evaporating or drying. February 13.

1846. J. King. Apparatus for drying granular, pasty, or pulverulent materials, or for carbonising animal or vegetable substances, or for concentrating or evaporating liquids; and an improved furnace for heating air for the same and for other purposes. January 20.

5340. A. Dervanx. Method and apparatus for clarifying muddy liquids. February 10.

5529. J. S. Sawrey and H. Collet. Apparatus for separating liquids from solid matters suspended therein. January 27.

6159. J. Hardman and J. Peake. Retort charging devices. February 17.

6387. W. Heyes. Apparatus for concentrating acids and other liquids. February 17.

7188. M. Merichenski. Improvements in carburettors. February 3.

15,192. O. M. Row. Apparatus for condensing steam and other vapours, and for heating or cooling fluids. February 10.

19,464. E. Kerr. Improvements in furnaces. February 10.

21,248. W. Butlin. An improved tnyere. January 20.

1892.

11. E. C. Peck. Taps or cocks for liquids. February 17.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

535. G. M. S. Wilson. Improvements in the manufacture of gas. Complete Specification. January 11.

848. G. B. Field. Means for burning straw, cornstalks, and such like fuel. Complete Specification. Filed January 15. Date applied for August 11, 1891, being date of application in United States.

864. J. Ruscoe. Improvements in apparatus for charging gas retorts. January 15.

878. G. T. Beilby. Process of and apparatus for the manufacture of cyanides. January 16.

879. G. T. Beilby. Process and apparatus for obtaining cyanides. January 16.

927. W. B. Hartridge. Improvements in or connected with apparatus for washing or purifying smoke. January 16.

952. W. S. Chenall and W. F. S. Chenall. Improvements in solidifying animal, vegetable, and mineral oils, and volatile and inflammable fluids. Complete Specification. January 18.

964. C. Allina. Solidifying petroleum and the carbhydrates contained in same for facilitating transportation and use as fuel, also re-liquefying same. January 18.

965. W. E. Vickers and G. A. Everett. Improvements in machinery or apparatus for effecting the complete mixture of inflammable gas or vapour with air. Complete Specification. January 18.

1437. I. S. McDougall and J. T. McDougall. Improvements in the treatment of oils for rendering them capable of transport or storage, and of use as fuel, or as illuminants, with greater safety and convenience than hitherto. January 25.

1569. J. Tennant, J. Tennant, and W. R. Tennant. Improvements in candles. January 26.

1575. A. Klönne. Improvements in the manufacture of illuminating and heating gas, and in apparatus therefor. January 26.

1647. J. Mitchell. Improvements in coke ovens. January 27.

1804. S. Fox. Improvements in the manufacture or production of water-gas and apparatus therefor. January 29.

COMPLETE SPECIFICATIONS ACCEPTED.*

1891.

1071. B. Corcoran. Mixing machine for amalgamating exact proportions of flours, chemicals, and other substances. January 20.

1805. T. W. Lee. Improvements in the manufacture or production and distribution of mixture of inflammable gas and air, and in apparatus therefor. January 29.

1958. W. Coultas, T. Siddell, and J. L. Smith. A novel or improved apparatus constituting a combined boiler and gas producer for the generation of steam and the production of gas, whether used in combination or for separate purposes. February 2.

1960. J. Isherwood. Improved apparatus for economising heat and fuel. February 2.

2073. W. H. Wilson. Improvements in and connected with the manufacture of illuminating gas. February 3.

2259. T. White. See Class IX.

2367. L. Sepulchre. Gas generator for the distillation of mineral oils and the combustion at a distance of a part or the whole of the products of the distillation applicable to apparatus for lighting and heating. Complete Specification. February 8.

2377. R. H. Courtney. Improvements in and means for increasing the illuminating power of candles and night and fancy lights; also in the holders to be used for same. February 8.

2434. J. Swallow and C. West. Improvements in artificial fuel. February 8.

2578. W. L. Malcolmson and W. E. Parker. Improved fuel. February 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

2736. V. Poltavtseff and K. Hodjaian. Means for generating heat from liquid and other fuel. February 17.

4279. C. F. Claus. Purification of water-gas or other producer-gas from sulphur compounds. January 20.

4321. J. Baxter and W. Baxter. Apparatus for refining paraffin. January 20.

5212. W. H. Munns.—From E. de Beauharnais. Manufacturing illuminating gas. February 3.

6134. J. Laing. Distillation of mineral oils, &c., and apparatus therefor. February 17.

17,351. G. R. Prowse. Apparatus for forming oxycalcium lights. January 20.

18,498. H. H. Lake.—From C. H. Wilder. Manufacture of gas from hydrocarbon oils, and apparatus therefor. February 10.

19,641. T. G. Springer. Manufacture of gas, and apparatus therefor. February 10.

21,881. W. Fairweather.—From The Acme Liquid Fuel Co. Process and apparatus for the manufacture of gas. January 20.

22,347. W. L. Rowland. Recovering cyanides from coal-gas. February 17.

1892.

535. G. M. S. Wilson. Improvements in the manufacture of gas. January 11.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, &c.

APPLICATIONS.

2129. H. Saxl. Process and apparatus for the production of benzol and its homologues, phenol, naphthalene, and anthracene, from resins or resin oils alone, or mixed with petroleum, petroleum residues, illuminating gas, and other hydrocarbons. February 3.

2367. L. Sepulchre. See Class II.

COMPLETE SPECIFICATION ACCEPTED.

1891.

6134. J. Laing. See Class II.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

802. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture of dyes of the rosauiline series and of leuco-compounds thereof. January 14.

22,641A. B. Willeox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the production of azo-colours on fibre. Filed January 22. Date applied for December 28, 1891.

960. A. Bang.—From G. A. Dahl, Germany. The production of fast yellow mordant dyeing azo-dyestuffs. Complete Specification. January 18.

1231. H. H. Lake.—From Wirth and Co., agents for A. Leonhardt and Co., Germany. Improvements in the manufacture of colouring matters. January 21.

1390. H. H. Lake.—From Wirth and Co., agents for A. Leonhardt and Co., Germany. Improvements in the manufacture of colouring matters. January 23.

1473. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture of dyes from substituted derivatives of diamido-diphenylmethane. January 25.

1657. B. Willeox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of colouring matters derived from anthraquinone. January 27.

2324. Brooke, Simpson, and Spiller, Limited, and R. J. Friswell. A new substance suitable for dyeing and other purposes and the process for its production. February 6.

2408. C. D. Abel.—From The Actier: Gesellschaft für Anilin Fabrikation, Germany. New manufacture of bases and of colouring matters therefrom. February 8.

2617. O. Imray.—From Die Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of ethoxy-phenylmethylpyrazolone and of para-ethoxy 1 phenyl-2'3 dimethyl-5 pyrazolone. February 10.

2718. S. Pitt.—From L. Cassella and Co., Germany. Improvements in the production of black dyes suitable for dyeing wool. February 11.

2789. S. Pitt.—From L. Cassella and Co., Germany. Improvements in the production of azo dyes. February 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

3622. R. Vidal. Production and separation of methylamines, ethylamines, phenylamines, and naphthylamines. February 10.

5103. R. Holliday and Sons, Lim., T. Holliday, and P. R. E. Seidler. Manufacture of a sulpho-acid of alpha-naphthol and of colouring matters therefrom. February 10.

3269. W. Majert. Manufacture of aromatic glycoecoll derivatives. January 27.

5437. W. Sherwood. A new or improved composition of ink for reproduction of copies by the manifold process. February 10.

5904. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Production of black colouring matters. February 10.

21,249. E. von Portheim. Manufacture of new colouring matters from naphthyl glycolines. January 27.

22,623. J. Imray.—From La Soc. L. Durand, Haegenin, et Cie. A new manufacture of colouring matters. February 3.

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATIONS.

840. J. Porritt, A. Porritt, M. Porritt, and S. J. Chadwick. A new yarn and process of manufacturing the same from waste fibres. January 15.

1077. W. P. Thompson.—From J. B. Jaensonlin and G. Oser, France. Improvements in treating or decortiating ramie and other similar fibres and in machines therefor. January 19.

1728. C. F. Dietrich and T. J. Palmer. Improvements in the manufacture or production of floor coverings or like materials with coloured designs or patterns and apparatus to be employed in the said manufacture. January 28.

1729. C. F. Dietrich and T. J. Palmer. Improvements in the manufacture and production of materials suitable for use as floor coverings, or for other analogous purposes. January 28.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

6294. J. Daw, jun. An improvement in dyeing mats, carpets, or other fabrics. January 20.

13,072. J. P. A. Blaye. Treatment of ramie fibre, flax, or hemp in the green or dried state. January 20.

17,642. F. J. H. Sampson. Process and appliance for obtaining fibre from rhea. February 17.

1892.

209. D. E. Coe. Manufacture of yarn from waste. February 10.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

22,641A. B. Willeox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the production of azo colours on fibre. Filed January 22nd. Date applied for December 28, 1891.

1506. J. Dawson. Improvements in the method of and apparatus for utilising the heat of spent liquors or liquids for dyeing, manufacturing, and other like purposes. January 26.

2096. W. Searle and W. H. Elliot. Improved apparatus for dyeing or chemically treating and drying paper, felt, or other fabrics. Complete Specification. February 3.

2730. G. H. Craven. Improvements in dyeing machines. February 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

22,263. L. Kern. Method and apparatus for preventing the escape of noxious gases in the processes of bleaching and otherwise treating textile materials. January 27.

22,437. C. Kellner. Process and apparatus for bleaching paper pulp, and other similar vegetable substances. February 3.

22,438. C. Kellner. Process and apparatus for increasing the bleaching properties of chlorine gas. January 27.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

610. F. Valentiner. Process and apparatus for the manufacture of concentrated nitric acid. January 12.

714. J. R. Thame. An improved process for the manufacture of the cyanides of sodium and potassium. January 13.

1032. P. Rogation de Lambilly. A new or improved method or process for the production of alkaline cyanides. Complete Specification. January 19.

1439. I. S. McDougall and J. T. McDougall. Improvements in the treatment of certain corrosive or poisonous liquids to render them capable of being transported, stored, or used with less danger than hitherto. January 25.

1548. P. Römer. An improved manufacture of potassium carbonate from potassium sulphate. January 26.

1642. O. Imray.—From M. M. Rotten, Germany. Improved manufacture of sodium and potassium bichromates. January 27.

1652. C. F. Claus. Improvements relating to the manufacture of alkaline sulphides and carbonates, and to the production or recovery of sulphide of hydrogen and other by-products. January 27.

1659. C. F. Claus. Improvements relating to the manufacture of alkaline sulphates, sulphides, and carbonates, and to the production or recovery of the hydrate of alumina, sulphide of hydrogen or sulphur, and hydrochloric acid or chlorine. January 27.

1692. G. E. Davis and A. R. Davis. Improvements in the preparation of chlorine. January 28.

1855. J. J. Tate and A. S. Ramage. Improvements in the utilisation of ferrous chloride liquors, especially those known as "waste pickle," from galvanising and tin-plate works. January 30.

2165. C. H. Cribb. Improvements in the production of carbon dioxide and lime from causticising refuse and from limestone and the carbonates of other alkaline earths, and in apparatus therefor. February 4.

2389. L. Brunner and A. Zanner. An improved process for preparing at the same time neutral sulphate of soda and precipitated phosphate of lime. Complete Specification. February 8.

2415. J. Wetter.—From the Firm of H. and E. Albert, Germany. Process for obtaining alkali phosphates from neutral or acid alkali sulphates. February 8.

2604. J. Morris. New or improved process for the production of crystals and crystalline masses. February 10.

2697. A. MacFarlane. A substitute for the acid tartrate of potassium. February 11.

2878. C. W. Kriens. Improvements in the manufacture of nitrates. February 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

1453. E. O. Lambart.—From S. Piek. Manufacture or production of salt from brine. January 27.

2252. P. G. W. Typke. Manufacture or production of certain phosphorus compounds. February 10.

4661. W. Mills. Manufacture of alkali and apparatus therefor. February 17.

4730. C. Marriott. Apparatus used in the manufacture of sulphate of ammonia. January 27.

5819. D. Rowat and J. Fullerton. Treatment of pickles and apparatus therefor. February 17.

5844. A. G. Haddock and L. Leith. Manufacture of alkali. February 17.

6388. P. J. B. Vincent. Manufacture of salt in blocks and cakes. February 3.

6500. J. Kolb. Production of chlorine. January 20.
 10,629. E. Edwards.—From O. Guttman and L. Rohrmann. Apparatus for condensing nitric acid. January 20.
 20,060. C. Kellner. Process and apparatus for the manufacture of hydrogen and chlorine from hydrochloric acid. January 20.
 22,320. La Soc. A. R. Pechiney et Cie. Manufacture of chlorine from hydrochloric acid gas. February 3.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

697. B. J. Brearley and F. T. Brearley. Improvements in machinery or apparatus for rolling glass. January 13.
 1943. G. Sowerby. Improvements in apparatus for and the method of melting glass. February 1.
 1974. W. Leuder. A new and improved process of marking glass by acids. Complete Specification. February 2.
 2375. Sir A. Hickman. Improvements in the composition and manufacture of refractory and basic bricks and tuyeres. February 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

4391. T. C. J. Thomas. Manufacture of glass. January 20.
 4610. F. Plant. Improvements in ovens, kilns, or furnaces for firing pottery or earthenware, and for other purposes. January 20.
 5068. F. Query. Kilns for use in the manufacture of pottery, porcelain, and earthenware, and other similar goods. January 27.
 5324. W. Walker. Production of glass-making materials. February 3.
 6257. W. C. Gibson. Kilns for bisuiting and burning glazed and enamelled clay goods. February 17.
 20,438. W. P. Thompson.—From R. S. Pease. Method and apparatus for manufacturing glass plates, sheets, and films. January 20.
 20,440. W. P. Thompson.—From R. S. Pease. Method and apparatus for producing cylinders, pipes, and other tubular bodies of glass. January 20.
 21,826. M. Epstein. Filtering tubes with ball-filtering material for purifying molten glass. January 20.

1892.

489. H. Warrington. Kilns for bricks, earthenware, porcelain, &c. February 17.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

736. T. J. Davey. Chamber oven for drying clay from slurry or any other materials of a similar nature in brick or cement works. January 14.
 795. E. Websky. Improvements in treating gypsum casts. Complete Specification. January 14.
 1195. A. Willard. Improvements in the manufacture of artificial stone. January 21.

1827. W. Brown. Improvements in the method of jointing concrete paving. Complete Specification. January 30.

1861. A. J. Campion. Improvements in the manufacture of hydraulic cement and concrete. January 30.

2131. F. W. S. Stokes. Improvements in apparatus connected with the continuous treatment of lime, cement, and the like materials, and in the lining of kilns and furnaces for burning materials of a basic character. February 4.

2165. C. H. Cribb. See Class VII.

2259. T. White. Improvements in the burning of bricks and cements, and in the manufacture of domestic and other fuel. February 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

2598. J. Ballantine. Improved medium or composition for decorative purposes. February 17.
 4750. La Soc. Anon. des Ardoisieres de Deville and V. Van der Heyden. Manufacture of material suitable for paving, building, &c. from waste pieces of slate. January 27.
 6011. J. Craven. Kilns for burning bricks, &c. February 17.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

540. A. Räder. A solder for aluminium. January 11.
 581. G. Pickhardt. Improvements in connexion with the use of aluminium and aluminium alloys. Complete Specification. January 12.
 890. W. Hutchinson. Improvements in the manufacture of iron and steel. January 16.
 1074. J. B. Alzugaray. Improvements in the treatment of certain ores, alloys, mattes, slags, and other compounds. January 19.
 1205. C. Emo. Improvements in the manufacture or production of aluminium. January 21.
 1211. J. F. Krebs. Method of preparing plates of aluminium or nickel or aluminated or nickeled plates for lithographic use. January 21.
 1273. W. Hutchinson. Improvements in the manufacture of iron and steel. January 22.
 1341. T. Twynam and J. Colley. Improvements in the manufacture of steel and iron. January 23.
 1368. A. J. Thorman. Treatment of iron sand, iron ores, and residuums containing iron. January 23.
 1443. R. B. Thomas. An improvement or improvements in coating sheets or plates of iron and steel with lead. January 25.
 1467. C. Moldenhauer. Improvements in the process of recovering precious metals from their ores. January 25.
 1471. A. Thomas. An improved process for the recovery of metals from their solutions. January 25.
 1530. G. W. Clark. Improvements in the manufacture of steel. January 26.
 1565. H. H. Lake.—From J. Gould, jun., United States. Improvements in and relating to the coating of metal plates, and to apparatus therefor. Complete Specification. January 26.
 1654. C. Hoepfner. Improvements relating to the extraction of silver. January 27.
 1776. W. Hutchinson. Improvements in the manufacture of iron and steel. January 29.
 1795. W. Gilchrist. Improvements in the treatment of iron. January 29.

1901. T. C. Fawcett, sen., T. C. Fawcett, jun., and G. Dyson. Improvements in cupolas or furnaces for melting iron. February 1.

1907. W. Muir. Improvements in the extraction of tin and other products from the refuse slags and debris of tin smelting furnaces. February 1.

1939. C. T. J. Vautin. Improvements in the method of and apparatus for hardening, tempering, or annealing metallic wire or tape. February 1.

1984. D. Dyrenforth. Improvements in the manufacture or treatment of iron. Complete Specification. February 2.

2193. N. Lébédoff. Improvements in the extraction and treatment of metals. February 4.

2214. T. D. Bottomo. Improvements in the casting and tempering of pure copper. February 5.

2241. N. Lébédoff. Improvements in the manufacture of aluminium alloys. February 5.

2261. B. Rösing and the Firm of M. Foerster. Improvements relating to the extraction of lead and to apparatus therefor. February 5.

2299. J. M. While. Improvements in the manufacture of iron. February 6.

2498. S. H. Brown and M. McBarron. Improvements in and relating to the annealing of metals. Complete Specification. February 9.

2583. J. Woodcock, J. Smith, and W. M. Mackey. Improvements in preparing ores, oxides, and compounds of iron for smelting. February 10.

2590. W. K. Greenway. Improvements in galvanising iron and steel. February 10.

2594. W. K. Greenway. Improvements in galvanising or coating iron with other metal or metals. February 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

1309. J. H. Pollok. Gold extracting reagents. January 20.

1374. A. M. Clark.—From La Société Anonyme de Produits Chimiques Etablissements. Treating ores and residues containing zinc by means of bisulphate of soda for the production of commercial products. January 27.

2508. A. de L. Long and J. Noble. Gas regenerative vertical ingot heating furnace. January 20.

4050. M. Mammesmann. Method of and apparatus for forming, rolling, and finishing metals. February 10.

4384. J. von Ehrenwerth. Processes and appliances for the manufacture of iron and steel. January 20.

4549. W. E. May. The casting and working of metals, and to apparatus for use in connexion therewith, and for other purposes. January 20.

4644. J. O. Arnold. Manufacture of steel ingots, steel castings, and ingot iron. February 10.

6246. W. S. Lockhart and E. W. Streeter. Process and apparatus for the separation of metals, precious stones, or other mineral from gangue, &c. mixed therewith. February 17.

10,985. F. H. Mason. Extraction of tin from tin slags and refuse by lead or its salts, carbonaceous matter, fluor-spar, and other suitable fluxes. January 20.

14,737. W. D. Bohm. Apparatus for leaching ores and separating gold and silver therefrom. January 27.

14,795. E. Martin. Manufacture of compound or metal coated wires. February 10.

19,330. J. Johnson.—From J. Gayley. Blast-furnace linings. January 3.

22,041. C. James. Treating plumbiferous copper mattes and ores. January 20.

22,177. T. J. Tresidder. Manufacture of armour plates. February 3.

22,694. E. Dor. Regenerative gas furnace for the reduction of zinc ores. February 10.

1892.

540. A. Räder. A solder for aluminium. January 11.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

645. P. Gendron. Improvements relating to electric welding. Complete Specification. January 12.

982. T. Parker, A. E. Robinson, and C. H. Parker. Improvements in or connected with the manufacture or production of chloride of zinc and alkaline sulphates, and of zinc and chlorine by electrolysis of solutions thereof. January 18.

1038. H. Koller. A new or improved manufacture of an exciting material for galvanic batteries. January 19.

1061. E. Hermite. Improvements in bleaching and disinfecting starch and fecula by electrolysis. January 19.

1141. C. Vogt. Improvements in dry electrical elements. January 20.

1145. H. A. Walker. Improvements in the manufacture of siliceous insulating material for electrical and other purposes. January 20.

1391. The London Metallurgical Co. and S. O. Cowper-Coles. Improvements relating to the coating of articles with a new metallic alloy by electro deposition. Complete Specification. January 23.

1426. C. G. Moor. Improvements in electrical batteries. January 25.

1484. J. B. Eutz and W. A. Phillips. Improvements in and relating to secondary batteries. Complete Specification. January 26.

1786. R. Pinna. Improvements in or relating to tanning by electricity. January 29.

1927. W. J. S. Barber-Starkey. An improvement in secondary voltaic batteries. February 1.

2106. H. Howard. Improvements in heating and welding by electricity. February 3.

2225. G. Nahsen. Improvements in the method of purifying electrolytes containing zinc, relating to or connected with the electro-metallurgical production of zinc. Complete Specification. February 5.

2329. O. Imray.—From T. J. Montgomery, United States. Improvements in process and apparatus for bleaching by electrolysis. Complete Specification. February 6.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

1049. S. Z. de Ferranti. Manufacture of dynamo-electric machines. January 27.

3417. W. H. Munos.—From G. A. Smith. Galvanic battery. January 20.

4757. T. L. Wilson. Electric reduction of aluminium and other metals, and production of alloys thereof. January 20.

4781. W. J. Eogledew. Solution for galvanic batteries. January 20.

4860. H. Howard. Apparatus for heating and welding by electricity. February 10.

4877. H. H. Lake.—E. A. G. Street and L. A. W. Desruelles. Production of porous materials and manufacture of same into electrodes for batteries. January 20.

5918. H. I. Harris and W. H. Power. Electric batteries. February 10.

5999. J. Greenwood. Production of chlorine and sodium amalgam. February 17.

6029. W. H. Walenn and I. A. Timmis. Electro-deposition of copper, brass, and bronze, applicable to other purposes. February 17.

6030. W. H. Walenn and I. A. Timmis. Electro-deposition of copper, brass, or bronze. February 17.

21,870. H. H. Lake.—From E. A. Clarke. Voltaic cells or batteries. January 20.

22,482. H. H. Lake.—From E. Weston. Voltaic cells. February 10.

1892.

645. R. Gendron. Improvements relating to electric weldings. January 12.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

952. W. S. Chenall and W. F. S. Chenall. *See* Class II.
2257. J. J. Speakman. Improved washing compounds. February 5.

2320. F. Hughes.—From A. Motte & Co., France. A new or improved mechanical process for winning the fatty matters contained in the water used for washing wool, and for commercial and domestic purposes. Complete Specification. February 6.

2482. A. Lobmann. Improvements in lubricating materials. February 9.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

747. H. Wyatt, jun. A method for making a solution of vegetable or other resins and resinoids for internal use. January 14.

790. W. Smith. Improvements in the manufacture of white lead by the acetate of ammonia process, more especially in respect of the regeneration and recovery of acetate of ammonia from the weak liquors and washings furnished in the process. January 14.

910. A. W. Harrison. An improved blacking. January 16.

1229. H. Traun. Improvements in and relating to the manufacture of hardened caoutchouc. January 21.

1882. D. Swan. Improvements in obtaining pigments. February 1.

2183. W. G. Taylor.—From the Gutta Percha Syndicate, Limited, Straits Settlements. Method of and process for obtaining gutta-percha from trees of the Sapota family. February 4.

2201. R. I. Clark. An improved manufacture of varnish. February 4.

2253. C. H. Bigland. Improvements in paints or protective coverings for ships' bottoms and other structures. Complete Specification. February 5.

2562. W. L. L. Grant and H. P. T. Dennys. An antifouling and preservative paint for protecting the bottoms of iron or wooden vessels, or other submerged surfaces. February 10.

2563. A. F. St. George. An improved substitute for and compound resembling india-rubber, and manufacturing the same. February 10.

2605. J. Dawson. An improved composition for removing varnish, paint or polish. February 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

2382. G. W. Seollay. Manufacture of paints or paint stock. February 10.

5501. W. Smith and W. Elmore. Production of white lead or basic carbonate of lead from galena or sulphide of lead ore, or from residual products containing sulphate of lead. February 10.

5681. C. A. Burghardt. Pigments having a lead basis. February 10.

6306. W. P. Thompson.—From A. Flugge. Production of a solution of myrrhic resin. February 10.

20,253. R. Ripley. The form or get-up of bag-blue. February 3.

20,274. R. Lender. Rust and acid-proof paint. February 10.

20,407. R. Pape. Manufacture of a hard insulating material. February 3.

21,279. W. J. Wigg. Manufacture of Venetian red. February 10.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

544. J. Menke. Improvements in artificial leather. January 11.

698. A. J. Boulton.—From E. Rauppach and L. Bergel, Austria. Improvements in or relating to the manufacture and use of glue. January 13.

838. S. Thorn. Improved substitutes for tannin of an article in substitution of what is commonly known as tanned leather. January 15.

951. L. Berram. Improvements in process and apparatus for extracting glue or gelatin and grease out of hide and skin waste, and of bones at comparatively low temperature. Complete Specification. January 18.

2429. H. E. Howe. An improved method of rendering leather used for the outer soles of boots and shoes flexible or pliable. Complete Specification. February 8.

COMPLETE SPECIFICATION ACCEPTED.

1891.

12,331. J. Shepherd.—From A. Krizek and R. Esche. Mineral size. February 3.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

1583. W. L. Wise.—From C. d'Abbadie de Barran, Island of Mauritius. Improvements in apparatus for use in the manufacture of sugar. January 26.

1858. W. L. Wise.—From C. d'Abbadie de Barran, Island of Mauritius. Improvements in apparatus suitable for cooling cane-juice and other substances. January 30.

2693. J. G. Healey. A new or improved liquid cement. February 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

5236. A. Schneller and W. J. Wisse. Refining or extracting sugar from raw sugar solution, juice, or molasses. February 3.

21,059. C. Kleyer and C. Kappesser. See Class XIX.

22,679. C. M. Higgins. Mucilages, sizes, and adhesive compounds. February 3.

22,682. C. M. Higgins. Mucilages, sizes, and adhesive compounds. February 3.

22,685. C. M. Higgins. Mucilages, sizes, and adhesive compounds. February 3.

1892.

420. E. Langen. Refining sugar. February 17.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

911. R. H. Leaker. An improved method of and apparatus for kilning malt. January 16.

1043. G. Bamberg. Improvements in the manufacture of condensed beverages. January 19.

1044. J. F. Henderson. Improvements in or applicable to the manufacture of unfermented grape wine. Complete Specification. January 19.

1445. J. S. Olver. A method of regulating the moisture and respiration of malt growing under the pneumatic system. January 25.

1738. W. P. Thompson.—From J. W. Meeus, Belgium. Improvements in apparatus for registering the flow of liquids in connexion with distilling, rectifying, or other apparatus. January 28.

1863. J. G. Hall. A new and improved refrigerator or apparatus for cooling wort and other liquids, and for other similar purposes, principally used in breweries and distilleries, applicable for condensing steam, spirit, or other vapours. January 30.

2210. J. Chalmers and J. W. Phillips. Cooling wort, to be called a refrigerator for cooling wort. February 5.

2678. H. de Soberon. Improved liquor, resembling brandy, and process for manufacturing the same. February 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891

5853. W. Heasman. Means for the hot aëration of wort. February 10.

21,059. C. Kleyer and C. Kappesser. See Class XIX.

21,708. S. Pitt.—From A. Savalle, Sons, and Co. Apparatus for distilling and rectifying. January 20.

22,124. C. H. Jolliffe. Apparatus for roasting, aërating, and attenuating brewers' worts during the process of fermentation. January 27.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

1055. J. H. Bovenkerk, jun., and A. C. Knyt. Improvements relating to the preservation of milk. January 19.

1150. K. G. Krikorian. A new or improved method of treating and roasting malt, and blending the same for infusion together with coffee. January 21.

1717. S. Saker and W. C. Glover. The manufacture of a compound for use in preparing infusions of tea. January 28.

2421. J. F. Boesen. A new or improved manufacture of meat extract. Complete Specification. February 8.

ERRATUM.—In December Journal, p. 1051, for No. 21,708, S. Pitt, read No. 21,706, O. Imray.

B.—Sanitary Chemistry.

1567. A. Leveux. Improvements relating to the treatment of sewage and other refuse, and to apparatus therefor. January 26.

1609. W. M. Greaves. Improvements in the treatment of sewage and other refuse. January 27.

2560. H. Lockwood. Improvements in the method of purifying sewage by means of lime in conjunction with a salt of iron. February 10.

C.—Disinfectants.

755. A. Gladstone. An improved antiseptic dressing for yarns and cloth. January 14.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1891.

2051. J. Y. Johnson.—From La Société Générale Herscher and Co. Means or apparatus for sterilising water. February 10.

2444. L. Smith. Means for storing and preserving food for domestic uses. February 10.

20,419. J. E. Alén. Method of preventing the curdling of albuminous solutions. January 27.

1892.

279. A. D. McKay. New chemical food. February 17.

B.—Sanitary Chemistry.

1891.

10,092. F. Livet. Apparatus for creaming house-dust and like refuse on new sanitary principles. February 3.

C.—Disinfectants.

1891.

4352. A. Lutschaunig. A new or improved manufacture, being a disinfectant, antiseptic, deodoriser, vermin and insect destroyer, and also applicable for use as an ingredient in fire-lighters. January 20.

5263. J. Y. Johnson.—From F. von Heyden. Improvements in the production of salicylic acid derivatives containing chlorine and sulphur. January 20.

20,495. A. Robertson. Sheep dip. February 17.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

669. F. Hawke and W. Mottershall. A new and improved carbon or carbonic paper for manifolding, duplicating, and like purposes. January 13.

709. H. H. Lake.—From H. M. Lenfant, veuve Vessier, France. Improvements in washing apparatus for use in the manufacture of paper. January 13.

2185. W. Jones. Improvements in or relating to the manufacture of transfer paper. February 4.

2629. V. B. Drewsen. An improved method of purifying the liquid which has been used in the manufacture of cellulose and the production of useful products therefrom. Complete Specification. February 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

6589. C. Lenz. Manufacture of paper and cardboard. February 17.

21,059. C. Kleyer and C. Kappesser. Treatment of peat for the production of cellulose, sugar, and alcohol. February 10.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

1438. I. S. McDougall and J. T. McDougall. Improvements in the treatment of solutions of arsenic or of salts of arsenic for diminishing the danger incidental to their transport, storage, and use. January 25.

1794. J. Y. Johnson.—From Messrs. Valentiner and Schwarz, Germany. Process for the manufacture of sulpho-acid of para-isobutylxylene, or artificial musk. January 29.

1808. J. Berlinerblau. Improvements in the manufacture of para-phenetolcarbamide and para-anisolecarbamide. January 29.

1946. H. Boisselier. A new combination of eucalyptus and its products. February 2.

2194. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. The treatment of amido-guanidine for the manufacture of a new compound and products derived therefrom. February 4.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

5222. A. Schneller and W. J. Wisse. Formation of ozone in presence of air or oxygen, and apparatus therefor. February 3.

6234. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Production of basic gallate of bismuth. February 10.

22,253. L. P. J. Pontallie. Apparatus for obtaining products of distillation, or separating volatile liquids. February 3.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

1938. J. Hauff. Employment of aromatic amido-compounds as developing means in photography. February 1.

2145. S. H. Fry. An improved method of making photographs by artificial light. February 4.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

1953. R. J. Winkoop and J. M. Kemp. Photographic printing apparatus, and improved method of preserving sensitised paper, and a protective and adhesive solution therefor. February 10.

20,600. R. Kopp. Photography in natural colours. January 27.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

1601. L. de Lantour Wells. Waterproof coating for matches. January 27.

1868. H. H. Lake.—From V. Groendahl and J. Landin, Sweden. Improvements relating to the manufacture of ammonium nitrate. January 30.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

4129. H. Maxim. Manufacture of nitro-substitution compounds of cellulose. February 10.

5027. E. von Brauk. Explosive compositions. February 10.

5821. C. H. Curtis and G. G. André. Explosives. February 10.

6128. J. Y. Johnson.—From The Dynamite Actien-gesellschaft Nobel. Manufacture or production of gunpowder or like explosives. February 3.

6129. J. Y. Johnson.—From The Dynamite Actien-gesellschaft Nobel. Manufacture or production of gunpowder or like explosives. February 10.

21,879. A. Ruston and E. Beadle. Railway fog signal detonators. February 3.

XXIII.—ANALYTICAL CHEMISTRY.

COMPLETE SPECIFICATION ACCEPTED.

1891.

2785. A. Tropenas and A. E. Weels. Apparatus for the rapid determination of carbon of steel. January 20.

PATENTS UNCLASSIFIABLE.

COMPLETE SPECIFICATION ACCEPTED.

APPLICATION.

1891.

797. A. A. Blandy. Improvements in the combination and treatment of certain materials for the production of a new material or substance. January 14.

15,613. A. J. Boulton.—From O. Korschelt. Producing physiological and medicinal effects upon men, animals, and plants, applicable also for accelerating the crystallisation of substances and the maturing of wine. January 20.



THE JOURNAL OF THE Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

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MARCH 31, 1892.

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Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary will be glad to hear from Members possessing odd copies of the Journal for January 1882; January, March, and May 1883; complete Volumes 1886; and February and July 1889—all of which are now out of print. He is prepared to offer 5s. apiece for January 1882, January, March, and May 1883. Members who possess spare copies of these numbers are requested to communicate at once with Mr. Cresswell.

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 Roseow, Jas., Journals to Birch Vale, *via* Stockport.
 Sanford, P. Gerald, Journals to 20, Cullum Street, Fenchurch Street, E.C.
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 Williams, Rowland, 1/o Manchester; Lancaster.
 Wilson, Dr. W. H., 1/o Kensington; 18, Kimbolton Road, Bedford (until October 1).

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 Palmer, Thos., 1/o Temple Chambers, Temple Avenue, E.C.

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SESSION 1891-92.

1892:—

April 4th:—

Dr. C. R. Alder Wright, F.R.S. "On Specific Gravities for Practical Purposes."

Mr. H. B. Fulton. "Note on Specific Gravity Apparatus."

Mr. Albert Baur, Ph.D. "On Artificial Musk."

Mr. F. H. Leeds, F.I.C., F.C.S. "Note on Rosin Oil."

Election of Officers and Five Members to the Local Committee.

May 2nd:—

Professor Wm. Ramsay, F.R.S., and Mr. J. C. Chorley. "The Distillation of Wood."

Dr. S. Rideal. "Notes on the Composition of some Indian Gums of known Origin."

June 6th:—

Mr. J. A. Nettleton. "Vinegar."

Dr. S. Rideal. "The Petroleum Jellies of Commerce."

Meeting held Monday, 7th March, 1892.

MR. THOS. TYER, IN THE CHAIR.

THE DANGERS IN THE MANUFACTURE OF EXPLOSIVES.

BY OSCAR GUTTMANN, ASSOC.M. INST.C.E.

With a few exceptions the dangers in connexion with explosives may be summed up in the terrible word, "Explosion." Those who have witnessed one are never likely to forget the impression. A sharp report, huge red flames shooting towards the sky, followed by indistinguishable dark masses, then a dull shower of falling pieces, followed by a dead silence. Where a second ago a neat-looking building stood, and busy hands were working, there is now a deep hole in the ground, and all around at great distances lie scattered the fragments of house, machinery, and workers. It is difficult even to identify these last. Their clothes, if not of wool, are burnt away, their features are no longer recognisable, and sometimes a foot on a limb, or a mark on a body is the only clue. The cause of the explosion can rarely be traced with certainty. Whoever has read the reports of Her Majesty's Inspectors of Explosives will have nearly invariably found more than one possible cause given, but they will at the same time have been astonished to find a power of generalisation displayed which has never yet failed to teach some sound moral for the benefit of those concerned. Unfortunately such reports are published only in Great Britain, and the few short notices which reach other countries are quite insufficient to give the manufacturers adequate information to enable them to provide effectively for the protection of their workpeople and their property. A feeling that it is the duty of each one to relate his experiences has led the author to give an outline of the sources of danger involved in the manufacture and use of explosives.

It is generally agreed that an explosion must first be defined as the *sudden* decomposition of a mechanical or chemical mixture into its components, whereby in a short space of time a great pressure is developed. Such an explosion may be started by different means and they are by no means the same in every case. Sometimes ignition will start the decomposition, sometimes a shock, friction, an electric spark, vibration, sudden heating, &c.; but as a rule it is necessary, as Sir Frederick Abel pointed out first, that a certain amount of vibration and vibration of a distinct nature be generated as a result of either of the above causes, in order to produce explosion.

The explosion is quicker, the larger the number of vibrations in unit time. The stronger the effect, the higher the heat produced and the larger the quantity of gases developed, as their expansion increases in proportion to their temperature. An explosion has the maximum effect, when the vibrations, the heat and the quantity of gas reach their maximum at the same time.

Here may be mentioned some of the more conspicuous cases of explosions.

Chloride of nitrogen explodes when thrown into boiling water. If a minute piece of paper, smeared with iodide of nitrogen, the temperature of explosion of which is 212°F. , be allowed to fall from a height of about 3 feet, it will explode on touching the ground. If such a piece of paper is put on a bass-violin and the E chord is struck, it is not influenced, but, if the G chord be struck, which gives more than 60 vibrations in the second, it explodes. If a gunpowder mixture be ignited in a tamped borehole it burns away by layers until the pressure of gas and the heat cause explosion. If dynamite be ignited in this way it will simply burn without detonation. If laid on an anvil and struck sharply at an angle ("glancing blow") all explosives in practical use will detonate. Dynamite explodes between steel and steel when 5·63 footpounds of work are done upon it (0·78 kilogramme-metres), gunpowder at 56 footpounds (7·57 kilogramme-metres); but whereas the explosion travels through the whole of the gunpowder, dynamite as a rule only detonates in the part struck by the blow. If a dynamite cartridge be exploded on the top of a gun-cotton charge the latter will only burn away, but if the places are reversed the gun-cotton is sure to detonate the dynamite. Each explosive has a certain temperature, beyond which it cannot be heated suddenly without detonation. This temperature is for example 212°F. for iodide of nitrogen, from 356° to 363° for nitro-compounds, and 518° to 608° for gunpowder.

It is therefore obvious that an explosion is not solely due to the explosive being heated to a certain temperature. In fact, the shock or friction, that will cause a great many explosives to detonate, may be quite insufficient to raise the temperature to any appreciable extent, even if the shock be concentrated on a single point, as in the case of a "glancing blow."

On the other hand anything which is likely to produce vibrations of a sufficient amplitude and frequency in the explosive should be carefully guarded against. Thus for instance it is well known, that a tuning fork will give a greater number of vibrations, if struck against an object of steel, than against brass, stone, or wood; and the same applies to any shock against an explosive lying between different bodies. Steel against steel is the most dangerous, wood against wood the most harmless. Yet it has been proved by Dr. Dupré that a glancing blow with a broomstick against a wooden floor will cause the explosion of most explosives. Of course it depends greatly in what condition the explosive itself is. A blow given to a full cartridge of blasting gelatin may be quite harmless; but if sufficient force be used to flatten the cartridge and to expose the last thin layer to a sufficient amount of shock, then an explosion of the whole cartridge may follow. There is also a great difference between the explosive being warm or cold. When warm explosives are as a rule more sensitive, both to decomposition and to shock or friction.

The causes of explosion may be placed under two headings, mechanical and chemical. The mechanical causes are mainly due to shock, friction, or ignition of some sort. The chemical causes vary with the nature of the

explosive. Mechanical mixtures, such as gunpowder, roburite, &c., are under ordinary circumstances exempt from dangerous chemical changes, but chemical compounds have always a certain amount of instability, which can only be avoided by careful manufacture. Of course there are also mechanical mixtures, which are liable to decomposition, and I need only mention the chlorate mixtures, which, especially in the case of fireworks, have led to many accidents.

In the following account each explosive will be dealt with separately, and the dangers attached to it at each stage of its manufacture pointed out. Of course only those explosives which are actually manufactured and in use will be spoken of, it being left to you to draw your own conclusions, by the similarity of cases, when other explosives come under your notice.

Gunpowder.

First by seniority and by the number of factories making it comes *gunpowder* and its imitations.

In this case, as in that of every other explosive a very important condition is, that the materials employed should be of the greatest possible purity, both chemically and mechanically.

In the nitrate (saltpetre, sodium nitrate, &c.) chlorine is the principal impurity. Although in the case of true gunpowder no saltpetre is now used which contains more than one ten thousandth part of chlorine, yet with gunpowder imitations, especially where sodium nitrate is used, this is not always the case. An assistant of mine once made some powder mixture, extracted the nitrate, which contained a large amount of chlorine from it, evaporated the solution in a porcelain dish to dryness and complete fusion. He then allowed it to cool, and after some time, began to remove the cake with a glass rod, when suddenly the whole flashed up. In this case it is evident that some nitrogen chloride had been formed, the liability of which to explosion by the slightest vibration is so well known.

Care has also to be taken that no saltpetre or powder comes into contact with a soldered joint. Weber found in a particular case that nitrate of tin was formed, of which there is an explosive variety; this has caused frequent accidents.

The charcoal presents no other danger than that of spontaneous combustion. It is a good practice to have the charcoal first ground in separate machines. Spontaneous combustion is due to the capacity charcoal has of absorbing and condensing the air, producing thereby heat. This may sometimes take place suddenly, as for instance, when a piece of charcoal is broken, and the interior, which has preserved its absorbing power, is brought into contact with moist air.

The sulphur is now generally ground before mixing it with the other ingredients. Although by quick grinding a large amount of heat may be produced, this is scarcely ever sufficient to fire the sulphur. But sulphur mills very often take fire, and this is chiefly due to the well known electrical qualities of sulphur, which are made evident by the friction and heat in grinding. A friend of the author connected his sulphur mills with the earth by means of copper wires so as to carry away the electric charge as it was produced; since this time he has never had a sulphur mill fire.

If a ventilator is used to carry away the sulphur dust, its exhaust pipe should go into a collecting chamber, as sulphur dust is dangerous.

In this country stamp mills are no longer used for the incorporation of gunpowder, but elsewhere they still exist. They have generally wooden beds and brass stamps, and but for the presence of grit, or some broken metal parts, they are safe enough, provided the powder is frequently "liquored." Still, most of the accidents occur with them, as these two conditions of safety are often accidentally absent, and the great amount of dust, thrown in the air by the violent blows of the stamps, takes fire easily by a spark, or by the friction of a stamp pole.

Mixing drums were formerly largely used, and seem to be coming into use again in this country for certain kinds of powders. As they are made of "sole" leather or wood with brass or wood balls revolving in them, there should be

no other danger in them than comes from overheating due to the quick movement. There is still another source of danger which will be dealt with presently.

The machines chiefly used for the intimate mixture of the gunpowder ingredients are the "incorporating mills" having generally pans and runners of cast iron. Sometimes the beds are made of wooden blocks on edge. Incorporating mills are known to explode from time to time, and formerly the well-worn excuse of a match, or a nail having got into the mill, used to be a readily-accepted explanation of the accident. Such an occurrence of course is possible, but must be very rare indeed. The chief cause is faulty construction of the mills. The runners weigh from four to five tons, and if the cake in the course of milling becomes dry and hard, the runner may lift in passing over a thicker piece, and then fall down on to a thin one. Good incorporating mills are now made in such a way that the runners always remain about $\frac{1}{8}$ inch off the bed, so that iron can never come in contact with iron. Another cause, which applies to mixing drums and nearly all other powder machinery, is electricity accumulated by the friction against the sulphur. Some years ago the author advised the "earthing" of incorporating mills, and he believes that the number of accidents has considerably diminished where his suggestion has been adopted. It is known that many of the explosions in incorporating mills happen when they are suddenly stopped or started after a stoppage, whereby a great amount of vibrations are of necessity set up in a single moment. Many accidents happen also in removing the cake from the bed, or when repairs are being made. It is essential and rightly enforced by Her Majesty's inspectors that the cake should only be taken away when damp, and that no repair should be done without having previously thoroughly washed and cleaned the whole building. The use of brass tools in such a case is only a diminution of the risk, and is not by any means a safeguard against accident, and even wooden implements should only be used after the charge is well moistened. To prevent communication between one mill and another, which very often are driven in pairs from one water-wheel or line of shafting, the drenching apparatus has proved to be very effective. Briefly, this is a water-tank placed on the top of the mill, and held in equilibrium by a "shutter," a flat lever board, which, when raised in the least degree upsets the tank. All the shutters are connected by a shaft, so that when an explosion in one mill takes place, all the other charges are immediately drowned.

When an incorporating mill explodes, the building only is, as a rule, damaged, and that not always much. A friend of the author's has adopted the excellent system of constructing the roof of the building with a very light framing, and securing the whole roof by two loose wooden pins only. If an explosion occurs the roof is simply lifted, giving enough opening to the gases to escape before sufficient pressure to materially damage the building can be set up.

The mill cake is next powdered in a "breaking down machine," which is essentially a roller mill with one pair of grooved and one pair of plain rollers. This machine requires no more attention than other powder machinery, except that it should be so made that the pressure on the rollers cannot exceed a certain limit. This is generally done.

Next comes the pressing, which is now generally done by hydraulic machines, roller presses being very rarely used. Formerly this pressing was done by placing in a square wooden box with hinged sides a layer of powder meal and a brass plate alternately, and then pressing a block of hard wood into the box. This caused the powder to adhere so strongly to the sides of the box that it required a good deal of force to open it, and sometimes occasioned accidents. Nowadays the damp powder meal is, as a rule, laid on an ebonite plate, spread out flat with a shovel, and another ebonite plate placed on the top of it, and so on, layers of powder and ebonite alternating until the required height is reached. This way of pressing is comparatively safe, provided great care is taken to keep the presses clean, and the hydraulic ram is not allowed to fall down too quickly. But there is again the danger of electricity, which in this case

especially must not be under-rated. The charge of a cake press with ebonite plates can practically be considered as an electric pile, and a large amount of friction or electric influence from outside may cause a sufficient electric charge to give off sparks. Several cases have been known, and the following instance occurred at a large continental factory. The workman, having just finished charging, opened the valve for the hydraulic pressure, when he became aware of an approaching thunderstorm. According to his instructions he left the building, and returned after the thunderstorm had passed away, but when he began to discharge the press it exploded. The man died, but stated before his death that in undoing the cakes a spark of 4 inches in length came on his finger.

It is therefore advisable to take great precautions in using ebonite. It is a very convenient material, being very tough, of smooth surface, hard and not subject to much wear and yet sufficiently elastic; it is therefore largely used for plates in cake presses, for the lining of hoppers in granulating and sifting machines, &c. but care must be taken that no electricity can accumulate even under unfavourable circumstances.

The reduction of the powder cake into grains is done by a machine similar to that used for breaking down the mill cake; the grains formed are continuously classified as they fall from the rollers by sieves placed underneath. There is a large amount of dust produced in this operation, and the author has not yet seen a single graining machine where the escape of dust into the room has been perfectly avoided, but he has seen many houses where the air looked worse than a London fog, and where with open doors you could see the cloud of powder dust coming out for more than three yards. As a matter of course, there is shafting in the house, the graining machines themselves contain a number of cog-wheels, bearings, &c., and sometimes the shafting itself is driven by a cog-wheel from another line of shafting. These cause a good deal of noise, which together with the darkness in the room produce a very uncomfortable feeling.

In many factories the graining is still done by the Lefebvre system, which consists of one or more sieves oscillating either longitudinally or in a circle, in which a weighted boxwood disc, hewn like a millstone, is moved to and fro, thereby breaking the cake. This way of graining produces of course still more dust.

In some places a ventilator may be found which draws out the powder dust through an opening in the building, and deposits it on sheets of cloth, but it is never efficient enough to clear the atmosphere of the room. It is the author's belief that a suitable casing round the graining machine, and a hood on the top in connexion with a good exhaust, leading in a depositing chamber, would answer the purpose much better. No cog-wheels should be allowed on the shafting inside the building. They do not always gear perfectly, and wear out in time, which causes dangerous knocks, and it would perhaps be advisable to put the shafting altogether outside the house, unless it runs at a low speed. The bearings of the graining machine should be provided with constant lubricators, such as Stauffer's solid grease cups, which prevent the inconvenience of the oil dripping about, and keep the bearings constantly greased.

During the glazing, rounding, and sieving, the powder is subjected to a constant friction of its particles against each other; and during the glazing especially, where there is still a large amount of moisture, a good deal of heat is developed. The plugs in the glazing barrels must be opened at regular intervals to allow the escape of the steam formed, and care should be taken with all these revolving machines to carry away any electric charge that has accumulated, which is easily done.

The drying of the powder is no longer done in the open air, however convenient this may have been. There was always the risk of grit flying into the powder, and of a concentration of the sun's rays, if exposed to it. Artificial heat is now generally resorted to, and in very few cases only are the fumes of a stove carried in pipes to the drying house. Steam, hot or warm water, are nearly always adopted now. The introduction of steam or hot water pipes into the building itself is objectionable, as a certain amount of dust, which is always produced in charging and emptying

the trays, accumulates on the hot pipes. Warm water pipes increase the time of drying a little, but are not open to this objection. The best way is certainly to have a steam or hot water stove outside the building, and to drive, by means of a fan, a current of air over the stove into the drying chamber. This allows an even temperature to be kept, and removes all danger, provided that the air inlet be so arranged that the current of hot air cannot pass directly over a layer of powder.

Sometimes the press cake is cut into large cubes for the so-called pebble or cube powder. No special allusion need be made to these machines, whatever may be their construction, as the exclusion of hard blows, the attention to knives, bearings, &c., is the same as with all other powder machinery.

The process which requires most attention, and which is not always in expert hands, is that of compressing the powder into prisms, cylinders, pellets, &c. There are two classes of presses in use, lever and hydraulic presses. With a lever press generally the powder is charged into a mould, closed at the bottom by a piston, and another piston is brought down on the top by a lever actuated by an eccentric. Of course there are a great variety of such presses. Some have a "block" with many holes, into the bottom of which comes a disc, then the powder charge, then a piston, and the whole goes under a press. In some presses the mould revolves on a table, and its holes are alternately opposite a plain part and a perforated part of the table, and, at the same time, subject to a piston compressing the charge, and, on another part, to a longer piston forcing the compressed cartridge through the hole in the table, whence it falls out in a receptacle. Sometimes a hopper slides over the mould, fills it, glides away, the charge is compressed, the bottom of the mould glides away, and the charge is forced out. Sometimes the mould is fixed, sometimes it is balanced during the compression, whilst a piston enters the mould from the top and from the bottom.

These latter presses are, perhaps, the best in the way of lever presses, provided the mould be guided vertically, and one of the two pistons has a safety arrangement, to prevent excess of pressure. Lever presses, where more than one cartridge is pressed at the time, are objectionable, as they seldom have a safety arrangement, and to make such an one effective would cost as much as a suitable hydraulic press.

It is well known to everybody who has had to do with the compression of pulverulent substances, that it is most difficult to have a number of moulds filled with exactly the same quantity in each. Even little hoppers, which open at a certain weight, will fail to give more than a rough equality. Also the state of the atmosphere and the shape and diameter of the mould makes a difference, as does also the size of the grains in the case of gunpowder.

Although gunpowder can bear a great pressure without injury, yet it is not advisable to do too much in this direction, as it is very easy to get local overheating by the presence of a foreign particle or a hard grain. Also the more powder is compressed, the more it will adhere to the mould, and in pushing out the cartridge a greater pressure will be required. It is the friction thus caused which produces the greatest heat, and where the most danger exists. When, therefore, a number of moulds are not equally charged, and they are all compressed by pistons fixed on a common head, the cartridge which contains most of the powder, may, at a certain stage, receive all the pressure intended for the lot, and will, in any case, get more than its share. Hence the necessity of an arrangement to prevent an excess of pressure. This can be done by weighted levers on the bottom pistons, or, much better and simpler still, by keeping each mould independent and moveable.

The same applies to hydraulic presses. Most of them have one ram only, so that the cartridge, which may vary from $1\frac{1}{2}$ to 3 inches in height, is far more compressed on the bottom than on the top. Those with one ram on top and bottom make a better compression, and want less pressure on either side, but they are costly and cumbersome. In neither of them, as a rule, is any arrangement to prevent an

excess of pressure provided, and the best means of doing this is the movable mould.

Presses for prismatic powder, where needles of phosphor-bronze enter the moulds, require careful inspection, as the slightest bend of a needle can cause leakage.

Another method of powder manufacture may be briefly mentioned, which was long ago known to the Tartars, and some nine years ago practised in this country. This method is to dissolve the saltpetre in hot water, add the other ingredients, and boil down the whole with constant stirring during the evaporation. The English system of inspection would have soon put a stop to the way in which this was done for some time on the Continent, where this process was carried out in a kind of washing copper with a coal fire underneath, and where the contents of the copper sometimes went off through part of the powder being caked at the bottom and excessively heated.

The manufacture of cocoa-powder does not differ from that of ordinary gunpowder except in the preparation of the charcoal, which is no more dangerous than the work of a rag boiler.

In connexion with gunpowder may be mentioned also the manufacture of safety fuses. This presents no particular danger, except that in spinning the first layers of the fuse, where a fine stream of powder falls in as the fuse is formed, the excess of powder falls on the floor covering a large area, requiring precautions to be taken against friction or the fall of the weight which keeps the fuse stretched.

Nitro-compounds.

The next group to be dealt with are the so-called nitro-compounds or chemical explosives. These are produced on a very large scale, and gain daily in importance; but their manufacture involves generally a great amount of machinery and apparatus, and the knowledge of all the accompanying circumstances is still far from being perfect, besides being sometimes of a very complicated chemical character.

Nitro-compounds are liable to explode at a lower temperature, are more sensitive to concussion and friction than gunpowder, and in addition, as products of chemical action, are liable, under unfavourable circumstances, to undergo chemical changes which may render them unstable.

A nitro-compound is generally formed by the action of nitric acid on a hydrocarbon, sulphuric acid being added in order to take up the water formed during the process and to keep the nitric acid as far as possible at its original strength, so as to avoid the formation of lower nitro-compounds, which would either reduce the force of the explosive, or even render it unstable.

Comparatively the least dangerous to manufacture are gun-cotton and collodion cotton. With the exception of the nitration and the compression into cartridges, the whole process is worked with a large excess of water, and although it is quite conceivable that a particle of gun-cotton surrounded by water may explode when struck by a heavy weight, yet such a case is hardly likely ever to occur.

The cotton has to be very carefully purified from resinous matter and soluble substances, as they would form unstable by-products if allowed to remain. This is usually effected by boiling the cotton in a solution of soda. The nitration is done in England by dipping the cotton into the mixture of nitric and sulphuric acids, which are contained in a cast-iron vessel, squeezing it roughly out on a grid, and then letting the nitration complete in earthenware pots, which stand in running water. On the Continent they employ nitrating machines, consisting of a cast-iron vessel with a lid screwed on, having a false bottom which can be moved by means of a screw passing through the lid. The cotton remains in the machine during two hours, and then the false bottom is lifted towards the lid, thus squeezing the cotton out. In another factory suction is applied underneath the false bottom to drain the cotton.

The nitrated cotton is further deprived of the bulk of its acid by treatment in a centrifugal machine, whence it is passed as quickly as possible into a washing machine.

Care has to be taken that the acid cotton remains constantly under the acid or the water, or at least well covered, else, as it absorbs moisture rapidly, it decomposes, and once

a decomposition is started it is almost impossible to stop it. This decomposition is attended by large volumes of red fumes, and sufficient means of ventilation and escape for such have to be provided from the outset in case they are formed. The warmer the mixture, and the less liquid acid it contains, of course the more liable it is to decomposition, hence it is on warm and moist days centrifugal machines are most liable to fire; this seldom happens in the winter, unless some water, oil, or other foreign material falls into it.

Once it is immersed in the washing machine, whose water has to be constantly changed, the gun-cotton is no longer subject to sudden decompositions during the subsequent processes of manufacture, but the acid still remaining in it has to be eliminated with the greatest care, or else a gradual decomposition will take place. I will not detail this manufacture, as it is well known; suffice it to say that gun-cotton, which stands the English Government's heat tests, is quite safe under all ordinary circumstances.

The compression of gun-cotton into cartridges requires far more care than that of gunpowder, as this is done in a warm state, and gun-cotton, even when cold, is more sensitive than gunpowder. When coming out of the centrifugal machines the gun-cotton should always pass first through a sieve, in order to detect nails or matches, which may by chance have got into it. What has been said as to gunpowder presses applies still more to those for gun-cotton, although the latter are always hydraulic presses. Generally the pistons fit the mould perfectly, that is to say, they make aspiration like the piston of a pump. But there is no metal as yet known which for any length of time will stand the constant friction of compression, and after some time the mould will be wider in that part where the greatest compression takes place. The best metal for this purpose has proved to be a special steel made by Krupp, but this also is only relatively better; for pistons I prefer hard cast iron. If the position of the moulds and the pistons is not exactly the same in all cases, what the Germans call "Ecken" (English, "binding") will take place, viz., the mould will stand obliquely to the piston, and a dangerous friction will result.

For certain purposes, such as torpedoes, engineers' cartridges, &c., the gun-cotton has to be turned in a lathe, or drilled or planed. This should always be done under a constant stream of water, to keep the tool cool, as well as the gun-cotton in contact with it.

Of course, it is necessary to protect the man working the hydraulic valves during compression. At Waltham Abbey they have a certain made of ships' bawlers, which is at the same time elastic and resistant. The author has found from experience that a partition wall 12 inches thick, made of 2-inch planks, and filled with ground cinders, gives very effective protection. There are scarcely ever more than 5 lb. of gun-cotton under pressure at the same time, and in the case of an explosion the parts projected embed themselves in the cinders. There is a door in this partition to get to the press, and a conical tube penetrates the wall, which enables the man to see the whole work from a safe standpoint. The roof or one side of the building should be made of glass, so as to give the explosion a direction, and as a matter of fact it will not injure the walls of the building, even if they are only one brick thick.

The drying of gun-cotton is no less attended with risks, if it is done by improperly constructed arrangements. It is generally accepted that the drying should not take place at a higher temperature than 104° F. To secure this an electric alarm thermometer should be provided. If a current of hot air passes over a layer of gun-cotton, the cotton becomes electrified, and most, if not all, the fires in gun-cotton drying-houses are due, in the author's opinion, to a neglect to carry away this electricity.

I am indebted to Mr. Walter F. Reid, F.C.S., for much information in this respect. He was the first, so far as the author knows, to make metal frames, carriers, and sieves, upon which is secured the cloth holding the gun-cotton, and to earth them.

In drying houses there is a large amount of gun-cotton dust produced, which deposits on walls, floors—in fact everywhere. This dust, being warm, is very sensitive to friction;

in fact, Colonel Cundill once told me that even the hard friction with a felt shoe has been known to fire it. The workers in these rooms should therefore always wear felt shoes or go barefooted, avoid all unnecessary friction, and frequently wash the floors and walls. The floor should be covered either with india-rubber or linoleum.

On no account should an exposed metal pipe for the conveyance of heat be allowed in the drying room. Although the heat may not exceed 104° , and the radiation of the pipe may be sufficient, yet there might be a more sheltered place, such as a bend, a corner near a wall &c. where the quantity of heat is accumulated, and a far higher temperature reached, than that of the air entering, and it is just such places that will be filled with cotton dust, which itself will serve as an accumulator of heat. An accidental blow on the metal pipe may also happen, so that it is best to exclude them altogether from the room.

The above remarks about gun-cotton apply to mixtures of nitrate and gun-cotton, such as tonite, potentite, &c.

The manufacture of nitro-glycerin and dynamite is by outsiders generally considered as an extremely dangerous one, and it certainly is in the hands of untrained and inexperienced people; but if conducted by experts it is far less risky than the manufacture of gunpowder. Still, as it is essentially a chemical operation, its safety will always depend upon the amount of care bestowed on it by the workpeople; it requires a great deal of supervision to be always on the watch for neglect of duty.

The sources of danger arising from the raw materials will first be considered. The nitric acid used should be reasonably free from nitric peroxide. Opinions differ as to what is a reasonable amount, and no doubt the heat developed during the process of nitration is increased by the presence of this, a large amount of hyponitric acid; and, if sufficient care be not taken, may cause decomposition and explosion. Some say it should not contain more than 1 per cent., but some of the most perfectly conducted factories use it with even more than 4 per cent. The author's experience has been, that nitric peroxide undoubtedly produces more heat by its great oxidising power, but as the temperature of the mixture is always kept under about 77° F., it means that the nitration will last longer, because the workman must allow less glycerin to run in, and consequently he is expected to be still more attentive. Hyponitric acid also reduces the yield of nitroglycerin considerably. As a rule, those factories which buy their nitric acid insist upon having as little hyponitric acid as possible, sometimes below half a per cent. and those which make their own acid are not particular about 1 per cent. more or less. If the process of nitric acid making is conducted in such a way that a minimum of hyponitric acid be present, it will be difficult to have more than 93 per cent. pure monohydrate, and a large quantity of weak acid will result. If highly concentrated acid only is made, containing 95 to 96 per cent. pure monohydrate, then more heat has to be applied, which will always decompose some nitric acid into hyponitric acid. Of course a high percentage of monohydrate and no weak acid are most to be desired, because the first gives infinitely better results, whilst the latter is of little value, and if, therefore, the hyponitric acid should be eliminated, then a costly and tedious process of bleaching is necessary. This is the reason why a dynamite factory which makes its own nitric acid has never been known to have less than 2 per cent. of hyponitric acid as an average, but some even as much as 7 per cent. A new process which the author has recently invented gives invariably less than 1 per cent. of hyponitric acid with from 95 to 96 per cent. pure monohydrate, and this is now being rapidly introduced into many factories. This process can even be worked in such a way that the acid will not contain more than one-tenth of a per cent. of hyponitric acid, and acid, with even as much as 99.40 per cent. pure monohydrate, has been made by this process. This is the strongest acid ever manufactured on a large scale, but there is a great amount of the possible yield lost. It may, therefore, be said, that unless the nitric acid is after its manufacture submitted to a long and expensive bleaching, the best which can be made on a commercial scale will always contain about 1 per cent. of hyponitric acid. As it is scarcely to be expected that

everybody can have the very best acid, the limit of hyponitric acid may be set at 2 per cent., which does not increase materially the danger of too much heat being developed. Beyond this limit the heat of the mixture may rapidly increase, and the workmen has to be constantly on the alert to shut off the inflow of glycerin, or to apply more vigorous cooling and stirring. As it is desirable that every process should depend as little as possible on the attention of the workmen for avoiding accidents, an excess of hyponitric acid should not be allowed.

Sulphuric acid and glycerin are nowadays made very pure. Arsenic may be in both, especially in the sulphuric acid, but it should never be allowed to exceed one-tenth per cent. on account of the well-known strong oxidising action of arsenious acid.

Glycerin is a very intricate substance, so far as its use for making nitroglycerin is concerned. Of course a large amount of organic matter, such as cellular substances from the tissue or fatty acids are both objectionable, as they form unstable compounds during nitration. The presence of chlorine also has to be avoided, because it will ultimately form hyponitric acid. But even if the glycerin is nearly perfectly pure, and contains nothing whatever but about 0.15 per cent. of total residue, organic and inorganic, it will sometimes happen, that the nitroglycerin made is full of a bulky, flocculent matter, which prevents its separation from the acids for a very long time. This only happens with glycerin of a special manufacture, and up to now even so high an authority as Mr. Otto Helmer has been unable to find out to what component or impurity this is due.

The operations of nitrating and separating the nitroglycerin do not require more attention than that the temperature should not even at the finish exceed 86° . I do not refer by this to the Bontny-Fancher process, which in itself had a special source of danger, inasmuch as in it the sulphuric acid was first allowed to act upon the glycerin, which caused the organic impurities to become charred, and to form minutely suspended carbon particles. This prevented the nitric acid, at its highest concentration, penetrating every particle of glycerin, and sometimes prolonged the separation for days. It will be explained later on why this must have been dangerous, or is still so as the process is still said to be used on a small scale at the French Government factory at Vonges.

It is in the apparatuses used for nitration and separation that the chief danger lies on account of their construction. The nitrating apparatus is now generally a large lead tank, with a number of cooling worms, through which cold water runs. The tanks are closed at the top with suitable openings for the admission of glycerin and compressed air, for the escape of the fumes and for the constant control of the temperature, also for discharging the tank either into the separating apparatus or into a drowning tank. All these arrangements of course complicate the nitrating apparatus, and require constant attention. A detailed description of the different apparatuses in use cannot be given in this paper, as it would be sufficient for a paper by itself, but some of the chief sources of danger, however, must be pointed out. First is the lead itself usually used in the construction. The combined action of nitric, nitrous and sulphuric acids on the lead is very great; but still greater is that of the fumes, when mixed with the outside air, because diluted acid attacks metals more than strong acid. The lead should be perfectly pure, some even prefer remelted old lead, as it becomes harder by remelting. If the slightest amount of zinc is present the lead is very soon perfectly honeycombed. The fumes should be drawn off through a pipe with a good draught in it, so that the outer air cannot enter the vessel. The compressed air used for stirring and cooling should come from a storage vessel, where it can deposit all its moisture, and the pipes leading to the apparatus should ascend as much as possible, and have a drain tap attached. All joints should be made quite tight, and the construction of the cooling worms must be well understood, as they will expand and contract, and can easily leak. It must be understood that the slightest leak of a water pipe may start a very serious decomposition, and it is therefore a good plan to test the whole apparatus every morning before starting work.

The manner of introducing the glycerin is another matter for consideration. In some apparatuses where a screw paddle assists the stirring, the glycerin runs on a disc attached to it, and is therefore scattered by centrifugal force in minute drops. Sometimes a perforated pipe supplies the glycerin, and very often an injector. Those injectors, which are placed near the bottom of the vessel, are soon eaten away, and sometime cause a sudden inrush of glycerin, which is of course to be avoided. Injectors or pressure vessels, which blow the glycerin through a pipe, are perhaps the best.

The temperature in the apparatus must be efficiently controlled; it is not sufficient to know the temperature of one part of the vessel only, since decomposition generally starts locally, and then spreads over the whole mass.

The taps for discharging to the separators and to the safety tanks want very careful fixing, and it is commonly said that it is a knowledge by itself to make all the different kinds of mastic or cements that are required in a dynamite factory. Of course the taps must not be placed so that water can get into them. At the same time much depends upon what pressure there is on the tap, and one of the objections to those huge American apparatuses is that they have a column of acid 10 or more feet high resting on the taps, or like 8 lb. pressure per square inch. It is so easy to get a tap or a plug knocked out, apart from the pressure on the tank and the enormous weight of the cooling worms.

The apparatus should of course be made so as to empty itself to the last drop, and the safety tap should be sufficiently large to empty the vessel in a few minutes.

Exactly the same remarks apply to the first separators and the bottles used in the secondary separation.

It might be appropriate to mention here, that a decomposition in a properly constructed apparatus is a very rare occurrence indeed, and due only to leakage, bad glycerin, or inattention on the part of workmen. Even if a decomposition should be seen starting, there is no need to drown a charge at once, or to lose one's head and run away. A decomposition, as has been mentioned, begins at one point, and spreads gradually through the whole mass. A slight decomposition will develop a huge volume of dark red fumes, and is certainly alarming to the novice, but it will take sometimes 10 or more minutes before it can develop into an explosion. The author has seen decomposing charges entirely saved by the coolness of the workmen, who freely used all the available means for cooling and stirring. In one instance, the acid underneath the nitroglycerin in a separator decomposed, and the man in charge, who was a new hand, in his confusion opened the nitroglycerin tap instead of the safety tap, and although the whole of the nitroglycerin had time to run into a water tank, it was more than a quarter of an hour before one could think of entering the building to drown the decomposing acid.

In the process for separating the nitroglycerin from the acids, there is the danger of a prolonged contact of the two liquids, which has been fully investigated by the Home Office in reference to the Pembrey accident. Nitroglycerin dissolves in sulphuric acid, and just at the line of contact between the two liquids many of those lower nitro-compounds collect which have been formed from the impurities in the glycerin. Others collect on the top of the nitroglycerin, where they are exposed to the action of the air. Pure nitroglycerin can remain a very long time in contact with pure nitric and sulphuric acid without alteration; but in a process where everything is impure, the lower nitro-compounds are soluble and unstable, and therefore the separation should be finished as quickly as possible. I have referred already to the glycerin retarding the separation, but there are also mechanical impurities in the other reagents which have even worse effect. If the sulphuric acid contain much lead, if the mixed acids have been in the storage tanks too long, and some lead or iron is dissolved in them, this will be suspended in minute, but bulky quantities in the mixture of nitroglycerin and acids which leaves the nitrating apparatus. Still more marked is this effect in the case of any carbonaceous matter introduced, such as straw from the carboys, gross organic impurities of the glycerin, &c. This is the case with the

Boutmy-Faucher process where by dissolving the glycerin in sulphuric acid, the impurities in the former are charred, and delay the separation in an extraordinary way. The worst case known to the author was one, when a second-hand air vessel was bought for the storage of sulphuric acid and a thick layer of rust prevented it being seen that the vessel had formerly been coated inside with tar. The sulphuric acid became quite black from the tar, and after two days' separation only half of the nitroglycerin could be recovered.

It must be understood that the difference of specific gravity between the nitroglycerin and the refuse acids is only 0.100, the former having a gravity of exactly 1.600 and the latter about 1.700, and although the greater fluidity of the acids facilitates to a great extent the separation, yet such bulky impurities remain for a long time suspended and form contact between the more sticky nitroglycerin and the acids, thus obstructing separation.

The secondary separator receives the spent acids, which generally contain minute globules of nitroglycerin in suspension, and it is essential that they should have time to separate. This secondary separation is the weakest spot in a dynamite factory. The fact that small quantities of highly acid nitroglycerin are floating on the top of strong acid, and, even with the best ventilating tubes, are exposed to the air, may account for some decompositions, but the author believes that a careful investigation of all the facts would nearly in every case point to another cause for an accident, and that cause either a leak of a water pipe or the intrusion of some organic matter.

Some experiments which the author has carried out with waste acids have shown that if *large* quantities of glycerin are poured into waste acid (which has nearly invariably the composition of about 10 nitric monohydrate, 70 sulphuric monohydrate and 20 water) a turbulent decomposition takes place in a very short time. If we take the process of nitration to consist of an interchange between the NO_2 group of the nitric acid and the hydrogen molecules of the glycerin until complete exhaustion of the former, then every particle of glycerin entering in excess will not be nitrated, but dissolved in the sulphuric acid, as after the formation of the bulk of nitroglycerin the nitric acid left occupies only about one-fourteenth of the whole mixture, and in spite of violent stirring it is difficult to cause the little nitric acid remaining to come in contact with the glycerin particles. Besides, this nitric acid, as it is seen from the composition of the refuse acids, is in a very diluted state, and if it could easily come in contact with the glycerin, it would only form mono- and dinitroglycerin, which are soluble. Thus it will be seen, that an excess of glycerin forms a very dangerous mixture, and on two occasions at least the cause of decompositions could be distinctly traced by the author to such an excess.

It must be pointed out that a small excess of glycerin may happen with any operation, as it is impossible to calculate exactly the quantity required, and a slight variation in the strength of the nitric acid will at once alter the quantity of glycerin, which can be converted into trinitroglycerin.

This is another reason why very strong acid with a rather higher percentage of nitrous acid is preferable to the reverse as the workman can guard against overheating, but he has no means of ascertaining the total nitrating capacity of the nitric acid. But a small excess of glycerin, although just affording the amount of danger connected with the work, is still not a distinct danger, so long as proper attention is paid. It is only a large excess which can produce a *sudden* decomposition, and it would be impossible to stop this. This excess of glycerin need not necessarily be the consequence of an error in weighing, it can also be brought about by using too weak nitric or sulphuric acid, or by a mistake in weighing the acids for mixing. The only remedy in this case is to watch the yield of nitroglycerin. If it falls below a certain limit, then part of the glycerin must have escaped nitration, and the only plan to adopt is to at once drown the waste acids, as containing too much glycerin. With good yields of nitroglycerin and proper attention the secondary separation never gives any trouble.

As the waste acids are in most cases treated in a denitrating apparatus to recover the two component acids separately, care must be taken that every particle of nitroglycerin is removed in the storage tanks before working them up. Small drops may come up after days, and an explosion of a denitrating plant in Italy was due to neglect in this direction. The storage tanks must also be protected against the weather, and have a safety tank attached, as their contents will sometimes decompose, especially in hot climates.

In the operation of washing and filtering the nitroglycerin warm water should be used with caution, as nitroglycerine begins to evaporate at 101°, and the inhalation of nitroglycerin vapours in larger quantities is injurious.

The other operations do not require more attention than with other explosives, except the formation of cartridges by lever presses, where the material falls through a funnel into a tube, and a piston on a lever forces the dynamite out in the form of a cylindrical mass. There are two kinds of presses, one where the parchment paper is wrapped round the tube, and the whole cartridge is made in one pressing, and others where the dynamite is pressed out by consecutive strokes with the lever, so that a continuous string comes out of the tube. This is broken off when it reached the required length, and then wrapped round with parchment paper. This kind of intermittent pressing is no doubt the best, and the single stroke presses are rightly objected to by the German industrial inspectors. It is patent that in order to press out a cylinder of soft material of about four inches in length, there is perhaps twenty times more force wanted than for a piece of an inch and any metal or grit particle or even a hard lump of kieselguhr may produce enough friction on the tube to cause an explosion. By far the majority of the explosions in cartridge hnts happened with single stroke presses.

Of course cartridge presses must be so constructed and secured as to prevent any hard blow or friction.

The manufacture of blasting gelatin, gelatin dynamite, and gelignite calls for very few remarks. As the process is carried out with the aid of artificial heating, care must be taken to avoid excessive heating, since the collodion-cotton may begin to decompose, and the nitroglycerin to evaporate. The machines for mixing, if such are used, and for making cartridges must be so constructed as to avoid undue friction, and to allow of ready inspection and cleaning.

The danger of freezing has still to be dealt with. It is well known that nitroglycerin freezes at about 46° F. Dynamite and blasting gelatin will freeze at slightly lower temperatures. Numerous experiments have shown that frozen nitroglycerin and dynamite are highly insensible against shock, and that even a bullet fired from a military rifle at 50 paces has failed to explode in, whereas soft dynamite explodes readily at 300 and more paces. Yet somehow frozen nitroglycerine *does* sometimes explode. To the author's own knowledge the removing of some frozen nitroglycerin from the ground by means of a pick-axe, the sudden turning of an earthenware tap, around whose plug some nitroglycerin froze, the cleaning of vessels containing frozen refuse, and even the forcible breaking of a frozen dynamite cartridge, have resulted in explosions, and it is probable that similar instances are known to others. The author believes that the explosion of frozen nitroglycerin is due to a sudden alteration in the molecular arrangement of the frozen nitroglycerin—such as Professor Tyndall stated in the case of ice—and the consequent production of vibrations sufficiently high to cause a detonation. This is certainly a striking illustration of the fact, that explosion is not merely a result of heat.

Blasting gelatin and the gelatin dynamites, on the other hand, are extremely sensitive in a frozen state, which is solely due to the collodion cotton. In the soft gelatinous state of course every shock is annihilated, and the gelatins are in fact indifferent in this state; but when the gelatin is frozen, and forms one rigid, hard mass, a blow will be readily communicated throughout the whole mass, and the collodion cotton will be the first to

explode. It is therefore of high importance that the nitroglycerin or dynamite should never be allowed to freeze during manufacture. Even in moderately warm rooms the cold earthenware taps may cause freezing, or drops of nitroglycerin spilt on the floor may become hard, and the danger of working frozen dynamite in cartridge presses is very great. It has repeatedly happened that small crystals of frozen nitroglycerin "cracked" on a wooden floor by being rubbed with a leather shoe.

The sun has a decided effect on the nitroglycerin, inasmuch as the heat generated will decompose it. This is the reason why the roofs and windows should be painted white; especially the window panes, as they will usually contain some faulty spots, which act like lenses. The action of the sun on nitroglycerin that had been inadvertently allowed to run away in the sand has several times produced explosions.

The refuse resulting from the sweepings, the residues on the filters, the mud in the deposit of washings, &c. have to be carefully burned. This refuse, or even defective dynamite, if laid out in a train, and ignited, will burn quietly for some time, but then suddenly explode. The author is indebted to Dr. Dupré, F.R.S., for the hint, that by pouring paraffin oil over such refuse it can be burnt without fear of explosion.

Although all the possibilities of danger have not been mentioned, and although perhaps the long list may have alarmed you, yet the author confidently asserts, from personal knowledge and long experience, that the manufacture of dynamite is far less dangerous and certainly less subject to sudden and unforeseen accidents than that of gunpowder, which has a record of casualties for more than five centuries.

Smokeless Powder.

The manufacture of smokeless powder has within the last four years come to the foreground, and is in many instances similar to that of the gelatin-compounds. As it is a comparatively new industry, chiefly in the hands of Governments, and as none of the powders can yet claim to have reached the stage of perfection, it may seem to be superfluous to enter into many details. The fact that nearly every factory has some process of its own, because everyone is anxious to keep its own experiences secret, makes general remarks very difficult.

Smokeless powders are practically of two kinds, those made from gun-cotton and a solvent only, and those made from nitroglycerin and gun-cotton with or without the aid of a solvent. Of late nitrated starch seems to be favoured. As a solvent acetone is now generally used, and the process of dissolving the gun-cotton, or making a gelatin of nitroglycerin and soluble gun-cotton, with or without the subsequent addition of insoluble gun-cotton and camphor, does not want any special allusion, as the machines for incorporating the materials are about the same as now used for the manufacture of blasting gelatin. But the subsequent working up into small square sheets or round discs, in imitation of the manufacture of certain pastries, requires more attention, although it must be said that the acetone, of which traces always remain in the powder, renders it comparatively safe. The jelly-like incorporated mass, when leaving the mixing machine, is subjected to a partial evaporation, and then passes through steam-heated rollers to be rolled into sheets, and at the same time to evaporate all the acetone. In these rollers small local explosions sometimes take place which are probably due to some undissolved gun-cotton being submitted to heat and friction, but which pass away without doing any harm. Great care has to be taken to collect the acetone vapours, as they are explosive and may spread over a large area. The cutting of these sheets into small squares is also without special risk, as the pressure on the sheet is small, and no undue friction is likely to occur. Of course, the powder should not be allowed to accumulate, as although considerable quantities of it can burn without explosion, yet the fire spreads quick enough to cut off escape, as has been proved at a fire in an Italian factory. The manufacture of cordite, the British smokeless powder, varies in some stages from that of others, and being the invention of Sir Frederick

Abel, and manufactured under his superintendence, does not call for further remark in this paper on the dangers of explosives.

The stability of smokeless powders with regard to atmospheric and climatic influence have still to be conclusively tested.

Other Explosives.

Nitrobenzene is, I believe, no longer used with explosives; its manufacture is well known, and is only dangerous during the nitration and through the poisonous effects of its fumes.

The manufacture of picric acid is also to a certain extent outside the scope of this paper. It presents no danger during the manufacture proper, but the finished product, when mixed accidentally with certain materials as lime, nitrate of lead, &c., will produce a detonating mixture, as has been successfully proved by Colonel Majendie and Dr. Dupré in their report about an explosion in Manchester.

Under the name of "Melinite," "Lyddite," "Ecrasite," &c., picric acid has been used for filling shells. Picrate of ammonia, trinitroresol and the ammonia salt of it are also used. They are melted in a hot water-bath and filled into the shells. They are exploded generally by a primer of gun-cotton. As this work is only carried out in military establishments, further consideration is not necessary before this Society. Neither is it necessary to enter into the details of manufacture of roborite, secunite, ammonite and similar products, or fireworks. The processes used with the former are very much the same as those used in other manufactories of explosives. In the manufacture of fireworks the preparation of the different mixtures, the compression into rockets, the distribution of pills for amorces, &c., can with little modifications be governed by the considerations applicable to gunpowder factories. Only the frequent use of chlorates, especially Chertier's copper, calls for attention as the cause of many decompositions, and all chlorate mixtures are extremely sensitive to shock and friction. Of course, if the mixture is moistened to form a paste, it will stand a great amount of shock, but when too much water is added, some particles may become exposed to the direct action of the blow.

The last explosive to be mentioned, before discussing the dangers in conveyance and use, is fulminate of mercury, which is used for filling caps and detonators. The manufacture is simple enough, and with ordinary precaution no accident should happen. Of course the ebullition after the addition of alcohol has to be carefully regulated, and attention has to be paid to the way how the developing vessels are carried about, the fume pipes put on, &c.; the nitrous ether formed should also be condensed away from fire. The washing of the fulminate should be well attended to, to avoid decompositions, and the ready-made fulminate should be stored with not less than 20 per cent. moisture. It is chiefly in the working up of the fulminate where the danger comes in. As to drying it, the ordinary precautions as to heating by a current of air, absence of metal in the room, having hair rugs or india-rubber mats on the floor are sufficient. The mixing of the fulminate with nitrates, chlorates, ground glass, &c., is perhaps the most dangerous part, as thereby a large amount of friction is produced. The process used at Woolwich is certainly the safest, and will give a better mixture than the usual work with a feather. It consists essentially of a silk bag on which there are diagonally placed india-rubber discs, like a string of pearls. To the bottom of this bag is fastened a thread, which is moved by a lever from behind an iron screen, thereby taking up and throwing down the fulminate between the discs. No explosion has happened at Woolwich since the introduction of this ingenious mechanism some years ago.

The filling of caps with the fulminate is done everywhere by carefully planned machines, which avoid friction and over-charging. The compression of the priming composition is best made in moulds attached to separate weighted levers for each cap, so that in spite of the probable inequality of filling, each charge should only receive the same pressure as the other. In some factories the whole press is sheltered

by a screen which is automatically closed during the compression, and no composition is allowed to be in the room.

In fulminate factories proper precautions must be taken against any possible friction. These are briefly the use of hair rugs, felt slippers, frequent washing and dusting of floors and rugs, preventives against spilling of material, &c. Like other mercury substances fulminate is injurious to the body, especially the gums of the teeth, if too much dust is produced and the ventilation not efficient.

The other dangers to be attended to in connexion with the manufacture of explosives are those which arise from the general arrangement in the factories.

This is the only country, to the author's knowledge, in which the exclusion of iron from the interior of the buildings, the absence of so much as a few grains of mud or grit on a floor, and in general the cleanliness throughout are rigorously enforced. It certainly made a great stir amongst the manufacturers when the Explosives Act came into operation, but seldom was there on the whole a wiser measure taken. If one remembers that last year only in one gunpowder factory were there fatal accidents, and that the mortality amongst the workmen in explosive factories was not larger than that in all London, you will agree with the author that the Explosives Act was very beneficial and that the inspectors who carry it out are doing most useful work. It is certainly not the absence of a little grit, because in thousands of cases it will be of no harm, but the general spirit of order, cleanliness and precaution instilled to the workmen which makes a factory safe.

According to the Explosives Act, every danger building must be provided with an efficient lightning conductor. In spite of the Lightning Rod Conference, in which so many eminent men took part, the question as to what forms an efficient lightning conductor in a factory for explosives is not yet definitively agreed upon. There can be no doubt that a lightning conductor is a good and useful instrument on a dwelling-house where an accidental disturbance in the arrangement may not do great harm, but the case is entirely different with a workshop or magazine for explosives. The thorough and reliable examination of a lightning conductor can only be done by an electrical expert, and in a factory where sometimes 100 of them have to be tested this takes several days. Yet, if a gale is blowing, or the factory is exposed to the influence of sea-atmosphere, the lightning conductor is soon out of order again. Then take the presence of machinery in the buildings, tram-lines, pipe-lines overhead and underground, and you will find that a lightning conductor is not only a very limited preventive, but very often a positive danger. Without further entering into this question the author thinks that a competent investigation of this subject with reference to explosive factories would be very beneficial.

A great many factories are now lit by electricity. Since this paper was written, special regulations in regard to electric lighting in explosive works have been issued by the Home Office. I do not wish to criticise these regulations, as too short a time has elapsed, and their effect cannot yet be appreciated. I will therefore only give my own experience. It is highly important that suitable lightning conductors should be attached to the circuit. From experience, the author knows of two cases where the lightning struck into the wires, which were carried overhead. The wires should always enter a building from opposite sides, so as to prevent accidental short circuits, and no joint or switch should be allowed inside the building. The lamps should invariably be surrounded by a tightly fitting large glass globe, which allows sufficient radiation of the heat. Although the heat on the outside of a lamp is scarcely larger than 120°, yet, if a lamp be covered with explosive dust, and the heat cannot radiate into the open air, there will be such an accumulation of heat that serious accidents may occur. As to an excess of tension in the current the best plan is to have an arrangement whereby, in case the tension rises over a certain limit, the whole of the plant is cut out of circuit. It is by far preferable to have the place in darkness than to see sparks travelling along the wires.

It would be quite impossible to write a paper by itself about the dangers in connexion with the use of explosives

in mines. Miners will frequently insist upon treating explosives with the greatest recklessness, and if it were not as a rule accompanied by a loss of life or limbs, it would be able to write quite an amusing paper about the innumerable ways in which the miners handle explosives. Carrying gunpowder in open boxes, with a candle on the hat or in the hand, squeezing detonators with the teeth, charging boreholes with boring bars, thawing dynamite on a hot stove, or even on an open fire, in a straw hat, are cases that frequently occur. It will still take a long time before anything like proper precaution will be taken everywhere.

The carriage of explosives, whether by road, vessel, or rail, is under ordinary circumstances free from danger. No explosive is licensed which does not in itself present a certain degree of safety, and the packing is so substantial that unless the packages are very roughly handled not even a spilling of explosive is likely to occur. For this reason, in almost every country the carriage of explosives by rail is allowed. Of the more important countries Great Britain alone makes an exception as regards gun-cotton and dynamite, but why cannot be said. The railways will carry gunpowder, detonators, blasting gelatin and gelatin dynamite, but not gun-cotton and dynamite. Gun-cotton is always sent with from 20 to 30 per cent. moisture, in which state it cannot be exploded by ordinary means. Dynamite is no more dangerous than gelatin dynamite, and in the 20 years during which it has been carried on Austrian railways not a single accident has occurred. Let us hope, that here also this obstacle will soon be removed; it injures the railways indirectly more than anybody else, as they are the largest consumers of coal and iron, which cannot be won without the use of explosives.

DISCUSSION.

Mr. ARNOLD PHILIP said that some 18 months previously in going over a large dynamite works, he had seen a plant employed for the recovery of the acids which had been used in the manufacture of the nitroglycerin. This apparatus consisted in part of two scrubber towers apparently built of flags of sandstone held together outside by iron tie-rods; inside they contained coke or some other suitable material on which to condense the acid fumes. The waste acids were heated in stills connected with the scrubbers; there was, however, some difficulty in employing this apparatus, for explosions were not infrequent. These explosions were usually slight in character, and chiefly occurred in the scrubbers, but they caused considerable financial loss by the damage which they caused to this part of the plant. All the trouble was due to the minute amount of nitroglycerin which remained in the waste acids even after they had been allowed to stand and settle for a very considerable time. On account of this difficulty there was a natural disinclination on the part of the manufacturers to distil waste acid, and it was not at all an uncommon thing in nitroglycerin factories for tons of it to be thrown away. If, however, these traces of nitroglycerin could be satisfactorily removed, the acids might afterwards be safely recovered, and a great saving thus introduced. It was possible that this might be done by dissolving out the trace of nitroglycerin by means of paraffin. Of course the strength of the acids in question made it quite impossible to employ either hydrocarbons of the benzene series or ether for this purpose. With regard to the question of lightning conductors, it would be interesting to know whether Mr. Guttman had had any experience with Professor Oliver Lodge's method of protecting buildings; this was based on the same principle on which electrometers were sometimes shielded by wire cages. Professor Lodge proposed to cover buildings with what was practically a network of galvanised iron wire. This material was of course far cheaper than copper or any copper alloy, and although not so good a conductor, yet for electric discharges of such high potential as lightning, as long as there was a metallic conductor, it really mattered very little whether it had a high or low conductivity.

Mr. DE MOSENTHAL said that he believed that Dr. Duprè's experiment with the broom stick was correct only so far as chlorate of potash explosives were concerned. Referring to the question of lightning conductors, an explosion due to

lightning had occurred quite recently in a manufactory on the Continent, where the rod had been examined by an expert a few days only before the explosion occurred, and was therefore probably in perfect order. In that case the conductor was placed on the earth works which protected the building, but it was generally supposed that the position of the conductors was immaterial. As Mr. Guttman had pointed out, very little was known about the subject; and it was to be hoped that the report of a Special Commission which had been at work in Germany for something like two years, would throw further light on the subject.

Lieutenant-Col. CUNDILL remarked that last year only one fatal accident had occurred due to the manufacture of explosives. He thought that statement spoke volumes for the care exercised by the manufacturers. His Department was much indebted to the trade for the way in which any suggestions made by them before the Explosives Act came into force had been carried out. The average number of deaths in England and Wales alone caused by explosions in manufacture in the seven years preceding the introduction of the Act was 39.5, the average was now something under eight for the United Kingdom. In 1890 there were eight deaths, but those were all in one factory; and the accident which caused the one death in 1891, was due to a man hammering a cast-iron die-plate with a steel punch in a building where there was gunpowder, this being a flagrant violation of the statutory rules.

After some observations from Mr. OTTO HEHNER:

Mr. GUTTMANN in reply said that the suggestion of Mr. Philip to use paraffin for effecting the better separation of nitroglycerin from the waste acids, had not, to his knowledge, been tried with nitroglycerin, but it had been tried with picric acid. He knew of a case where it had been used for many years for separating the picric acid, but he had recently seen a sample of a compound which had been found during such separation, which was a dangerous one. He had been asked to make experiments with this substance as an explosive, but it smelt so decidedly acid, that he requested that it should be taken back as soon as possible and washed. He had carefully considered Professor Oliver Lodge's system of lightning conductors. The idea, however, was not new. A Belgian (Mr. Melsens) was the first to make lightning conductors in that manner. Professor Zenger of Prague had developed it, and it had been very extensively tried by the Austrian military authorities. In that country, in the mountain region of the Karst, a thunderstorm occurred nearly every day, and the lightning struck everything above ground. They had a number of exposed forts and military stores there, containing gunpowder, ammunition, ready-made shells, &c., and it was not a pleasant feeling to find these things exposed to such thunderstorms. They had tried the wire cage system and it was found to be a very effective protection. Col. Ph. Hess placed in such a cage one of the bridge detonators employed for military purposes, which are so sensitive that the smallest amount of electricity would fire them, and he could not get an explosion although he applied the sparks of a Wilmhurst machine. So far no more had been heard about the practical application of this system. As to Mr. de Mosenenthal's observations, he would just mention that the broom stick question had been discussed in that room by Dr. Duprè. If he remembered rightly it was in connexion with kinetic, an explosive which it had been attempted to introduce in this country. For a long time the English Government would not pass it, on the ground that it was not safe. This the agent of the firm who introduced the explosive tried, in that room, to explain was not the case. He remembered reading Dr. Duprè's speech on that occasion, in which he stated that everything in the hands of a man who was willing went all right, but that if any person who was not conversant with the matter struck the substance with a broom stick on a wooden floor it would go off. He believed that any explosive which Dr. Duprè had tested, did not fail to explode when struck with a broom stick. Lastly, he would deal with Mr. Hehner's observations. He (Mr. Guttman) had often discussed the question of glycerin with Mr. Hehner, and he was aware that Mr. Hehner held that a small quantity of chlorine, acid, or

aldehydes in glycerin was not very important; yet he believed he expressed the opinion of manufacturers when he stated that they held the opposite view. Mr. Hehner had said that experience was the principal thing to be taken into consideration, and the experience of manufacturers showed that the presence of chlorine developed hyponitric acid, a body, the formation of which they desired to avoid as much as possible. The same remarks applied to aldehydes and poly-glycerins. It was probably these constituents that formed the amount of organic matter in the residue. If 1 per cent. of organic matter was present in the residue, there was sure to be a smaller yield of nitro-glycerin, and a larger development of nitric peroxide.

the residue obtained was fused with hydrogen potassium sulphate. The mass was then dissolved in a dilute hydrochloric acid and the amount of alumina, lime, and magnesia determined.

RESULTS OF ANALYSIS EXPRESSED IN PERCENTAGE OF WEIGHT OF PAPER ANALYSED.

WHATMAN'S DRAWING PAPERS. *Double Elephant.*

Found.	Per Cent.	Per Cent.
SO ₃ ...	0.8025	
Al ₂ O ₃ ...	0.1328 (trace Fe ₂ O ₃) calculated as potash alum	SO ₃ .. 0.4163
CaO...	0.1853	" CaSO ₄ " 0.2651
MgO...	0.0367	" MgSO ₄ " 0.1874
		" 0.8688
		Total SO ₃ found..... 0.8025
		Deficiency 0.0663

Imperial 140 lbs.

Found.	Per Cent.	Per Cent.
SO ₃ ...	0.5685	
Al ₂ O ₃ ...	0.0548 (trace Fe ₂ O ₃) calculated as potash alum	SO ₃ .. 0.1718
CaO...	0.2264	" CaSO ₄ " 0.3234
MgO...	0.0145	" MgSO ₄ " 0.0289
		" 0.5241
		Total SO ₃ found..... 0.5685
		Excess 0.0144

Imperial 96 lbs.

Found.	Per Cent.	Per Cent.
SO ₃ ...	0.6520	
Al ₂ O ₃ ...	0.0940 (trace Fe ₂ O ₃) calculated as potash alum	SO ₃ .. 0.2043
CaO...	0.2618	" CaSO ₄ " 0.3783
MgO...	0.0153	" MgSO ₄ " 0.0306
		" 0.7085
		Total SO ₃ found..... 0.6520
		Deficiency 0.0515

Imperial 72 Lbs.

Found.	Per Cent.	Per Cent.
SO ₃ ...	0.5939	
Al ₂ O ₃ ...	0.0840 (trace of Fe ₂ O ₃) calculated as potash alum	SO ₃ .. 0.1037
CaO...	0.2812	" CaSO ₄ 0.4017
MgO...	0.0561	" MgSO ₄ 0.1122
		" 0.6175
		Total SO ₃ found 0.5939
		Deficiency..... 0.0237

The calculations were made as follows:—

From the amount of alumina found the amount of potash alum present was calculated, and the sulphuric acid (SO₃) it would contain deducted from the total acid found. The amounts of sulphuric acid necessary to combine with the calcium oxide and magnesia found were also deducted from the total. We found in three cases out of four the amount of acid required to combine with all the bases was slightly deficient, possibly indicating the presence of a basic alum. In the case of the Imperial 140 lb., which we analysed twice with agreeing results, we can only suppose that there was an excess of alkali bases which we did not determine, as the paper and extract were basic to Congo paper. Although it is possible that alum, even when basic and present in small quantities, may act on certain colours, such as ultramarine, it would, in the absence of experimental data, be hazardous to express an opinion as to the nature and extent of such action.

THE ACID ACTION OF DRAWING PAPER OF DIFFERENT MAKES.

BY DR. P. NORMAN EVANS AND DR. QUIRIN WIRTZ.

In the proceedings of the Chemical Society of February 4, 1892 (Session 1891—1892, 20), an article appeared under the above heading by Professor W. N. Hartley, F.R.S.

On reading it we were surprised to find that the author had discovered free sulphuric acid in drawing papers manufactured by such celebrated makers as Whatman, Saunders, Hollingworths, and Arnold.

Papers of both old and recent manufacture are said to have contained free acid in spite of the well-known fact that the merest trace of free sulphuric acid will rapidly change cellulose into the brittle hydrocellulose, completely spoiling a paper containing it.

Professor Hartley further tries to trace the free acid to the souring of the materials after bleaching, and states that linen fibres,* even when steeped frequently in pure distilled water, persistently retain traces of free acid.

But how does such treatment as this compare with mill practice? This, as a rule, is somewhat as follows: after being soured with a little sulphuric acid the materials are circulated and washed with a large stream of hard spring water for about four hours, and thus any trace of acid that might otherwise be left in the fibres is neutralised. If we examine the reactions on which Professor Hartley bases his opinion that free acid is present in the papers that he examined; we find, as a well-known fact, that the two indicators, namely, litmus and helianthin, used by him show an acid reaction when brought in contact with pure potassium-alum. Now such alum is almost invariably used in sizing high-class papers with animal size, the object of its use, being to reduce the adhesiveness of the gelatine, on which also it acts as an antiseptic.

The question which we will next attempt to answer is this: Did not Professor Hartley mistake the alum reaction for that of free acid?

In order to answer this in a satisfactory manner we wrote to the manufacturers of Whatman's paper, and asked them to kindly send us some sheets of the same four qualities of paper as those which Professor Hartley had examined. These we tested as follows:—50 grms. of each of the papers was seven or eight times treated with boiling water until all soluble matter was extracted and no residue was left on evaporating a small quantity of the water. The extract so obtained was concentrated by evaporation and then made up with distilled water to 200 cc. Both the original dilute solution and the concentrated were found acid to litmus, but both were neutral to Congo red, which, as is well known, is unaffected by alum, but is turned blue by the smallest trace of free acid. As a further proof of the absence of free acid we determined the total sulphuric acid present in one portion of the concentrated extract, and evaporated another portion to dryness on the water-bath and

* The papers we examined contained more cotton than linen.

THE ACID ACTION OF DRAWING PAPERS.

BY C. F. CROSS AND E. J. BEVAN.

IN a recent communication to the Chemical Society (Proc. Chem. Soc. 1892, 19) Professor W. N. Hartley has called attention to the "acid action" of drawing papers. After examining representative specimens—chiefly "Whatman" papers—he arrives at the following conclusions:—

1. That the majority of papers of this class show an acid reaction. 2. That the acid reaction is due to the presence of free acid. 3. That this acid is sulphuric acid left in the "fibre" (rags) through imperfect washing after the process of souring. 4. That this conclusion from the results of analysis is supported by the observation of the difficulty of removing sulphuric acid from *linen* fibre by successive and exhaustive treatments with *pure* water.

It would occur to anyone familiar with the technology of paper-making that Professor Hartley was unaware that the details of manufacture render his conclusions in the highest degree improbable, and that therefore the evidence upon which they are based should have been proportionately unimpeachable.

To these conclusions, taken in order, we will oppose the results of our own experience in regard to these papers, which afford a much simpler and, *a priori*, more probable explanation of the acidity which Professor Hartley has observed.

1. The reactions of these papers, if and when acid to certain indicators, such as those employed by Professor Hartley, are *basic* to others, *e.g.*, methyl orange and Congo red. 2. That the apparent "acidity" is due to the presence of a *basic sulphate of alumina*, alum being an essential constituent of the mixture used in sizing these papers. 3. That in the making of the "Whatman" papers no free acid could survive the long process of washing of the soured rags. They are in fact treated for 3 to 4 hours in an "engine" with a continuous stream of the *exceptionally hard water* of the district (Maidstone). 4. In the "Whatman" papers *cotton* and not *linen* (flax) cellulose is the preponderating constituent.

To bring the matter, however, to a more direct experimental issue we procured samples of the following makes of "Whatman" paper, which were submitted to examination:—

1. Imperial.....	141 lb.	1891.
2. Imperial.....	72 lb.	1892.
3. Imperial.....	96 lb.	1892.
4. Double Elephant	133 lb.	1892.

These papers all showed a distinctly acid reaction with litmus and cochineal. The aqueous extracts from weighed quantities of the papers were titrated with standard alkali in presence of litmus as indicator; the results are given below, calculated to 100 grms. of the papers:—

1. Required to neutralise	1.3 cc. normal NaOH
2. " "	2.3 cc. "
3. " "	1.3 cc. "
4. " "	4.3 cc. "

With carefully neutralised solutions of *Congo red* and *methyl orange* on the other hand, the papers, as well as the aqueous extracts, gave a *distinctly basic* reaction.

Analysis of the aqueous extracts showed that they contained in each case a *basic sulphate of alumina*, and estimations of alumina showed that the quantities present were approximately in the ratio of the above results of titration.

Papers (1) and (4) were further treated with pure absolute alcohol. After evaporating the alcohol, the residues were treated with water, and the solutions, *basic* to *methyl orange*, were titrated with standard acid. Calculating the results on 100 grms. paper:—

1. Required to neutralise	0.6 cc. normal acid.
4. " "	0.5 cc. "

It is sufficiently proved by these results that the papers do not contain free acid; on the other hand, that they do

contain sulphate of alumina, but in the form of a *basic salt* with a ratio $\text{SO}_4 : \text{Al}_2\text{O}_3$; *certainly less than 5:2*. (Compare this Journal, 1886, 73; 1889, 253.)

We do not deny of course that papers *may* contain free acid, and it is not for us to say that the papers examined by Professor Hartley did not contain free acid. What is certain, however, and what we desire to emphasise, is that the *evidence* adduced by him being merely that of an *acid reaction*, is no proof whatever of the presence of free acid. We now suggest the only probable explanation consistent with the experience* of specialists, and with the results of examination of fair, trade samples of the particular papers which he has found to possess the serious defect in question, and Professor Hartley will no doubt take this suggestion into consideration in any further investigations on this subject.

We may now look a little more generally at the important questions opened up by the communication which we have found it necessary thus to criticise.

1st. Is the "acidity" of a sulphate of alumina more or less basic—which we take to represent a normal acidity of hard-sized papers—prejudicial to the permanence of pigments applied in the form of water colours to the paper containing this salt? The answer to this must come from those who have made a special study of pigments in relation to the conditions under which they have to struggle, so to speak, to retain their beauty unimpaired.

2ndly. Admitting for the moment that the condition of "acidity" does prejudice the life of pigments, is it in the power of the paper maker to suppress this acidity without prejudicing on the other hand the quality of his paper *quâ* paper?

To this question we can give an answer based upon experience. Most of the high-class papers made in the Kentish district are finished with a neutral or slightly basic reaction. There is every reason, *a priori*, why this should be so. The souring of bleached rags is an exceptional treatment, and, this excluded, the treatment which the rags undergo, *i.e.*, boiling and bleaching, are uniformly with alkaline or basic reagents. The alum of the size is then the only contributor of acid, and to its action is opposed, in addition to the basic residues from the above treatments, that of the exceptionally hard waters (14–20 grms. CaCO_3 per gallon) used in the manufacture—and we may reckon at the very lowest 5,000 gals. per ton of paper used on the machine—and also that of the soap, which is a usual ingredient of the mixture used in sizing.

Thus at Messrs. Joynson's mills, St. Mary Cray, where the process of souring the rags is seldom resorted to, the papers produced, including the drawing paper, finish with a neutral or slightly basic (to litmus) reaction.

At Messrs. Balston's mill, where the "Whatman" papers are made, the souring process is practised; but the condition of the subsequent treatments are so adjusted that the alum used in the sizing is reduced to the condition of a basic sulphate in the finished paper.

Our final conclusions are therefore these—

(1.) The "acidity" of drawing and other papers—when normally acid—is not due to the presence of *free acid*, but to sulphate of alumina, always more or less "basic," but with reactions which are acid to certain indicators.

(2.) That if shown to be a defect in relation to any uses for which the papers are intended, the acidity may be suppressed by the adoption of very simple expedients, without prejudice to the qualities of the papers.

DISCUSSION.

Mr. WM. THORP had not heard the original paper, and therefore was not fully informed on the subject. His experience had been that it was easier to get chemicals into fibres than to get them out. He had first encountered the question in the case of water analysis some years ago, when it had been necessary to free filter-paper from ammonia. He had passed many litres of water, free from

* The sum of the evidence adduced by Professor Hartley is the acid reaction *together with* precipitation of BaSO_4 on adding BaCl_2 to the aqueous extract. The *a priori* interpretation of this evidence should have been the presence of a sulphate having acid reactions.

ammonia, through a filter, and the ammonia was present in the filtrate to the end of the chapter. That led him to the conclusion that the ammonia was present inside the fibre of the paper, and required time for removal. The difficulty was overcome by soaking the filters for some days in water free from ammonia, then, on using them without drying, they imparted no ammonia to the filtrate. His remarks were made, not so much as a criticism of the paper, but as a hint to those present as to the difficulty of removing soluble substances from fibres.

Dr. SAMUEL RIDEAL thought that the authors' statements came rather late in the day. He was under the impression that the last numbers of the *Chemical News* and *Proceedings of the Chemical Society* contained a paper by another author, who stated that the presence of sulphuric acid was probably due to alum being present in the fibre of the paper. There was one point which had not been raised by the authors, and which was mentioned in the discussion on the original paper by Professor Hartley, namely, whether it might not have been possible that the papers had absorbed sulphuric acid from the air. That would exonerate the manufacturers, but at the same time render it possible for sulphuric acid to be present. He had been offered a sample of Whatman's paper, made in 1837, and he would be very glad to present it to the authors of the paper if it could be of any use to them.

Mr. JOSEPH ARNOLD, as a manufacturer of one of the papers mentioned, would like to state that no acid whatever had been used in the manufacture of his papers, they were simply made of linen and cotton rags washed in pure water, no acid, chlorine, or chemical of any kind being used. He could not, therefore, understand how Professor Hartley could find acid in his (Mr. Arnold's) paper.

Mr. W. F. ANDERSON, as one who had had a wide experience in making drawings, would like to say that he was always under the impression that drawing paper was made of linen, and cartridge paper of cotton. There was a very great difference between proper drawing paper and cartridge paper. He had known the size to disappear from the paper, and had in fact found that a roll of drawing paper invariably got spongy after 12 months, owing to that cause. Those who were makers of drawing paper would do well to look into that point. He did not know what the paper mentioned by Dr. Rideal made in 1837 could be. If he was right in his suspicions, it would be little better than blotting paper now.

Dr. RIDEAL thought it would be interesting to see whether the paper referred to contained any alum, *i.e.*, whether the sizing had been rendered anti-septic by the addition of alum. As the paper referred to had been exposed in a stable for 20 years, any sulphuric acid which might have been present would probably be found as ammonium sulphate.

Mr. R. GALLON explained that the reason why paper became spongy was that it was not kept properly. Paper was a most delicate substance to keep in working order, and after a few years the size would be affected by damp, and sponginess and spottiness would ensue.

Mr. BEVAN, in reply, said that with reference to Mr. Thorp's observation as to the difficulty of removing chemicals from fibre, he would like to point out that this difficulty chiefly applied to solutions of an alkaline nature. It was well known that it was extremely hard to remove caustic soda from cellulose, but it was a simple matter with acid. The process to which rags were subjected was much more drastic than any laboratory treatment. The rags were broken up until they formed almost a milk in the water. Referring to Dr. Rideal's remarks as to the possibility of the paper being acid on account of the action of sulphurous acid derived from coal-gas, if the facts were as he (Dr. Rideal) had stated, Professor Hartley ought to set the matter right, so as to exonerate the paper-maker. He (Mr. Bevan) presumed that Mr. Arnold's statement that no chemicals were used in the manufacture of his paper referred to the first treatment of the rags. He supposed

Mr. Arnold would not wish it to be understood that no chemicals were used in the sizing. (Mr. Arnold remarked that chemicals *were* used in the sizing.) He (Mr. Bevan) would point out that certain makes of paper, such as Joynson's, not only contained no free acid, but actually gave a slightly alkaline action to certain reagents.

EXPLOSIVE NITRATES FROM THE JUTE FIBRE.

BY C. F. CROSS AND E. J. BEVAN.

In a recent issue of *Dingl. Polyt. J.* **283**, 88, we read a communication by Otto Mülhäuser under the title, "Die Jute ein Rohstoff für Schiesswolle."

Following the appearance of this communication, we observe that the journal "*Industries*," 1892, 236, gives prominence to an abstract of the author's results under the title, "Nitrojute, a New Explosive."

Those who have studied the chemistry and chemical technology of the jute fibre will, with ourselves, be anxious to discover what Dr. Mülhäuser has contributed to the advance of either, or both.* The substance of the communication in question we take to be the quantitative study of some four preparations of the well-known explosive nitrates obtainable from this fibre. The conditions of "nitration" chosen were a comparatively long immersion in the nitrating acid, the composition of which (ratio $H_2SO_4:HNO_3$) was varied, as was also the proportion of acid to fibre. With the long exposure (3—4 hours) to the nitrating acid, there is, as the author states, a disintegration of the fibre bundles, and the nitration is attended by secondary decomposition and conversion into products soluble in the acid mixtures. These facts were fully described by ourselves some few years ago (*Chem. Soc. J.* **55**, 202), and from them we concluded that the highest yield of nitrate is represented by an increase of weight of 55 per cent., corresponding approximately with the formation of a tetranitrate of the *ligno-cellulose*, which latter we formulate for statistical purposes as $C_{12}H_{13}O_9$. In this product the general structural features of the original fibres are preserved. This high yield is only obtained with exposures of short duration: in fact, after 15 minutes' immersion at the ordinary temperature, decomposition is usually seen to ensue with liberation of gas and the appearance of nitrous fumes.

In Mülhäuser's experiments it is evident, from the conditions of the treatment and from the low yield of the products (130 per cent.), and from the disintegration of the fibre bundles, that such secondary decompositions took place, and that the products probably, therefore, approximate to derivatives of *cellulose* rather than of the *ligno-cellulose*, the more oxidisable "non-cellulose" or lignone constituents having suffered decomposition.

The author, in fact, regards his product as a *cellulose* pentanitrate— $C_{12}H_{13}O_5(ONO_2)_5$, but appears to consider it unnecessary to account for the intermediate steps by which such a product has been obtained from a compound cellulose (of the approximate formula $n.C_{12}H_{13}O_9$). We have suggested the above explanation on the basis of our own researches, and hope that it may receive due consideration in any further investigations which the author may carry out on the subject.

From the point of view of technological application, we have always failed to see any advantage in the lignified textile fibres as raw materials for explosive nitrates.

There are a large number of raw materials approximating more or less to a pure cellulose which can be obtained at from 10*l.* to 25*l.* a ton, and which will yield on treatment from 150 to 170 per cent. of explosive nitrate, superior in explosive power and stability to the products obtainable from jute *et similia*. In our opinion, therefore, the application of the latter is not within the range of practical consideration.

* Dr. Mülhäuser's views of the constitution of the jute fibre as a chemical individual are hardly reconcilable with our own (*Chem. Soc. J.* 1889, 666; 1882, 90; 1889, 199; *Chem. News*, 77)

On the other hand, there are certain raw fibrous materials which yield nitrates of very distinctive characteristics, *e.g.*, the Sunn hemp (*Crotalaria Juncea*) and the Madar fibre* (bast fibre of *Calotropis gigantea*). These certainly invite investigation, both from the scientific and practical point of view, and we hope that Dr. Müllhäuser will extend his investigations to include these and other raw materials, as also to clear up some of the points which he has left untouched in his study of the "nitration" of the jute fibre.

BETTING'S BALANCE.

EXHIBITED BY MESSRS. GROSSCURTH AND LUBOLDT.

This balance aims at two ends. One, securing greater accuracy by reason of non-exposure of the working parts during the operations of weighing. The second, preserving the weights from the inevitable wear and tear which constant handling entails, and also to facilitate the speed at which weighing can be performed.

The beam is stiffened in an upward direction, and the possibility of its bending reduced to a minimum. The planes are all of agate.

The weights are made to rest, when not upon the pan, on forked levers worked from the outside. The same method is employed for the riders, so that the minimum of exposure and the maximum of convenience are gained. A provisional specification has been filed.

Manchester Section.

Chairman: Ivan Levinstein.
Vice-Chairman: Edw. Schunck.

Committee:

J. Angell.	J. Grossmann.
G. H. Bailey.	P. Hart.
R. F. Carpenter.	A. Liebrmann.
G. E. Davis.	Sir H. E. Roscoe, M.P.
H. Grimshaw.	C. Truby.
Harold B. Dixon.	D. Watson.

Hon. Local Secretary:

J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Friday, February 5th, 1892.

MR. IVAN LEVINSTEIN IN THE CHAIR.

A DISCUSSION took place on the New Building Bye-Laws, 1890—1891, issued by the Manchester Corporation, in the course of which it was pointed out that annoyance and injury would be inflicted on those engaged in the chemical and allied trades if they were compelled to submit plans of apparatus and plant before erecting them. It was also contended that the word "building," as used in the bye-laws, was intended to refer only to public buildings, warehouses, shops, and residences, and not to chemical works

or the plant therein; and a desire was expressed to obtain an authoritative definition of the term "building" from the Corporation.

Finally the following resolutions were passed:—

1. "That, in the opinion of this meeting of the Manchester Section of the Society of Chemical Industry, annoyance will be caused and injury inflicted on all persons engaged in the chemical and allied industries if the bye-laws of the Manchester Corporation, 1890 and 1891, referring to new streets and buildings be interpreted by the Corporation as also applicable to plant."

2. "That the Chemical Section of the Manchester Chamber of Commerce be requested to consider the Bye-Laws of the Manchester Corporation of 1890—1891, referring to new streets and buildings, so far as the same affect the interests of those engaged in the chemical and allied industries."

ERRATA.

This Journal, 1892 (February Number), page 131, col. 1, 19 lines from bottom of page, after the word "moisture," insert the following:—"makes it appear probable that the action is one of oxidation. The following word "That," to begin a fresh sentence, as "That modification," &c.

This Journal, 1892 (January Number), page 8, col. 1, the last line should read:—

" „ „ unfiltered, &c."

Nottingham Section.

UNIVERSITY COLLEGE, NOTTINGHAM.

Chairman: L. Archbutt.

Committee:

F. Clowes.	E. W. Small.
J. B. Coleman.	H. J. Staples.
C. H. Field.	C. Taylor.
H. Forth.	Sir John Turney.
E. Francis.	J. T. Wood.
S. J. Pentecost	

Treasurer: J. M. C. Paton.

Hon. Local Secretary:

R. L. Whiteley, University College, Nottingham.

Meeting held at University College on Friday,
December 4th, 1891.

THE ESTIMATION OF SILICA IN CLAY.

BY L. ARCHBUTT, F.R.C., F.C.S.

DURING the last few years, at least two writers have called attention to errors inherent in the usual process for determining silica in silicates, errors which have not recently been discovered, but against which we have long been warned, but perhaps not sufficiently, by Fresenius at any rate.

George Craig (Chem. News, 60, 227) states that by fusing pure silica or siliceous matter with mixed alkaline carbonates, decomposing with HCl, and evaporating to dryness, not more than 97.5 per cent. of the silica can be found in the insoluble residue left on dissolving up, and this statement has led James P. Gilbert to make a number of experiments with silicates of different compositions, the results of which are given in a valuable paper to be found in the Chem. News, 61, 270 and 281.

Gilbert's experiments show that in the analysis of silicates containing Al_2O_3 , but which are practically free from CaO and MgO, dehydration, even at the high temperature of $280^\circ C$, will not prevent some milligrammes of the silica

* See Report on Indian Fibres by Cross, Bevan, and King, E. and F. N. Spon, 1887.

from passing into the filtrate, so that in accurate analysis the silica in the filtrate must *always* be recovered; and, secondly, that it is better to dehydrate at a temperature of 100° C., because the silica obtained is purer by dehydrating at that temperature than at higher temperatures, and quite as much is rendered insoluble.

As the presence of TiO_2 in clay makes it always necessary to volatilise the silica with HF after weighing it, the presence of a little more impurity is of no great consequence; and as silica cannot be prevented from passing into the filtrate, it seems best to estimate silica on a separate quantity of clay, and to estimate the other chief constituents in a portion of the clay from which all silica has been removed by treatment with HF and H_2SO_4 .

It has been pointed out by L. Smith (Fres. Quant. Anal., 7th edition, 1, 192) that the silica obtained by decomposing clay by means of KHSO_4 is liable to contain a large amount of impurity owing to the formation of a sparingly soluble double sulphate of Al and K, but 1 was not prepared to find that the silica obtained by this method is liable to be considerably below the truth.

The clays which were subjected to analysis contained SiO_2 from 46 to 53 per cent., Al_2O_3 from 21 to 24 per cent., Fe_2O_3 from 7 to 13 per cent., alkalis from 2 to 3½ per cent., H_2O (combined and moisture) from 8 to 10 per cent., with smaller quantities of TiO_2 , FeO , CaO , and MgO . 1 gm. of the clay, rubbed as fine as possible in an agate mortar, was fused for 2 hours with 10 grms. of pure KHSO_4 which had previously been fused till quite calm. The temperature during the whole time of the fusion was not higher than that required to maintain the contents of the covered platinum crucible quite fluid. The melt was then placed in cold water mixed with some H_2SO_4 , and left to dissolve. The insoluble residue was washed until the washings gave no precipitate with BaCl_2 even on standing, and the dried siliceous matter was ignited at the highest temperature of the muffle until constant in weight. The SiO_2 was then volatilised with HF and H_2SO_4 , and the residue was again ignited until constant in weight. The results obtained were as follows:—

No. of Sample.	Time fused.	Pure SiO_2	Residue left by HF calculated as per Cent. of original Clay.
		Per Cent.	
1	1 hour	50·65	4·0
1	2 hours	50·51	4·3
2	"	51·70	3·0
3	"	45·65	3·35
4	"	49·25	3·55
5	"	49·25	13·00
6	"	50·75	4·5

Wishing to obtain a confirmation of these results, I determined the SiO_2 in the first three samples by the mixed carbonates method carried out as follows:—1 gm. of the finely-powdered clay was fused with 5 grms. of pure mixed carbonates and a little KClO_3 . The fusion was extracted with water, decomposed with excess of HCl , and dried up over a steam-bath, the solution being stirred well just at the last to reduce the residue to small grains. The dish was covered with a clock glass and placed in the air oven at 150° C. for one hour. It was then allowed to cool, the residue was treated with 10 cc. of HCl (1·11 sp. gr.) and 20 to 30 cc. of water, and heated on the steam-bath for a short time in the covered dish, then dried down and again heated to 150° C. for one hour. The dry residue was now digested with 20 cc. HCl in the covered dish for half an hour at a gentle heat, then water was added, and the dish was heated on the steam-bath. Finally, the silica was filtered off, washed, dried, and weighed, after ignition at a high temperature till constant. The SiO_2 was then volatilised as SiF_4 and the residue was weighed.

The following results were obtained:—

No. of Sample.	Pure SiO_2	Residue left by HF and H_2SO_4 calculated as per Cent. of the Original Clay.
	Per Cent.	
1	51·15	0·45
2	51·75	0·45
3	45·65	0·95

It will be seen that No. 2 clay gave the same result by this method as by the KHSO_4 method; but Nos. 1 and 3 gave results from 0·5 to 0·7 per cent. higher. At this stage the work had to be set aside for several weeks, and, on resuming, it was thought desirable to try the effect of decomposing the clays by fusion with mixed carbonates and then evaporating with sulphuric acid.

It was decided, however, not to decompose the solution of the fusion at once with H_2SO_4 and evaporate, because, according to Gilbert, this leads to obtaining silica which is very bulky and gelatinous. The solution was therefore first evaporated to dryness with HCl , and then in the case of No. 1 clay 20 cc. of pure concentrated H_2SO_4 were added, and when the violent effervescence had ceased the lid was removed from the dish and the evaporation was carried on until H_2SO_4 fumes were evolved. The residual contents of the dish were cooled, treated with 20 cc. HCl (1·1) and some water, and digested hot for one hour, then filtered.

It was observed that the SiO_2 contained small lumps, which were not altered by heating with HCl . In the case of No. 2 clay, 25 cc. of sulphuric acid were added to the dry HCl residue, and when action had ceased, the rod and sides of the dish were rinsed down with water and the solution evaporated until H_2SO_4 fumes came off. In the case of No. 3 clay, the residue left by evaporation with HCl was first treated with enough water to dissolve up the KCl and NaCl , and then 20 cc. of pure sulphuric acid were added, by degrees, to avoid loss by the violent effervescence which occurred, and then evaporated till H_2SO_4 fumes came off.

The SiO_2 obtained in each of these experiments was lumpy. After filtering and washing, the filtrates were evaporated and again heated until H_2SO_4 fumes came off strongly. On dissolving up in HCl and water it was found in each case that a further small quantity of silica had been rendered insoluble. This further quantity was weighed separately in the case of No. 1, but in Nos. 2 and 3 it was added to the main quantity.

The following results were obtained:—

No.	Main SiO_2	SiO_2 out of Filtrate.	Total Pure SiO_2	Residue left by HF and H_2SO_4 calculated as per Cent. of Original Clay.	
				Out of Main Silica.	Out of Second Silica.
	Per Cent.	Per Cent.	Per Cent.		
1	50·52	0·89	51·32	1·4	0·05
2	..	..	52·73	0·84	
3	..	..	46·36	0·99	

It will be seen that these results are from 0·17 to 0·98 per cent. higher than the last, although dehydration had been effected by heating with H_2SO_4 . It seemed to me, therefore, that the reason why the KHSO_4 method first used had given low results might be due to the fact that the clays had not been ignited before fusion, and that the water which they contained had never been completely expelled at the temperature of the fusion.

To test this, 1 gm. of No. 1 clay was taken first heated to strong redness for 10 minutes, and then fused with KHSO_4 for 2½ hours at as high a temperature as could be obtained without driving off much H_2SO_4 . The fusion when cold was heated

with HCl (1·1) and water in about equal volumes, instead of treating with cold dilute H₂SO₄. This was done to try and obtain a purer silica. After filtering and washing the filtrate was evaporated with 20 cc. of pure concentrated H₂SO₄ and heated until fumes came off strongly for some time. This resulted in the obtaining of a little more silica, which was filtered off. The filtrate was evaporated a second time until H₂SO₄ fumes came off strongly, and again dissolved up. This time a mere trace of insoluble matter remained. It was, however, filtered off and the two recovered traces were weighed separately. The result obtained was:—

	Per Cent.	Per Cent.
Pure SiO ₂ (main quantity)...	50·96 plus a residue of	4·09
Pure SiO ₂ (from filtrates) ...	0·45 plus a residue of	0·05
Total pure SiO ₂	51·41	

It seems from these experiments almost hopeless to obtain by a single dehydration the whole of the silica, and I have therefore provisionally adopted the following method as being upon the whole the least troublesome and the most reliable.

The Process.

1. Strong ignition of 1 gm. of the finely powdered clay.
2. Fusion with 5 grms. of pure mixed carbonates.
3. Extraction with water (about 200 cc.), acidifying with HCl in good excess, and evaporating to dryness on the steam-bath in a porcelain dish, reducing the residue to small grains.
4. Heating the dish and dry residue in an air oven to 150° C. for 1 hour.
5. Dissolving up in HCl and water, filtering, and washing the silica.
6. Evaporating the filtrate with 20 cc. of strong H₂SO₄, till fumes are evolved *very strongly*. The acid will fume before it is fully concentrated, and the object to be aimed at is to heat till the acid is fully concentrated.
7. Dissolving up in HCl and water, filtering, and washing the additional small quantity of silica.
8. Igniting the mixed silicas at the highest temperature of the muffle until constant in weight. Then volatilising with HF and a few drops of H₂SO₄, and igniting the residue till constant in weight. The difference is pure SiO₂. The last three out of the six clays were treated in this way, but the recovered SiO₂ was weighed separately for information.

No.	Pure SiO ₂ (per Cent.)			Residue left by HF, calculated as per Cent. of original clay.	
	1st ppt.	2nd ppt.	Total.	1st ppt.	2nd ppt.
4	50·72	0·70	51·42	0·15	0·05
5	51·32	0·90	52·22	0·15	0·05
6	51·93	0·40	52·33	0·24	0·05

For easy comparison I have arranged the results in the following table:—

PERCENTAGE OF PURE SiO₂ OBTAINED.

No.	By fusion of unignited Clay with KHSO ₄ for 2 hrs. at temperature just high enough to keep the mass quite fluid.	By fusion of ignited Clay with KHSO ₄ for 2½ hrs. at higher temperature, and evaporating filtrate with H ₂ SO ₄ .	By fusion with mixed Carbonates and dehydration twice at 150° C. in the usual way.	By fusion with mixed Carbonates, dehydration once at 150° C., and heating filtrate with H ₂ SO ₄ .
1	50·65	51·11	51·15	51·32
2	51·70	..	51·75	52·73
3	44·95	..	45·65	46·36
4	49·25	..	..	51·42
5	40·25	..	..	52·22
6	50·75	..	..	52·33

It is evident from these results that sulphuric acid cannot be depended upon as a dehydrating agent for silica unless the evaporation be pushed to the extreme.

DISCUSSION.

Dr. CLOWES asked if any check experiments had been made with pure silica, and wished to know if the highest results obtained really represented the total amount of silica present in the clay?

Mr. WHITELEY asked if any other dehydrating agents had been tried besides pure sulphuric acid?

Mr. ARCHBUTT replied in the negative, and said that the results did not pretend to be any more than one of those incomplete investigations which not unfrequently had to be undertaken in the ordinary routine of laboratory work.

Dorsetshire Section.

Chairman: Sir James Kitson, Bart.

Vice-Chairman: Dr. F. H. Bowman.

Committee:

A. H. Allen.	J. Lewkewitsch.
W. Breditt.	C. Rawson.
T. Fairley.	Jas. Sharp.
A. Hess.	A. Smithells.
R. Holliday.	G. Ward.
J. J. Hummel.	T. Whitaker.

Hon. Local Secretary:

H. R. Procter, Yorkshire College, Leeds.

Notices of Papers and Communications should be addressed to the Hon. Local Secretary.

SESSION 1891—92.

1892:—

April 4th.—Annual Meeting.

Mr. Thomas Fairley. "On the Analysis of Coal-Gas for Impurities."

Mr. H. R. Procter. "On the Analysis of Gaubier." (II.)

Meeting held Monday, March 7th, 1892.

SIR JAMES KITSON, BART., IN THE CHAIR.

MEASURES.

BY SYDNEY LUPTON, M.A.

At first sight nothing seems more easy than for a Government to provide a uniform and accurate system of measures, and to render the use of it compulsory throughout its dominions. When we examine a little further into the matter, we cease to be surprised that all the labour and ability which has for so long been expended upon the subject has produced such very unsatisfactory results.

Our system of measures has gradually grown up by a series of survivals of what was considered to be the fittest, and ought in reality to be treated from an historical point of view. Want of time, and the fact that I am addressing those specially interested in the use of units as they now are, compels me to omit all historical and theoretical details, and many different kinds of measures such as those of value, time, and angles, and to confine my remarks to the more common measures of length, area, volume, mass or weight, density or specific gravity.

Two systems of measures only are so widely used as to require special discussion, the English or imperial system, and the metric or French system.

Speaking very roughly, the imperial measures may be said to be used more or less in Great Britain and Ireland, the British possessions, the United States, and to a small extent in Russia. In all these countries the metric system is permissive. The metric system is used throughout the continent of Europe, except in Russia and Turkey; in Central and Southern America, and in Japan. In all these countries survivals of older systems are used along with the metric. Outside these limits each country uses a special system of measures of its own.

Before we can usefully discuss the two systems, it is necessary to dwell in some detail upon three conditions which are universally present and affect all systems of measurement. They are (i.) temperature; (ii.) the pressure of the air; (iii.) gravitation, or the attraction of the earth.

(i.) Speaking generally, substances expand when they are heated, and therefore some definite temperature must be chosen at which our measures are to be made or to which they must be reduced by calculation.

In the English system 62° F., $16^{\circ}6$ C., or one-sixth of the distance between the freezing and the boiling point of water, has been selected. Considerable care and accurate thermometers are required to keep a body at this temperature for any length of time; on the other hand, it is so near the ordinary temperature of our rooms, that for rough purposes any correction may be neglected.

The standard temperature in the metric system is 0° C. or 32° F.; it is easily and correctly obtained for any length of time by the use of melting ice, but is so far from the temperature at which we live that considerable corrections must in most cases be made.

—	Δ	Coeff. Lin. Exp. for 1° C.	Exp. 0° to $16^{\circ}6$ C.
Brass	8.1	0.000019	0.00031
Bronze (Baily's metal)	8.4	0.00001774	0.0003
Iron	7.8	0.0000112	0.00019
Platinum	21.5	0.0000086	0.00014
Glass	2.5	0.000009	0.00015
Pine wood	0.56	0.000005	0.00008

—	Δ	Coeff. Cub. Exp. for 1° C.	Exp. 0° to $16^{\circ}6$ C.
Water	10	From 4° C.	0.00112
Mercury	136	0.00018	0.003
Platinum	215	0.0000257	0.00013
Air	0.0013	0.00367	0.061

(ii.) The second condition affects only the apparent mass of bodies. We live and work in an atmospheric ocean which exercises a pressure varying about a pound each way from a mean value of 14.7 lb. per square inch (1,033.3 grm. per sq. cm.) on every surface exposed to it. Solids and liquids are practically unaffected by this change of pressure, but the mass of a given volume of gas, such as the air itself, varies directly with the pressure upon it. The pressure of the air is measured by the barometer, that is, by the height of the column of mercury which balances it.

On the English system the standard height of the barometer is 30 in. at 62° F.; on the metric system, 760 mm. at 0° C. Hence the English standard is equal to $30 \times 25.4 = 762$ mm. of the metric standard.

When two bodies are counterpoised in a balance, each apparently loses a weight equal to the weight of the air which it displaces. So that the true weight of a body is its

apparent weight + the weight of the air which it displaces — the weight of the air displaced by the weights—

$$W = w + w \left(\frac{1}{\Delta_s} - \frac{1}{\Delta_w} \right) (a)$$

The weight (a) of a cubic centimetre of air at the temperature t° C. under a barometric pressure h mm. when the tension of aqueous vapour is v mm. and the attraction due to gravitation is g , is—

$$(a) = \frac{0.001293}{1 + 0.00367 t} \times \frac{H - 3 v/8}{760} \times g/g_{45}$$

The correction is usually a small one, amounting to the addition of 1.06 grm. when a litre of water is weighed against bronze (Δ 8.4) weights.

(iii.) The last condition introduces a small correction when masses are compared by a spring-balance at different places, or work is measured in units, such as foot-pounds or kilogramme-metres, which depend upon the attraction of the earth.

The attraction which the earth exercises upon a body is measured by twice the distance through which the body would fall freely towards it from rest in a second. This distance is usually measured in feet or metres, and symbolised by g . By comparing pendulum observations taken as far as possible all over the world, it has been found that g varies with the latitude. Each nation used to take the value of g in its own capital as the standard attraction of the earth, but the value of g at sea-level in latitude 45° has now been generally accepted as the unit. The value of g at any other place in latitude ϕ may be calculated from $g = g_{45} (1 - 0.00257 \cos 2\phi)$. If the place of observation be situated on a flat plain h metres above sea-level, g is further decreased by a coefficient $(1 - 0.0000002 h)$. The following table gives a few of the more important values of g at sea-level:—

$$g = g_{45} (1 - 0.00257 \cos 2\phi)$$

$$g_{45} = 32.1727 \text{ ft.} = 9.80606 \text{ metres.}$$

Approximate Place.	ϕ	g .
Equator	0°	0.99743
Bordeaux.....	45°	1.0000000
Paris O.	$48^{\circ} 50' 11''$	1.0003432
Lizard Point.....	50°	„ 4463
Taunton.....	51°	„ 5343
London S.O.	$51^{\circ} 29' 53''$	„ 5780
Tewkesbury	52°	„ 6217
Nottingham	53°	„ 7084
Leeds.....	$53^{\circ} 48' 20''$	„ 7776
Harrogate	54°	„ 7942
Newcastle	55°	„ 8790
Edinburgh	56°	„ 9627
Bremen.....	57°	1.0010453
Dunrobin.....	58°	„ 11266
Kirkwall	59°	„ 12065
Poole.....	90°	„ 25700

A pound weight true at Bordeaux would apparently weigh nearly $5\frac{1}{2}$ grains too much on a spring-balance in Leeds, and the work done in lifting a pound through a foot in Leeds is about 1.0008 of that done in performing the same operation in Bordeaux.

In each of the systems there are two fundamental units, that of length and that of mass:—

The yard is the distance between two fine lines cut on plugs of gold sunk in a bar of Baily's metal.

The pound is the mass of a cylinder of platinum marked P.S. This cylinder has the specific gravity 21.1572 com-

pared to water at 62° F. and displaces 0.40282 grains of standard air.

The metre is the length of a rectangular platinum bar known as the Metre des Archives.

The kilogramme is the mass of a cylinder of platinum known as the Kilogramme des Archives. ($\Delta 20.5487?$)

Both these metric standards are not very satisfactory, the platinum is of low and uncertain density and probably impure. The shape of the metre is not theoretically the best and it has been accidentally injured.

Numerous copies of these standards have been made to save the wear and tear of frequent reference to them.

Thus the brass commercial standard pound (W) ($\Delta 8.143$) has the same weight in vacuo as P.S. displaces 1.04706 grains of standard air and is assumed as the unit for all ordinary weights.

The brass commercial standard kilo. ($\Delta 8.206$) is used for a similar purpose in France.

From these fundamental units all the other subsidiary units are obtained; thus the acre is 4,840 square yards, and the hectare is 10,000 square metres.

The measures of volume would seem to follow naturally from the cubes of the measures of length, but in practice they are obtained from the measures of mass.

The gallon is the volume occupied by 10 lb. of water weighed in air against brass ($\Delta 8.143$) weights, understand at sea-level in London. It is nearly 0.16 of a cubic foot.

The litre is the volume occupied by a kilo. of water at 4° C. in vacuo; for all practical purposes it is a cubic decimetre. This close connexion between the measures of volume and length is a marked advantage in the metric system.

The so-called Mohr's litre, somewhat largely used by German men of science, is the volume occupied by a kilogramme of water weighed in air at 17.5° C. and 760 mm. against brass weights; it is about 1.00231 of a true litre.

The density of a substance is measured by the number of units of mass contained in the unit of volume of it.

The specific gravity of a substance is measured by the number of times it is heavier than an equal volume of some standard substance, usually water.

Owing to the relation between the kilo. and the cubic decimetre of water in the metric system, specific gravity referred to water at 4° C. and density measured in kilo. per cubic decimetre or grammes per cubic centimetre are expressed by the same number.

In the English system, specific gravity must be multiplied by 62.2786 (mass of a cubic foot of water) to obtain density in commercial pounds per cubic foot.

For technical purposes use is made of many hydrometer scales which give specific gravities referred not to water but to some other liquid too often entirely hypothetical. Three common examples may be mentioned.

Sykes' hydrometer, used in the English Excise, sinks to zero in "standard alcohol" which has a specific gravity of 0.825 at 60° F. The scale is marked with 11 divisions, and weights numbered from 10 to 90 can be added below the surface of the liquid. A table supplied with the instrument gives the proportion of "proof spirit" specific gravity 0.919 at 60° F.

The scale reading of Twaddell's hydrometer multiplied by 5 added to 1,000 gives the specific gravity referred to water taken as 1,000.

In Beaumé's scale for liquids heavier than water, the zero point is the density of water, while the specific gravity of a solution of 15 parts of salt in 85 parts of water is marked 15 ($\Delta 1.1116$), equal divisions are continued to 68 at the base of the rod ($\Delta 1.8425$).

In the metric system all multiples and sub-multiples of the unit are obtained by the use of 10 and its powers. The convenience of this method for working at sight or for using tables is enormous, but the multiplier is occasionally too large or too small for convenience, i.e., the foot is much more useful than the decimetre.

The English multipliers seem to have been chosen haphazard and the result is not satisfactory. A mile contains 1,760 yards and a yard 36 inches, it does not occur to every-one automatically that a mile contains 63,360 inches.

The relative advantages of each system may be briefly summed up as follows:—

Of the metric system:—

- (i.) Decimal multiplication and division.
- (ii.) Close connexion between measures of length, area, volume, mass, and density.
- (iii.) Standard temperature easily obtained.

Of the English system:—

- (i.) The foot and pound are found practically to be more convenient units than the decimetre and kilogramme.
- (ii.) The standard temperature is nearly the mean ordinary temperature, hence the reductions are small and may frequently be neglected.
- (iii.) Multiplication and sub-multiplication by 12 or 2 is often more convenient than that by 10.

One of the strongest and most effective arguments for the introduction of the metric system into France was the intolerable burden of the great variety of measures which it superseded. The same argument has not lost its force in England at the present time. Almost every petty town and every trade has its own special measures for the bewilderment of the learner and the confusion of the trader.

Many local measures seem luckily to be dying out, and there seems some hope that the 16 different acres which were in use in Great Britain and Ireland a few years ago may shortly be reduced to one. On the other hand, each trade seems to demand its own peculiar measures; thus, an imperial stone is 14 lb., a stone of glass 5 lb., a stone of meat 8 lb. in London, 10 lb. in Leeds, a stone of sugar or butter 16 lb., and a stone of hemp 32 lb.

Owing to the complication of our systems of measures but few children in our elementary schools progress in arithmetic beyond the tedious subjects of measures and money, and a very easy calculation shows that at least 500,000,000 working hours are annually wasted in elementary schools.

Trade customs also afford to the dishonest trader great assistance in fraud; a purchaser would expect a blanket 12 quarters wide to measure 9 feet; he finds by the custom of the trade it measures only 7 feet. A quarter being not 9 inches but 7. A further iniquity is the introduction into trade of "reputed" pounds or stones, which simply means that the purchaser buys paper at the price he is willing to give for tea or tobacco. In any individual retail transaction this seems a very small amount, but the true measure is the weight of paper used by the retail trader in a year. Each ton he has bought at 3d. a pound and sold as tea at 2s., has put 196l. of illicit gain into his pocket.

Everyone will probably admit that such trade measures and customs as the above ought to be absolutely and entirely abolished.

Three ways out of the difficulties of our present system seem to be possible, though each way bristles with difficulties:—

- (i) to adopt an entirely new system.
- (ii) to adopt the metric system with possibly some small alterations which would probably be accepted by those nations which now use it.
- (iii.) to keep as nearly as possible our present units, but to modify the sub-multiples and multiples, and to make the connexion with the metric system easy.

(i.) No one has yet been bold enough to propose an entirely new system of measures for general adoption. The C.G.S. system, which expresses all measures in terms of the centimetre, gramme, and mean solar second, has met with very limited acceptance, even among men of science, and in practice the Board of Trade unit, the 1,000 watt-hours, or 3,600,000 volt-coulombs, has invaded the very electrical sanctuary of the method.

For engineering purposes Rankine proposed the general use of the foot, pound, and second.

Both these systems, though good in theory, require the use of very small and very large numbers. We are more accustomed to think and speak of a week than of 604,800 seconds.

(ii.) Most men of science, who are habituated to the facilities of the metric system, desire at once to make it, with all its faults, universally compulsory.

I may quote for their consideration from Mr. Christolm's report to the Royal Commission in 1869, five slightly modified objections to the metric system, and add three others:—

- (a.) The metre and the kilogramme are not the scientific units which they profess to be, but only a definite length and a definite mass.
- (b.) The relation between the kilogramme and the cubic decimetre of water is *not* exact.
- (c.) The original metric standards are very imperfect in construction, and to a certain extent impaired by use. They are the absolute property of the French Government.
- (d.) Though the decimal division has great advantages, there are some counterbalancing disadvantages. Thus, while 10 is exactly divisible only by 5 and 2; 12 may be divided by 6, 4, 3, 2. And again, to weigh from 1 to 10 decimal subdivisions, five weights—1, 1, 1, 2, and 5—are required, while with binary subdivisions, five weights—1, 1, 2, 4, 8—will weigh from 1 to 16. Duo-decimal or binary division seem in some respects more adapted to the practical needs of the people, *e.g.*, mechanical engineers use the binary subdivisions of the inch.
- (e.) More than 30,000,000 of our present measures would have to be thrown aside as useless, and the cost of replacing them would be considerable. A large number of bottles, casks, &c. would have to be re-made.
- (f.) Though the metric system has been permissive in England since 1864, and in India since 1870, it has not come at all into practical use, which seems to show that the need is not equivalent to the trouble and cost of the change.
- (g.) The metric system has no units so practically convenient as the foot and the pound.
- (h.) The metric names are so cumbersome and pedantic that they must be changed before the system is introduced into England.

I believe that the opinion of men of business, on the other hand, is almost unanimously opposed to the introduction of the metric system.

Some may at once ascribe this opposition to the natural conservatism and obstinacy of the British mind, especially where trade customs are concerned. I prefer to attempt to investigate the causes which give rise to the feeling.

So far as measures are concerned, the operations of trade may be classed as manufacturing, internal, and external.

(a.) In the great majority of manufacturing operations proportions arrived at by trial and continually used are quite familiar to the workmen. In comparatively few cases does the master or scientific adviser arrive at theoretical results by the aid of the metric system and translate them for the use of the workman.

(b.) In the case of internal trade the manufacturer, wholesale dealer, and retailer soon becomes familiar with the comparatively few measures used in his own special branch, and gets over any difficulties of calculation by traditional rule of thumb or the use of tables. Unfortunately, as has already been pointed out, so far as the general public go, the legal maxim "*caveat emptor*" is only too true, and opportunities for fraud should be minimised by the abolition of trade customs. Were this reform strictly carried out, in retail trade at all events, experience in France does not seem to show the great superiority of the metric system.

(c.) External trade. Many of our Consuls abroad declare that we lose a good deal of export trade owing to supplying our goods of a length and weight not generally understood, and that we should sell more if the goods were packed according to the metric system. How far there is real ground for this suggestion is a matter for the careful consideration of traders; but an outsider would imagine that if the necessity existed each firm could for itself make the few changes required without waiting for the initiation of the Government. The mere conversion of English to metric measures is very easily accomplished by the aid of a table of multiples which can almost be printed on a visiting-card.

The total value of British imports and exports in 1890 is returned as 718,000,000*l.*; of which 340 millions were transacted with countries using British measures; 300 millions with countries using metric measures; and 108 millions with countries using special measures.

It does not seem that under any of these three heads there is great urgency for an immediate change.

(iii.) In conclusion it may be expected that I should attempt the impossible, and mention modifications which might render our present system more satisfactory.

The objects to be aimed at seem to be (a.) absolute uniformity throughout the Empire; (b.) decimalisation; (c.) convenient relationships between the different kinds of measures; (d.) easy conversion to and from the metric system.

Many proposals have been made, but none fulfils all, or even the greater part of these conditions. The first very slight reform, uniformity of measures throughout even Great Britain and Ireland, would probably be stoutly resisted by traders. We should no longer have the gallon divided into four quarts, but into also six wine bottles holding 11,666 $\frac{2}{3}$ grains of water each. The gallon of beer, 33/40 of the imperial gallon, divided into eight reputed pints, and so on.

If we assume that the foot and the pound are the most convenient fundamental units, to bring them into conformity with the metric system, each must be somewhat increased, and we have:—

MEASURES OF MASS.

1 New Pound = 1.10231 Old Pound = $\frac{1}{2}$ kilo.

	Value of New Weighs in		Of Old Weights in Old Pounds.
	New Pounds.	Old Pounds.	
Grain	0.0001	0.00011	0.000113
Dram	0.01	0.011	0.0039
Ounce	0.1	0.11	0.0625
Pound	1.0	1.1	1.0
Stone	10.0	11.0	14.0
Cwt.	100.0	110.2	112.0
Ton	2,000.0	2,204.6	2,240.0

The ton would be equal to the metric tonne, and the pound to half a kilo. Many of the existing weights could be utilised by slightly reducing them.

The changes required in the measures of the length are somewhat more considerable. According to Kupffer, the metre must be reduced by four parts in a million, that a kilogramme of water at 4° C. may occupy a cubic decimetre. Suppose this change universally accepted, and the foot taken as one-third of the metre.

MEASURES OF LENGTH.

1 New Foot = 1.09363 Old Foot = $\frac{1}{3}$ metre.

1 New Foot Square = 1.196 Old Foot Square.

1 New Foot Cube = 1.308 Old Foot Cube.

	Value of New Measures in		Old Measures in
	New Feet.	Old Feet.	Old Feet.
Yot	0.01	0.0109	$\frac{1}{3}$ " = 0.104
Inch	0.1	0.1093	0.083
Foot	1.0	1.09	1.0
Yard (metre)	3.0	3.28	3.0
Fathom	10.0	10.9	6.0
Chain	100.0	109.4	60.0
Furlong	1,000.0	1,093.6	690.0
Mile	10,000.0	10,936.3	5,280.0
League	100,000.0	109,363.0	15,840.0

Three feet would be a metre, and three furlongs a kilometre, the new mile would be rather more than twice the old one. The old inch, so widely known for engineering purposes, would be very nearly represented by eight jots.

The length of 3° or 180' of mean latitude on the surface of the earth is $180 \times 6,076 = 1,093,680$ old feet, or almost exactly 100 new miles. Hence if we return to the old definition of the knot as 1' of mean latitude, we have the simple relation 9 knots = 5 miles.

The old acre of four rods contained 10 square chains of 66 feet or 43,560 square feet. Though the change is considerable it seems best to derive the measures of surface directly from the squares of the measures of length.

MEASURES OF AREA.

	Value of New Measures in		Of Old Measures in
	New Square Feet.	Old Square Feet.	Old Square Feet.
Pole	100	119'6	272'25
Rood	100 00	11960'0	10890'0
Acre	1000 000	1196000'0	43560'0

The new acre would be equal to about 27'45 old acres and the new rood to 14'51 of an old acre.

The Fahrenheit should be replaced by the Centigrade scale of temperature, and efforts should be made to abolish the last traces of Réaumur. The standard temperature for scientific and accurate work should still be the melting point of ice, 0° C. As a subsidiary standard temperature for all ordinary purposes, 17° C. or 290° absolute would be a great convenience. Thermometers accurate at that temperature to 1° are now obtainable at a comparatively cheap rate, and there does not seem to be the same necessity which there used possibly to be for reducing say all barometric readings for meteorological purposes to 0° C. For all trade purposes, specific gravities referred to water at 17° C. are sufficiently near if taken in the laboratory without reduction.

The standard height of the barometer should be still taken about as 760 mm., but at 17° C. instead of at 0° C. This would be equal to 22'8 inches at 17° C., a small reduction of about 3 parts in 1,000 would have to be made in the normal masses of gases, and the coefficient of expansion would become 0'00345.

A cubic foot of water at 4° C. would weigh $2000/27 = 74'074$ lb.; but since a cubic foot of water at 4° C. becomes 1'001162 cubic feet at 17° C. and $\frac{2}{3}$ of a cubic foot of air at 17° C. weighs about 0'08 lb., a cubic foot of water would weigh at 17° C. in air against brass weights very nearly 74 lb. Hence specific gravities referred to water at 17° C. multiplied by 74 would give densities in commercial pounds per cubic foot.

Since a kilo. of water weighed in air at 17° C. occupies 1'002223 cubic decimetres, a true cubic decimetre under the same conditions weighs 997'78 grms.

The gallon or volume of 10 lb. of water in air against brass weights would contain 135'3 new or 305'4 old cubic inches, and might be divided into five bottles or quarts and 10 pints. If a similar definition were accepted in the metric system a quart would be a litre. The use of these measures should be restricted to *liquids*; coals, grain, fruit, and other solids in small pieces should be sold only by weight.

The following numbers show the relations of the new to the old measures:—

Old wine bottle $\frac{1}{4}$ gallon = 46'2 cubic inches.

Old quart.....	63'4	New quart...	61'1	Reputed quart.	57'2
Old pint	31'7	New pint	30'5	Reputed pint ..	28'6

The pharmaceutical fluid ounce contains 437'5 grains of water, the new fluid ounce would contain 770 grains. It would possibly, however, be better to follow the German example and make up prescriptions by weight. A scruple of 10 grains, rather less than half the old scruple, might possibly be convenient.

Specific gravity referred to water at 17° C. would be expressed by the same number as stones per gallon or pounds per pint.

According to the old measures at 0° C., a cubic foot of air weighed 0'080728 lb., and of hydrogen 0'005592 lb. To convert to the new measures at 17° C.—

$$\times \frac{(1'09363)^3}{1'06239 \times 1'1023} = \times 1'117$$

hence a cubic foot of air weighs 0'09016 lb., and of hydrogen 0'006246 lb.

For all practical purposes 100 cubic feet of air weigh 9 lb., and specific gravities referred to air at 17° C. multiplied by 9 give densities in lb. per 100 cubic feet.

DISCUSSION.

The CHAIRMAN opened the discussion by remarking that he found no difficulty in our present system in ordinary commercial transactions, but in dealing with countries using the metrical system great confusion arose. In a recent visit to America he found a 2,000 lb. ton was in use throughout the iron trade. He considered that there was no possibility of displacing the inch as the mechanical unit of length, the inch being used in India and the Colonies, United States of America, Mexico, South America, &c. At the same time, in fulfilling some French and Spanish contracts his mechanics had had occasion to use the metrical system, and he found that the English mechanic readily comprehends and works the system and finds it very convenient. He considered the adoption of the metrical system would greatly facilitate the comparison of prices, &c., but would have no great advantage in ordinary commercial transactions. He would strongly advocate two simple reforms, viz.:—

1. A 2,000 lb. ton.
- II. A 100 lb. cwt.

Dr. LEWKOWITZCH agreed with Mr. Lupton in condemning the hydrometer scales in use, Twaddell's degrees as meaningless, and Beaumé's several scales as entirely irrational.

He inquired why pounds should be preferable to kilos. He contended that in practice there was a greater liability to error by using the English measures (*e.g.*, converting pounds into quarters and hundredweights) than in the metrical system, where only the ordinary mistakes made in adding were possible.

The contention that the kilo. was not exactly what it pretended to be was merely sentimental; probably 100 years hence further research would show corrections to be necessary of which we had at present no knowledge.

With regard to the difficulty of effecting the change, he recollected the transition stage in Prussia; the system was first introduced in the schools, and was rapidly adopted in commercial circles.

So far as he had studied them in the short time allowed, Mr. Lupton's proposed measures appeared good. The idea of making the pound equal to half a kilo. was that adopted by the Zollverein in 1858, and this measure made the transition to the kilo. easier.

He would prefer to use 0° C. rather than 17° as the standard temperature, and so obviate the errors due to incorrect calibrations of a thermometer.

Mr. PROCTER suggested that the reason why the metrical system had not come into use was that it had not been taught largely in schools, although it was a legal (allowed) measure and of much greater importance than many of the extraordinary measures taught. By teaching the metrical system to children they would be able to compare the two systems and would doubtless become dissatisfied with our present measures. He would suggest as practical reforms that the names of the metrical units could be shortened, and the denomination written directly after the whole

number and before the decimal figures, to avoid errors in the decimal place, *e.g.*, instead of 13·576 kilos, write 13 k. 576, a method used in Germany.

Professor SMITHIELLS also remarked that the metrical system was too seldom taught, even in schools bearing a good reputation, and he seldom found a new student who had any real idea of the magnitude concerned. He thought the effect of teaching it, as opposed to our own irrational system, would be beneficial, the system being logical and concise, and therefore tending to clearness of thought. He believed the introduction of a new system would be largely dependent on philanthropic and public-spirited endeavour on the part of those anxious for the convenience of their fellow creatures and in the pressing exigencies of business.

He considered the use of "proof" spirit and irrational hydrometers by the Excise Department to be a disgrace to the country.

He thought certain reforms, such as the introduction of rational hydrometers, the doing away with the local variations of the stone weight, and the adoption of the 2,000 lb. ton, should be immediately attempted.

As to Mr. Lupton's measures, he doubted whether it would be easier to adopt them than the metrical system.

Mr. G. W. SLATTER, in reference to hydrometers, remarked that he had found them so faulty in graduation that he always used specific gravity flasks or the hydrostatic balance.

Mr. LUPTON, in replying, said that he had chosen 17° C. as his standard because for ordinary work this would involve no correction for temperature. When the standard was fixed at 0° C., there were no thermometers in the market sufficiently accurate for taking the ordinary temperature, whereas now a 5s. instrument would be exact enough for ordinary work.

The pound was proved to be a more practical unit than the kilo. The German "pfund" and French "demikilo." were more extensively used in retail trade than the kilo.

His scheme was merely a rough draft, and he was surprised that it had not been more severely criticised.

Meeting held in the Philosophical Institution, Edinburgh, on Tuesday, February 2nd, 1892.

PROFESSOR CRUM BROWN, D.Sc., F.R.S., IN THE CHAIR.

THE PROPERTIES AND MANUFACTURE OF CELLULOSE.

BY WALTER HODGEN, F.C.S.

CELLULOSE is a frank forgery of many of the auxiliaries of civilised life. Its existence depends on the closeness of its resemblance to what is scarce, and, in consequence, costly.

The methods necessary to produce so close a resemblance to the real article cannot be followed out without considerable cost, and it is necessary to bear in mind that the cheapness of really good articles in cellulose is only relative to the value of the originals. Of these latter, perhaps ivory is the most important, and the decline in the supply necessarily tells heavily in favour of this department of the imitative industry; and, certainly, no better substitute than cellulose has as yet been found. But, indeed, it may generally be stated, as the specimens exhibited will show, that many of the results obtained, besides ivory, such as tortoiseshell, coral, amber, &c. resemble so closely the article copied that only experts can detect the difference.

In the case of the imitations to which I have hitherto alluded, the material is in a hard state, but it is also made in a more pliable form, which is used extensively in the manufacture of collars and cuffs, resembling closely when well made those in linen, the appearance of the threads and stitches being effectively produced.

The discovery of cellulose is said to have been made by a Mr. Hyatt, Newark, United States, but a patent for a similar material was taken out by an English chemist, the late Alexander Parkes. There can be no doubt that the latter produced a material corresponding in every respect to cellulose, which he named "Parkesine."

Cellulose is made from cellulose, which having gone through a nitrating process is dissolved by suitable solvents and then dried. Cellulose being, therefore, the base of the manufacture, naturally comes to be considered first. It has been defined, in a few words, as "the residue from the exhaustive alternate treatment of vegetable tissues, with alkaline solvents and weak oxydants."

The substance of bleached cotton may be taken as the typical cellulose, the process of bleaching having removed the foreign substances with which the cellulose is associated in the plant. A neat and clean arrangement for the purpose of bleaching pulp is a good deal used by paper manufacturers and others in France, where, I may say, much of my practical experience has been gained. It is known as Hermite's electro-chemical process of bleaching, and a short description of the apparatus may be found interesting in this connection. The electrolyser consists of a bath made of galvanised cast iron. The negative electrodes are formed by a certain number of zinc discs upon two small rods or shafts, which turn round slowly. Between each disc are placed the positive electrodes, which are composed of platinum gauze fitted into ebonite frames, the platinum gauze being soldered to a piece of lead and perfectly isolated. Each frame or positive electrode communicates by the piece of lead with a bar of copper which traverses the electrolyser, and the contact is made by means of a nut and screw, so that each frame containing the platinum gauze can be taken out while the machine is working. The copper bar to which are fixed the positive electrodes is in communication with the positive pole of the dynamo. The current is distributed in all the platinum electrodes, from which it passes, through the medium used, to the zinc discs forming the negative electrodes, and thence to the negative pole of the dynamo. Each electrolyser produces in twenty-four hours of work a power of bleaching equal to 125 kilos. (275 lb.) chloride of lime at 33 per cent. chlorine, and requires 8½ horse-power. The liquor is a mixture of chloride of magnesium, common salt,

Glasgow and Scottish Section.

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Dr. G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1891—92.

April 5th (Glasgow):—

Mr. C. A. Fawsitt. "The 'Dry Heat' Vulcanisation of Rubber with Special Reference to the Use of an Improved Vulcaniser."

and caustic soda, and is pumped through the electrolyser until the liquor is strong enough for use, when it is allowed to flow over the pulp to be bleached.

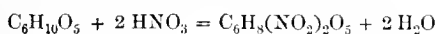
To turn, however, from the appliance to the material dealt with, cellulose has a specific gravity of 1.45. Its empirical composition corresponds to $(C_6H_{10}O_5)_n$, by which, together with its constitutional relationships, it is included in the group of carbohydrates. If examined through the microscope it will be found to be, when pure, a white translucent substance, but more or less opaque in the mass. It may be identified by its property of giving a blue reaction with iodine solution, in presence of, or after, treatment with dehydrating agents. When burnt—owing to the presence of mineral constituents—there is always an ash, however small, which usually takes the form of the original fibre. Another inorganic constituent, essential to the fibre under ordinary atmospheric conditions, is its hygroscopic moisture, or water of condition. The quantity usually present in cotton is 6 to 7 per cent., varying with the temperature and the dew point. Cellulose is a typical colloid, which, when fully hydrated, takes a gelatinous form. We are told that "in life there is a gradual and molecular dehydration of the tissues, and a progress from the gelatinous and amorphous condition to the specialised forms of maturity. Dehydration of a vegetable tissue, by exposure (after isolation) to air, but more especially by contact with alcohol, confers in a measure the properties which distinguish the fully elaborated cellulose and *vice versa*, the rehydration of the cellulose by artificial means may be regarded as in a limited sense the reversal of the process of growth."

Seeing that science has not yet found a direct practical means of rendering cellulose soluble, attention has therefore turned to nitrating the cellulose as a means to this end. True, cellulose has been dissolved by the ammonia-copper reagent (cupric hydrate in strong ammonia), in contact with which the fibre gelatinises, and finally disappears on complete solution. There is, however, no value in this as a practical method. Messrs. Cross and Bevan have, it is said, discovered a process of dissolving it, but no details of the process are available. The nitration process has, in consequence, been accepted as the only practical means of obtaining the desired object.

Pure cellulose, then, having been got in a suitable form, such as cotton or specially prepared paper, the manufacture now divides itself into three stages:—

- (1.) The production of the pyroxylin.
- (2.) The treatment of this compound with solvents in order to make it plastic.
- (3.) The drying process.

First, then, the *Production of the Pyroxylin* is accomplished in the following manner:—To avoid weakening the mixed acids more than is necessary and increasing the temperature, the cellulose must be as dry as possible. This having been seen to, the material is now ready for the conversion process. The nitrating shed is fitted with acid-mixing tanks, reservoirs for stocks, pots for the nitrating process, and washers. Weighed quantities of the cellulose are plunged into the mixed acids contained in earthenware pots. Nitric acid of moderate strength is used (1.38 to 1.45 sp. gr.) so as to avoid the formation of higher nitrates, the dinitro-cellulose being what is wanted. Sulphuric acid of 1.68° Tw. is employed. The temperature is from 70° to 90° F., according to the state of the acids. After about 20 to 30 minutes the cellulose is chemically converted into pyroxylin or nitro-cellulose, water being at the same time formed in the reaction—



The mixed acids are now run off and the pyroxylin allowed to drain for a minute or two, after which hydraulic pressure is employed so as to squeeze out as much of the acids as possible, these being valuable for future use when brought up to the necessary strength. The cake thus formed is then taken to washers arranged so as to break it up quickly, after which it is thoroughly washed in clear water in a succession of tanks. Bleaching—the next process—is done, either with chloride of lime or permanganate of potash. The water is allowed to drain off, and the

pyroxylin is further freed from it by a hydro-extractor, after which it is chopped into small pieces and the rest of the water got rid of by hydraulic pressure.

(2.) *The Treatment of the Pyroxylin with Solvents.*—Pyroxylin is not soluble in alcohol alone, but is readily soluble in a mixture of alcohol and camphor, and this is the solvent generally adopted. A mixture of this is therefore made and sprinkled over the pyroxylin in close boxes, the solvent being sparingly used on account of the cost. Having been allowed sufficient time to soak thoroughly into the mass the product is cut out of the boxes in pieces, and placed on rollers gently heated. Here it undergoes, thoroughly, a kind of kneading process, until it is uniform, when it is cut away from the rollers in sheets of the desired size and thickness. This process goes on until a sufficient number of sheets is obtained, when they are piled one above the other, and the whole pressed into a solid block by means of a hydraulic press. The block thus formed is next taken to a planing machine, specially constructed and beautifully adjusted, so that a sheet may be cut from the solid block of celluloid as thin as note paper. On this machine the block is placed and cut up into the thickness required, whether it be thin sheets for the manufacture of imitation linen, or thick ones for knife handles or other purposes.

(3.) The third and last process, that of *Drying the Material*, may be described in a few words. The sheets having been cut are placed in a heated chamber, where they are allowed to remain from one day to six months, according to the thickness and nature of the stock. When ready the celluloid is worked, by means of intricate machinery, as well as by the more ordinary methods of carving, turning, and moulding, into an endless variety of articles of both beauty and use.

As regards the colouring and markings, it is sufficient to say that they are the results of elaborate experiments and processes which are jealously safeguarded as secrets of the industry.

It may be added in conclusion that celluloid has a specific gravity of from 1.30 to 1.45, according to the degree of pressure to which it is subjected and the quantity of pigments in its composition. It is not affected by weak acids, and is water- as well as air-proof.

DISCUSSION.

DR. J. R. PATERSON said that he would like to ask the following questions, viz.:—If the production of the article to imitate ivory was a secret? If the substance was easy to work on the lathe? Did it work as well as vulcanite? And if any efforts had been made to obtain a solvent that would do away with the smell of the article?

THE CHAIRMAN asked if when the gelatinous mass was made into such a cake as that shown, it shrunk much in the process of drying; and if the manufactured article got softer as it got older, for as it smelt strongly of camphor it was bound to be continually losing that commodity?

MR. E. C. C. STANFORD said that they were very much indebted to the author for this paper if it were only from the fact that there could be so few chemists who knew anything about the manufacture of celluloid. He supposed there was no doubt that it really was a mixture of collodion and camphor. One great drawback it had was its inflammable nature. Some time ago, one of the principal American manufacturers of this article (he believed there was only the one manufacturer in the United States) wrote to him sending some fine samples, one of great transparency, and he said he could introduce the article very largely for windows, &c., which could not be broken; but the one great difficulty he had was that if you put a candle to it the whole thing burst into flames. He wanted to know if some method could not be adopted to prevent that? He (Mr. Stanford) would therefore like to ask Mr. Hogben if this substance could not be denitrated, for if it could, then it would be a most valuable article for many things. He would call particular attention to the imitation of ivory

shown, because that was one of the most difficult things to imitate, as it was produced by successive layers of natural growth, and the sample was beautifully done.

Dr. A. P. AITKEN asked if celluloid was harder than horn.

Mr. W. I. MACADAM said he had seen some celluloid balls, similar to the sample shown, which on standing in a shop window had completely collapsed.

Mr. J. LAING asked if bottles had been manufactured from this material, and if it would be suitable for lining trunks. Also what was the size of the largest sheet made, and if the sheets could be joined together.

Mr. HOBGEN, in reply to Mr. Paterson, said (1) the imitation of ivory was a secret; (2), the substance was easily worked on the lathe; and (3) a solvent had been obtained to do away with the smell, but there were practical difficulties attending its use. With reference to the Chairman's questions—(1), the gelatinous matter did shrink until it was dried in the stoves; and (2) yes, the manufactured article got harder as it got older. In regard to Dr. Aitken's question, celluloid was harder than horn. As to Mr. Macadam's statement about the balls he had seen collapsing, perhaps the reason of this shrinking was that they had been made too thin. Then, in reply to Mr. Laing, bottles had not been made from celluloid, but he fancied it would be quite suitable for the lining of trunks, if its inflammability were not an objection. The largest sized sheets that were made were 4 ft. long \times 20 in. wide, and these could easily be joined together. Lastly, in reply to a question by the Chairman, he said that it was only a thin layer of celluloid that was put upon billiard balls.

Meeting held at the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, March 1st, 1892.

MR. E. C. C. STANFORD IN THE CHAIR.

THE LATE PROFESSOR DITTMAR.

THE CHAIRMAN said that since their last meeting the hand of death had again been busy among them, and had taken from their midst their valued friend Professor Dittmar. He need not say that in his death they had lost not only one of their colleagues, but a man of eminent position in science, and the committee had prepared the following resolution, which they proposed to transmit to Mrs. Dittmar:—"The Committee of the Scottish Section of the Society of Chemical Industry hereby record their deep sense of the great loss the Society has sustained by the death of their late colleague, Professor Dittmar, a loss which will be felt wherever the science of chemistry is known. They desire to express their sincere condolence and deep sympathy with his widow and family in their affliction."

THE PREPARATION OF PURE PHOSPHORIC ACID FROM PHOSPHATE OF SODA, WITH AN ACCOUNT OF SOME EXPERIMENTS ON THE PHOSPHORUS-NITRIC ACID METHOD OF MANUFACTURE.

BY GEORGE WATSON, F.C.S.

Pure phosphoric acid is a substance used to a certain extent in pharmacy, constituting, as it does, one of the ingredients of metallophosphatic syrups of various kinds. The acid, usually sold for the preparation of these syrups, is a thick colourless liquid of a sp. gr. of 1.750, containing about 89 per cent. of orthophosphoric acid. It must conform to all the tests of the British Pharmacopœa, that is to say, it must be free from notable quantities of lime, iron, magnesia, or other basic substances. It must not coagulate albumen or produce a precipitate when warmed with mercuric chloride solution. Neither may it contain nitric or sulphuric acids, and it must be absolutely free from arsenic.

It is commonly prepared, so far as I am aware, from yellow phosphorus, but as this latter substance is itself made from crude phosphoric acid by means of carbonaceous reduction, it is evident that the preparation of pure phosphoric acid from phosphorus, viewed in conjunction with the phosphorus manufacture, is essentially its preparation from crude phosphoric acid, the intermediate production of phosphorus being simply a method of eliminating the various impurities inherent in the crude acid.

As phosphorus is a somewhat expensive article, however, although less so now than formerly, the possibility of doing away with its use and of preparing the pure from the crude acid by some cheaper process, naturally suggests itself.

Some years ago, therefore, I made some experiments with this object, and although I was unsuccessful in working out a paying process, yet as I had also carried out some experiments on the phosphorus-nitric-acid method of manufacture, I thought a description of the whole might be of interest to the Section.

After several abortive trials, which it is needless to describe minutely, such as the lixiviation of "superphosphate" with methylated alcohol, the ignition of ammoniac phosphate, the boiling of ammoniac phosphate with hydric nitrate and with "aqua regia," it occurred to me that in the treatment of sodic phosphate with hydric chloride, there existed a reaction which was somewhat hopeful. For hydric chloride, in its affinity for bases, is, at ordinary temperatures, one of the most powerful acids known, while hydric phosphate is a relatively weak one. On consulting tables of the relative affinities of acids it is seen that the strengths of these two acids are in the ratio of 1 to 0.25. In other words, if, for example, a formula weight of monosodic phosphate in dilute aqueous solution be mixed with a formula weight of hydric chloride, the soda divides itself between the two acids in proportion to their affinities. If the amount of base existing as chloride when equilibrium is attained be represented by the symbol "*a*" then the total amount present being one equivalent, $1-a$ represents the amount retained by the hydric phosphate, and the ratio $\frac{a}{1-a}$ is a measure of the relative strengths of the two acids. In the case under consideration this ratio is equal to $\frac{1}{0.25}$, from which the value of "*a*" is found to be 0.80, or 80 per cent. of the soda now exists in solution as chloride. Further, as sodic chloride is practically insoluble in a saturated solution of hydric chloride, then by saturating the solution with this gas, one would expect to have all the dissolved sodic chloride precipitated, and the relative amount of hydric chloride being simultaneously much increased a further decomposition of the remaining 20 per cent. of sodic phosphate might be expected to take place, resulting in the liberation of an increased proportion of hydric phosphate. As the use of dilute solutions, however, was out of the question on the ground of economy,

my first practical experiments were confined to gassing melted crystals of disodic orthophosphate with hydric chloride. A preliminary experiment, in which 4 lb. of pure disodic phosphate, mixed with a little water, were used, showed that the soda was virtually all separated by this treatment; the resulting liquor on draining off from the sodic chloride being found, on analysis, to contain soda equal to only 0.705 per cent. of the syrupy hydric phosphate (sp. gr. 1.750) actually present. I then proceeded to try the process on a larger scale, the following being a few typical experiments.

Thus, 65 lb. of pure disodic phosphate, melted and gassed with hydric chloride, weighed after saturation 90 lb. On settling, syphoning and draining off the clear supernatant, 48 lb. of liquor were obtained, which on evaporation gave 12 lb. of syrupy hydric phosphate, corresponding to a yield of 60 per cent. of the theoretical amount. The acid was found, on testing, to be quite free from all impurities with the exception of a small amount of soda similar to that mentioned above.

Another experiment, in which 63 lb. of sodic phosphate were used, absorbed 24 lb. of hydric chloride, while the liquor, drained off from the precipitated sodic chloride, weighed 53 lb. On evaporation of this liquor 13½ lb. of syrupy phosphoric acid were obtained corresponding to nearly 66 per cent. of the theoretical quantity.

In the next trial the proportion of hydric chloride was increased. To 67 lb. of melted sodic phosphate crystals were added 20 lb. of pure aqueous hydric chloride (sp. gr. 1.160), then the whole saturated with hydric chloride gas as before. Of this, 23 lb. were absorbed, an amount almost identical with that absorbed in the previous trials. On draining off, 80 lb. of liquor were got, giving, on boiling up, 15 lb. of hydric phosphate, equal to a yield of about 75 per cent.

Another experiment was then made in the following way: 70 lb. of sodic phosphate were melted and saturated with hydric chloride as before, the amount absorbed being 29 lb. while the liquor drained off amounted to 56 lb., and gave on evaporation 14 lb. of hydric phosphate, or two-thirds of the total amount obtainable. The residual salt was then digested with one gallon of water for a few hours. This liquor on draining off weighed 13½ lb. On saturation with hydric chloride it weighed 16½ lb., and gave 2 lb. of syrupy hydric phosphate. On digesting the original salt with a second gallon of water, 17½ lb. of liquor were produced, absorbing 4 lb. of hydric chloride gas and giving 1½ lb. of hydric phosphate, the total yield being thus equal to 81 per cent. of the theoretical.

In the two experiments first described, the weight of sodic chloride produced, supposing all the hydric phosphate to have been liberated, is 22½ lb., while the weight of liquor obtainable, if the sodic chloride had been obtained anhydrous, should have been 69½ lb. The difference between this weight and the mean weight of liquor actually drained off is therefore 19 lb. As this seemed a large amount of liquid to be held by 22½ lb. of sodic chloride, I was inclined to believe that a considerable portion of the sodic phosphate was not decomposed, but was simply thrown down as monosodic phosphate.

Consequently I then proceeded to examine the reaction more carefully on a small scale, using, instead of crystallised disodic phosphate, anhydrous sodic pyrophosphate and digesting it with definite weights of pure aqueous hydric chloride.

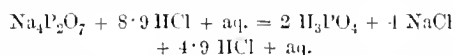
The sodic pyrophosphate used was made from the ordinary pure disodic phosphate of commerce by a further threefold crystallisation. The purified crystals obtained were then melted, filtered through paper, and the filtrate evaporated to dryness. The residue after powdering was then ignited, in successive small portions, to a red heat for about an hour. The hydric chloride used was prepared by distilling ordinary pure analytical acid and bringing the distillate up to the requisite strength by bubbling in well-washed hydric chloride gas. It was found, by alkaline titration, to contain 40.736 grms. of hydric chloride per 100 cc., measured at 12° C., while the specific gravity at the same temperature was 1.176, thus indicating 34.63 per cent. A specific gravity determination at 15° C. gave 1.174,

which from Kolb's table is equal to 34.45 per cent. of hydric chloride.

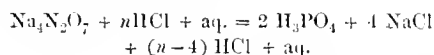
In carrying out an experiment, the pyrophosphate was always again ignited just before weighing out, and while still warm was again ground in an agate mortar. A weighed quantity was then placed in a dry stoppered bottle, a definite quantity of hydric chloride run in, and after inserting the stopper the whole shaken up at intervals and allowed to stand a prescribed time.

In the first experiment 10 grms. of pyrophosphate and 40 cc. hydric chloride were digested together for 24 hours, then the liquid filtered off through a funnel plugged with glass wool into a ½ litre flask, and the residual matter washed with methylated alcohol until acid free. The filtrate was then made up to the mark with water and the hydric phosphate estimated in 20 cc. by "magnesia mixture," after having boiled it for 30 minutes to ensure that all the pyrophosphoric acid was converted into the ortho form. The precipitate obtained weighed 0.3337 grm., equivalent to 7.365 grms. of hydric phosphate in the ½ litre. The total amount of hydric phosphate obtainable from 10 grms. of sodic pyrophosphate being 7.368 grms., this result is equal to 99.95 per cent.

Experiment No. 2 was similar to the above in all respects saving that 30 cc. of hydric chloride were used instead of 40 cc. The precipitate obtained from 20 cc. weighed 0.3356 grm., equivalent to a total of 7.407 grms. of hydric phosphate, or 100 per cent. The result of this experiment may be expressed symbolically as follows:—



or as a general expression representative of the complete decomposition of sodic pyrophosphate by the minimum of hydric chloride; we have—



in which n = a number less than 8.9. Other three experiments were then made to ascertain the value of n .

Experiment No. 3.—7.4215 grms. of pyrophosphate and 11.636 grms. of hydric chloride were digested 48 hours. As in this case, however, there might not be a sufficient excess of hydric chloride to prevent some of the sodic chloride from going into solution, 50 cc. of methylated alcohol were added before filtering off, the liquid being then filtered through paper into a litre flask, and the residue washed acid free with alcohol as before. The filtrate was then made up with water to the mark, and 50 cc. taken for the determination of hydric phosphate. The precipitate weighed 0.2225 grm., equal to a total of 3.929 grms. of hydric phosphate in the litre, or a yield of 71.811 per cent.

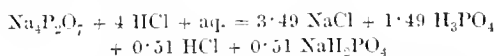
Experiment No. 4.—10 grms. pyrophosphate were digested with 17.5 grms. hydric chloride for 48 hours, diluted with alcohol, filtered off, and the filtrate made up to a ½ litre. The precipitate obtained from 20 cc. weighed 0.2955 grm., equal to a total of 6.522 grms. of hydric phosphate, or 88.518 per cent.

Experiment No. 5.—In this experiment 10 grms. of pyrophosphate were digested with 16 cc. hydric chloride for 66 hours, then diluted with alcohol and treated as before, the filtrate being made up to a ½ litre. The estimation of hydric phosphate in 20 cc. gave a precipitate weighing 0.3315 grm. equal to 7.317 grms. of hydric phosphate in the ½ litre or 99.348 per cent.

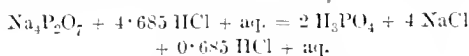
In experiments Nos. 3 and 4, an interesting relation between the hydric phosphate set free and the hydric chloride required for its liberation exists, which enables us to calculate the value of n . Thus in experiment No. 3, the weight of anhydrous hydric chloride contained in the 11.636 grms. of aqueous acid taken is 4.0190 grms. If from this weight there be subtracted the weight of dry hydric chloride required to combine with half the soda in the 7.4215 grms. of pyrophosphate (*i.e.*, the amount necessary to transform the normal sodic pyrophosphate into disodic pyrophosphate or possibly monosodic ortho-

phosphate) there is obtained the number 1·9823. Multiplying this by 2 gives 3·9646, a number practically identical with the weight of hydric phosphate found to be liberated (3·929 grms.). From this experiment it is seen that the hydric chloride acts with two functions: firstly a portion is used to saturate half the soda in the pyrophosphate, then the remainder acts on the resulting salt and sets free twice its weight of hydric orthophosphate. Examining experiment No. 4 in the same way, a similar result is arrived at. Thus deducting from the weight of hydric chloride used (6·0444 grms.) the weight required to combine with half the soda of 10 grms. pyrophosphate (=2·7443 grms.) there is obtained 3·3001, which multiplied by 2 gives 6·6002, a number virtually identical with the weight of hydric phosphate bound to be liberated (6·522 grms.).

Assuming then this relation to hold for all quantities of hydric chloride, and calculating the least weight necessary to completely liberate the hydric phosphate from 10 grms. of pyrophosphate, there is obtained 6·4283 grms. of dry hydric chloride which is equal to 15·8 cc. of the aqueous hydric chloride, used in these experiments. In experiment No. 5, 16 cc., or only 1·3 per cent. more than this, was found to liberate all the hydric phosphate from this weight of pyrophosphate, so that the statement made may be taken as true. The following equation represents therefore the final distribution of matter when equivalent weights of sodic pyrophosphate and aqueous hydric chloride are digested together at the ordinary temperature under the conditions specified:—



while the expression representing the complete decomposition of the pyrophosphate by the minimum of hydric chloride is—



The symbol "aq." signifies, of course, the amount of water contained in the aqueous hydric chloride.

This reaction was not found to constitute a paying process for the manufacture of phosphoric acid. The washing out of the acid retained by the salt by means of alcohol was inadmissible, while the use of hydric chloride solution for this purpose would have led to the necessity of considerable evaporation and the recovery of the hydric chloride used if the costs were to be kept within reasonable limits. Further, it was found that the sodic phosphate had to be quite free from sulphates, otherwise the soda was not completely separated. The sodic sulphate thus left in the syrupy acid had, when in small quantities, the effect of imparting a gelatinous consistency to it, while in some cases when the amount was larger the acid became quite solid on cooling. In other cases again the acid was apparently all right when at first prepared, but on standing for some days it became milky from the separation of sodic sulphate. This precipitate of sodic sulphate took a long time to settle, and the separation not being complete the clear supernatant acid had always a gelatinous appearance. Only when the sodic phosphate was quite free from sulphate was the acid suitable.

The practical experiments described above were made in the early part of the year 1888. After they had been completed there appeared in the Chemical Society's Journal, 54, 321, an abstract of a paper by A. Bettendorff, published in the Zeits. Anal. Chem. 27, 24—26, in which this reaction is made use of for the detection of sodium in glacial phosphoric acid. According to this chemist 98·5 per cent. of the sodium of sodic pyrophosphate is separated as chloride on digesting the pyrophosphate with aqueous hydric chloride of 1·19 sp. gr. He also suggests this reaction as a convenient method of preparing hydric phosphate directly from sodic phosphate. I find also that a similar process has been proposed by A. Joly (Compt. Rend. 102, 316—318) in the case of monammonium phosphate, the liquor obtained, however, after separation of the ammonic chloride, being heated by him with successive

portions of hydric nitrate in order to complete the expulsion of the remaining ammonia as well as the hydric chloride.

I have now to describe the experiments made on the phosphorus-nitric-acid method of manufacture. As this is an oxidation process, however, it may be of interest to review shortly, in the first place, the results obtained by other chemists on the oxidation of phosphorus by various means.

Phosphorus is not so easily oxidised into the state of pentoxide, or of hydric phosphate as one might imagine from its great inflammability. It is true that when burned in abundance of air or oxygen, the pentoxide is the only final product, but when it is burned in a confined air space, as, for example, under a bell-jar, a considerable amount of the trioxide is also produced in addition to a certain quantity of the suboxide P_2O_3 . (See also this Journal, 1885, 574, et seq.).

Thorpe and Tutton have shown (Trans. Chem. Soc. 57, 545—573) that when phosphorus contained in a combustion tube is burned in a comparatively rapid current of air, in addition to the formation of the suboxide, a certain quantity of the trioxide is also formed, the oxidation being, however, under the conditions of their experiments, a relatively feeble one, if compared with that taking place in the open air. On the other hand, according to the same chemists, phosphoric oxide is the only oxide formed when phosphorus glows in the air at the ordinary temperature (Chem. Soc. Trans. 49, 833) while they also prepared from the products of the slow oxidation of phosphorus in dry air an oxide of the formula P_2O_4 (*loc. cit.*). This oxide they consider to be the true tetroxide of phosphorus, and not the anhydride of hypophosphoric acid ($\text{H}_4\text{P}_2\text{O}_6$) obtained by Salzer, by the slow oxidation of phosphorus partially immersed in water.

Again, J. Corne (J. Pharm. Chim.), by heating phosphorus to 75° C. in a solution of cupric nitrate, found that hypophosphoric acid was formed while J. B. Senderens (Compt. Rend. 104, 175—177) states that amorphous phosphorus when heated with solutions of argentic or cupric nitrates gives in the one case a precipitate of silver, in the other a precipitate of copper phosphide, the phosphorus being at the same time oxidised into hydric phosphate.

It is also known, that on dissolving yellow phosphorus in dilute hydric nitrate, a certain amount of hydric phosphite is produced which amount is greater at the initial stages of the solution (Fresenius' Qual. Analyses, 9th ed., 176), but no determinations of the relative proportions of the two acids seem to have been made. I therefore thought it would be of interest to examine this point.

For this purpose a flask of about 1 litre capacity, having a short, thick walled neck, was taken, and a glass condensing tube of about three feet in length and three-quarters of an inch bore fitted to it by grinding. An indefinite weight of yellow stick phosphorus (usually about 60 grms.) was then placed in the flask and 500 cc. of dilute hydric nitrate run in. The condensing tube was then inserted, and the contents heated up till the reaction was started, the reaction being then kept going for the prescribed time, external heat being used when necessary. The phosphorus used was a good sample of commercial stick phosphorus, containing a little arsenic, and the hydric nitrate used was prepared by distilling pure analytical acid and diluting the distillate to a sp. gr. of 1·223. A titration of this acid with standard soda showed that it contained 35·77 per cent of HNO_3 . This acid was used in experiments Nos. 1, 2, and 3, while in the remainder weaker acids made from it by dilution were used. At the end of an experiment the solution was diluted to a convenient strength and two comparable volumes taken for the estimation of total phosphorus and that existing as hydric phosphate. The hydric phosphate was always precipitated as ammonio-magnesian phosphate directly from the solution after having diluted it to a volume of 250 cc. The total phosphorus was estimated in its portion of the liquid after it had been evaporated to a film with 60 cc. of nitro-hydrochloric acid, this treatment being found to effect a complete oxidation of the hydric phosphite. The annexed table contains the results of these experiments.

TABLE SHOWING THE ACTION OF HYDRIC NITRATE ON YELLOW PHOSPHORUS.

No. of Experiment.	Strength of Hydric Nitrate.	Time of Cohobation.	Weight of $\text{Mg}_2\text{P}_2\text{O}_7$ Precipitate obtained = H_3PO_4 produced.		Weight of $\text{Mg}_2\text{P}_2\text{O}_7$ Precipitate obtained = Total Phosphorus dissolved.		Ratio of Phosphorous to Phosphoric Acid.	Remarks.
			Cc.	Grm.	Cc.	Grm.		
1	Per Cent. 35.77	5 hours	40	gave .3461	20	gave .1928	1 : 10.47	
2	"	About 2 hours.	5	" .2071	5	" .2713	1 : 3.85	Allowed to proceed to an end without external heating.
3	"	$\frac{1}{2}$ hour	20	" .1353	20	" .2546	1 : 1.35	
4	29.70	2 hours	5	" .1373	5	" .2215	1 : 1.94	
5	"	$\frac{1}{2}$ hour	40	" .1186	20	" .1228	1 : 1.11	H_3PO_3 oxidised by Br water in estimation.
6	23.15	2 $\frac{1}{2}$ hours	20	" .2213	10	" .2412	1 : 1.013	
7	"	$\frac{1}{2}$ hour	40	" .1190	20	" .1296	1 : 1.014	
8	16.06	$\frac{1}{2}$ hour	20	" .0965	20	" .2165	1 : .961	Liquor not diluted before withdrawing portion for analysis.
9	8.37	$\frac{1}{2}$ hour	50	" .1028	50	" .2263	1 : .994	Do. do.

From these experiments it is seen that as the strength of the hydric nitrate is reduced, the ratio of the phosphorous to the phosphoric acid alters until in experiments Nos. 6 and 7 it corresponds to that of equal weights. In the two last experiments, in which still more dilute hydric nitrate was used, the proportion of hydric phosphite formed is slightly greater, although not to any remarkable extent, the ratio still practically being that of equal weights. Further, from the first five experiments, in which the strongest acids were used, it is seen that the effect of reducing the time of cohobation is also to increase the proportion of hydric phosphite formed. These show that in addition to the fundamental reaction, a secondary one is going on, in which the hydric phosphite formed in the primary reaction is being oxidised into hydric phosphate. The primary reaction, therefore, must correspond to the formation of some larger proportion of hydric phosphite than that found in experiment No. 3 for example. If, then, the effect of diluting the hydric nitrate be to eliminate this secondary change, the ratios found in the last four experiments probably represent the fundamental reaction, and these ratios correspond to the formation of equal weights of hydric phosphite and phosphate. From a consideration of the results obtained by the chemists already mentioned it might have been expected that the primary reaction would have been one in which equivalent weights of the two acids were formed, corresponding to the ratio $\frac{\text{H}_3\text{PO}_3}{\text{H}_3\text{PO}_4} = \frac{1}{1.15}$, but in only one experiment (No. 5) is this relation at all approximated to, and this experiment does not represent a state of equilibrium. At the same time, it is possible that this may be the principal reaction, and that the excess of hydric phosphite is due to another hye reaction. For, in boiling yellow phosphorus with hydric nitrate, little globules of phosphorus are thrown up to the surface of the liquid and there undergo a slow combustion in the atmosphere of the flask, with the result that the upper part of the vessel becomes filled with white fumes. In all these experiments these fumes were formed and issued from the end of the condensing tube into the air. In nearly every case a portion condensed in the cool end of the tube as a white film, while in experiment No. 8 a series of lambent flames passed continually down the tube from the orifice. At the conclusion of experiment No. 1 this film was washed into a small beaker with cold water. It did not wholly dissolve in the cold even after digesting for half an hour, but on boiling it went into solution with separation of a pale yellow powder. The solution, when tested qualitatively, showed the presence of both phosphate and phosphite, the latter so far as could be judged in larger amount. The white fumes, therefore, evidently consisted largely, if not wholly, of phosphorous oxide. On the other hand, if the equal weight ratio be due to this secondary reaction, it is remarkable that the ratios found in experiments Nos. 6 to 9 do not show a greater variation among themselves than they do. On the whole, I think

that the balance of evidence, so far as it goes, is in favour of the statement that the primary reaction taking place is one in which equal weights of hydric phosphite and hydric phosphate are formed, but further experiments are necessary on this point.

In carrying out this reaction for the preparation of phosphoric acid a few points have to be attended to. As the formation of hydric phosphate from phosphorus, oxygen, and water liberates a much larger amount of heat than the corresponding formation of hydric nitrate, the reaction between phosphorus and hydric nitrate is an exothermic one. The speed of the reaction, and therefore the period of time in which this heat is evolved, depends on the concentration of the hydric nitrate and the extent of phosphorus surface exposed to it. Consequently, if the oxidation is being done in a glass retort cooled only by radiation, and the amount of heat generated be greater than can thus be dissipated, the excess is spent in distilling over water from the retort. The hydric nitrate becoming in this way continually stronger, the reaction may become more and more tumultuous, until, when all the liquor has been driven over, the temperature has risen so high that any phosphorus still present begins to distil, and the vessel may be broken. The strength of the hydric nitrate and the extent of phosphorus-surface exposed to its action must therefore be such that this does not happen. The strength given in the text-books for the hydric nitrate is the best one, viz., an acid of about 1.200 sp. gr. From my own experience, it is not advisable to use an acid of greater gravity than 1.250 nor one much below 1.200, so that the limits are somewhat narrow. By increasing the surface of the phosphorus, however, the speed of the reaction can be safely accelerated to a certain extent. Thus, using 1 lb. of phosphorous and 12 lb. of hydric nitrate (sp. gr. 1.215), and reacting for one working day, 2 $\frac{1}{4}$ lb. of syrupy phosphoric acid were produced. With the same weight of hydric nitrate and 1 $\frac{1}{4}$ lb. of phosphorus, and reacting for as nearly as possible the same time, 3 lb. of phosphoric acid were obtained, while 1 $\frac{1}{2}$ and 1 $\frac{3}{4}$ lb. of phosphorus gave under the same conditions 3 $\frac{1}{4}$ and 3 $\frac{1}{2}$ lb. nearly of phosphoric acid respectively.

When working the process continuously, it is not advisable to continue the oxidation until all the phosphorus has been dissolved as the reaction becomes very slow when the phosphorus becomes small in amount, but it is better to pour off the liquor at the end of a day's working and re-start with an augmented amount of phosphorus and a new quantity of hydric nitrate.

The liquor obtained in this way, which still contains some hydric phosphite, is then evaporated in glass retorts until all the hydric nitrate has been expelled, by which time the oxidation is complete. The oxidation of this remnant of hydric phosphite seems to take place in stages, as during the concentration the liquid, which is at first nearly colour-

less, becomes brown, and evolves nitrous fumes. It then becomes clearer until the concentration has proceeded further, when it again becomes brown, and evolves more nitrous fumes, and so on, the final oxidation taking place when the evaporation is almost finished. The heating is then continued until the liquid stops bubbling, and is kept hot for a short time in order that the acid may be rendered quite colourless. The strong acid at this temperature has a corrosive action on glass, so that the heating must not be too long continued, otherwise, the temperature rising, the retort may be spoiled, but even with all care the glass in course of time becomes so thin that the retorts have to be laid aside.

The phosphoric acid obtained still contains the arsenic originally present in the phosphorus from which it has to be purified. This is done by precipitation as sulphide. A suitable quantity of the acid is diluted with water to a gravity of from 1.200 to 1.250, and heated up in a stoneware pan to a temperature of about 70° C. A stream of hydric sulphide is then passed in until the arsenious sulphide, which at first imparts a uniform yellow colour to the liquid, separates out as a precipitate. The liquor is then allowed to stand about 18 hours until cold, when it is again well gassed with hydric sulphide. After standing till the next day it is filtered through a sufficient thickness of calico, and the filtrate, which is now free from arsenic, evaporated to a gravity of 1.750.

This concludes my experiments on this subject at the present time, but when time permits I intend to examine the action of aqueous hydric chloride on several other phosphates, phosphites, and hypophosphites of metals which form chlorides insoluble in hydric chloride, and will have pleasure in placing the results before the Society at a future date.

DISCUSSION.

The CHAIRMAN said that a record of experiments of this sort upon any point in chemistry—even if, or perhaps especially if, they proved failures—was very valuable. He gathered that in the experiments related in the first part of the paper the phosphoric acid was made pure, with the exception of the presence of soda. Perhaps that was not so bad an impurity as others. Arsenic was often present, and that was worse. This impurity prevented the use of such phosphoric acid in medicine.

Professor E. J. MILLS asked if Mr. Watson had tried the experiment of simply passing a current of air through the nitric acid during oxidation, and, if not, he might be allowed to suggest it to him.

Mr. C. A. FAWCETT said that Mr. Watson's paper, coming as it did from a manufacturer of pure acids, would no doubt be a valuable contribution to the literature on the subject. He had occasionally to use phosphoric acid, and found it difficult to obtain, with even a moderately small percentage of iron, at a reasonable price. The author had stated that the acid he had examined contained notable quantities of iron: would he kindly say what it was in per cent. Some phosphoric acid that he had seen was more like a solution of phosphate of iron than phosphoric acid.

Mr. W. G. O'BRIEN asked: In what vessels did Mr. Watson evaporate his phosphoric acid from the dilute to the syrupy condition? He had made some experiments on a semi-manufacturing scale with a view to produce pure phosphoric acid, from bone-ash, Florida-rock, and Bull-river-rock, in the course of which he found the phosphoric acid to act very severely on the metallic vessels employed—glass or porcelain being too small for the purpose. Lead, copper, and tin were tried under similar conditions, lead lost 2.0 per cent., copper 0.4 per cent., and tin 5.1 per cent., thus showing that neither of these metals was very well adapted to the purpose. He fully agreed with Mr. Fawcett in saying that the preparation of a really pure phosphoric acid was not an easy matter, as he found, when working with natural phosphates, that the elimination of all traces of CaO and SO₃ was to be very difficult, and the acid so obtained almost invariably darkened in colour on obtaining a specific gravity of about 1.5. He, however, found that a strong, though

really not pure, acid could be obtained in this way. He did not consider a process in which spirits were employed could be a financial success, and also thought the preparation of phosphoric acid from phosphorus by oxidation with nitric acid was a costly method. He had been told that a phosphoric acid, which he found to be comparatively pure, had been obtained from a superphosphate prepared from Florida-rock and sulphuric acid, but as his own results did not confirm this, he could not say if the statement were correct.

Mr. E. RODGER said that he understood Mr. Watson objected to the process of obtaining phosphoric acid by the oxidation of phosphorus in the usual way, because of the presence of arsenic. He did not see what advantage the process of oxidising with nitric acid had over the ordinary one, as in both cases the arsenic was oxidised, and so the phosphoric acid was contaminated; but Mr. Watson had doubtless some good reason for making use of nitric acid. Regarding the manufacture of phosphoric acid from phosphate rock, he might say that if pure sulphuric acid were used to decompose phosphate of lime, a very decently pure phosphoric acid was obtained straight away, which did not contain either arsenic or soda.

Mr. WATSON in reply said that in regard to the preparation of phosphoric acid, there were two qualities made, a pure quality used solely for medicinal purposes and a crude or impure one made in larger quantities and used, he believed, in certain processes of the sugar industry. The paper referred only to the former, and he had no experience of the manufacture of the latter. He used glass vessels in the concentration, which were quite suitable for the quantities required; but even for the concentration of larger quantities he thought that the use of glass retorts, such as those used in vitriol concentration, should be feasible. No metal dishes, with the exception of platinum ones, could be used in evaporating phosphoric acid to a sp. gr. of 1.750. When he said that the acid must be free from notable amounts of iron, lime, &c., he meant that it must fulfil the tests of the British Pharmacopœia, and although no definite percentages were there stated he supposed that a half per cent. of total impurity, exclusive of arsenic, would be the limit. Arsenic could not be tolerated. He had not tried the experiment suggested by Professor Mills, but had no doubt it would recover a large proportion of the nitric acid. Mr. Rodger was mistaken in saying that he objected to the process of obtaining phosphoric acid by the oxidation of phosphorus in the usual way, and as he (Mr. Rodger) said, the arsenic being derived from the phosphorus, it was certain to appear in the phosphoric acid, no matter by what method the phosphorus was oxidised. Hence it had to be eliminated afterwards, and he found that precipitation as sulphide in the way described was a convenient way of doing this. Phosphoric acid made from rock phosphate and sulphuric acid could no doubt be obtained free or nearly so from lime, but it would still contain the alumina, magnesia, and oxide of iron present in the mineral phosphate, and these substances, especially alumina, were objectionable in a pharmaceutical phosphoric acid. He had recorded his experiments on the nitric acid method of oxidising phosphorus (and, indeed, all the experiments described) simply in the hope that the description might be of interest to the members and not because he preferred the process as a practical method of making pure phosphoric acid.

Obituary.

EMERITUS PROFESSOR REDWOOD.

DR. THEOPHILUS REDWOOD, Emeritus Professor of Chemistry and Pharmacy to the Pharmaceutical Society of Great Britain, died on Saturday, March 5, at his Welsh home, Boverton, Glamorganshire, in the house where he was born eighty-six years and five days previously.

Dr. Redwood was very fond of his home at Boverton. It was a small estate belonging to his father, and was where he passed his boyhood. It came into his possession after the death of an elder brother, and for many years the Professor turned thither every summer vacation. His wife died there in 1868, and he is now buried beside her in Llanwit Major Churchyard. During the last two or three years he has spent the greater part of his time at Boverton, paying only occasional visits to London when important business required his attention at his laboratory. He had a little laboratory at his home; but his hobby at Boverton was to make improvements on his estate—gardening and such other country work as came in his way—for others as well as for himself. He was well known, and much loved and respected by his neighbours, poor and rich, for many miles round—his helpfulness and his unvarying kindness being often called into requisition.

Dr. Redwood was first introduced to the drug trade at Cardiff, and in that same town last August he appeared before pharmacists for the last time. His son tells us that he believes that occasion was the last on which his father took part in any public function of any kind. Very hearty indeed was the reception given to him when he stepped forward to second the vote of thanks to the President for his address. It was just seventy years ago, said the speaker, that he commenced his pharmaceutical studies in that town. He had a claim, therefore, to look upon himself as a Cardiff pharmacist. In those seventy years, he reminded his audience, Cardiff had grown from a little town with four or five thousand inhabitants, with neither docks nor railroads, to the great busy place with its 128,000 inhabitants, and its vast docks and industries.

Young Redwood went to the shop of his brother-in-law, Mr. Charles Vachell, who did a large general trade and also practised as an apothecary.

Some three years later a Quaker lady who knew John Bell, of Oxford Street, was staying at the house of young Redwood's father, and through her influence an opening was made for him in that celebrated pharmacy. Some four or five years after he had entered the house, and when he had arrived at the principal-dispenser counter, it was found necessary to enlarge the pharmacy. The firm offered a premium for the plan which should be approved by them for enlarging and remodelling the shop, and all in the place, partners and assistants, were invited to compete. Many drawings were sent in, but the one which received the prize was Redwood's. His design was approved in every detail, and though it involved some structural alterations, these were carried out exactly as described, and the shop as it now exists is almost the same as that which young Redwood planned.

While he was engaged in the business of John Bell & Co., the son of the chief, Jacob Bell, came into the establishment. Jacob Bell was four years younger than Redwood, and he had the sense to take him as his guide and instructor in pharmaceutical matters.

Redwood left Oxford Street and established a business of his own in Crawford Street. There he fitted up a small factory, and began the manufacture of some chemical and pharmaceutical products, devoting especial attention to the perfection of the preparation of extracts *in vacuo*. His business subsequently passed into the hands of Mr. Thomas Biggs, to whom succeeded Mr. Frederick Curtis, who removed it to Baker Street, and whose successors, Messrs. Jameson and Son, are the present proprietors.

In 1841 Jacob Bell commenced the organisation of the Pharmaceutical Society, and from that date till Mr. Bell's death, in 1859, Mr. Redwood was the thoughtful, painstaking, wise, but singularly unobtrusive supporter of the enterprise to elevate the status of the British chemist and druggist. Through those years Mr. Redwood was the organiser of the Society's scientific, and, to a great extent, of its educational work. Some Jubilee reminiscences, from Mr. Joseph Ince, show how the scientific work of the Society was done in its early days. There were excellent evening meetings, good papers were read, important processes explained, and there were several able men who could be relied upon to discuss whatever was brought forward. The Council appointed a committee to

provide for the evening meetings, but Redwood, as the scientific officer of the Society, communicated all papers. There arose complaints that Redwood was too much in evidence, and Mr. Bell, always anxious to encourage every one to take part in the common work, stepped into the background, and took his friend with him. The entire control of the evening meetings was handed over to the committee, and when the session of 1851-52 opened there was no paper and no suggestion, and October 1851 is a blank in the official records. Mr. Bell and Professor Redwood were requested to resume their original positions.

Mr. Redwood was appointed Professor of Pharmacy to the Society when the school was first founded, and when Mr. Fownes resigned, on account of ill-health, the Chair of Pharmacy was united with that of Chemistry. The laboratory, which was the first in this country specially arranged for giving practical instruction in chemistry and pharmacy, was planned from Professor Redwood's designs. The College of Chemistry, under Dr. Hofmann, and the Birkbeck Laboratory at University College, under Professor Fownes, followed soon afterwards, the latter of these being constructed on the same principle as that of the one in Bloomsbury Square.

Professor Redwood was for many years Secretary of the Chemical Society, and also of the Cavendish Society. His degree of Ph.D. was conferred upon him by the University of Giessen, at the special request of Liebig when he was resigning his professorship at that institution.

In 1847 Redwood edited and partly re-wrote a new edition of Gray's Supplement to the Pharmacopœia. In 1849 a further edition was produced, and as by this time there was scarcely any of the original left, it appeared as Redwood's Supplement. Subsequently he edited and adapted for English readers a work on practical pharmacy, which was published as "Mohr and Redwood's Practical Pharmacy." A great part of the English edition was new matter written by Redwood. Another important literary work which he undertook was the re-casting of Pereira's "Materia Medica." This work was done in collaboration with his colleague Professor Bentley. He assisted Mr. Bell to found the "Pharmaceutical Journal," and to conduct it until that gentleman's death in 1859. From 1859 to 1870 Redwood was himself the chief editor. When the first British Pharmacopœia was published, in 1864, it was found so unsatisfactory that the Medical Council was obliged to call in the aid of some pharmaceutical experts. Dr. Redwood and Mr. Warington, of the Apothecaries' Hall, were engaged to prepare a new edition.

For fullness of knowledge on pharmaceutical matters Dr. Redwood had, perhaps, no equal in this country. When he had to speak in public he was generally very deliberate, but always very clear, and his words were always exactly the correct ones. But when he had to reply to an attack on his work, he was at his very best.

Dr. Redwood was married in 1845 to Charlotte Elizabeth, the eldest daughter of the late Mr. T. N. R. Morson, but he had the great misfortune to lose her in 1868 after a long illness. He leaves six sons and two daughters. A younger sister of his wife, the widow of his half-brother, kept house for him at Boverton, and was with him at his death.

Dr. Redwood was public analyst for the county of Middlesex, for the London districts of Holborn and St. Giles, and for the borough of Finsbury.

The Redwood Scholarship founded in his honour by a general subscription some six years, when he retired from the active duties of his professorship, will after the present session be appropriately associated with the Research Laboratory.

To the majority of those who read this tribute, Dr. Redwood has always been an old man in years, though as young as the youngest in thought, in quickness of apprehension, in debate, and in cordiality. From his earliest days to his latest he seemed absolutely free from prejudices.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

On the Durability of Aluminium. C. Winkler. Zeits. f. angew. Chem. 1892, 69.

See under X., page 244.

PATENTS.

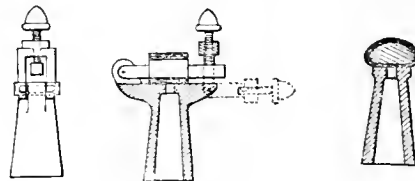
Improvements in Apparatus for Cooling, Heating, and Drying Liquid and other Substances. T. A. Shaw and J. Rushton, Bradford. Eng. Pat. 4597, March 14, 1891.

IN a closed chamber of rectangular section the inventors dispose a number of perforated plates horizontally, surmounted by a filter and a distributing plate. On opposite sides of the chamber, at alternate divisions between the plates, are fixed the inlets of pipes connected with main pipes through which air or steam can be made to enter as may be required, the surplus escaping through one or two outlets in the third side of the chamber. Two similar but smaller receptacles are placed at a lower level, one on each side below the main vessel, and these are similarly fitted up with partitions, pipes, and exits. The liquid to be treated enters by a pipe in the top of the larger vessel, passes over the distributing plate through the filter, and descends through the perforated partitions, being exposed on its way to the action of the steam or hot air, if it is a question of evaporating or heating, or to that of cold air if the liquid is to be cooled. Two outlets near the bottom of the chamber lead the liquid through suitable pipes to the two lower vessels, where it is similarly treated, issuing finally from the lower ends of these vessels in the heated or cooled state as required.

The patentees claim the arrangement described and shown, and the specification is accompanied by two sheets of drawings.—B.

Improvements in Chemical Fire Extinguishers. J. Haslam, Tonge. Eng. Pat. 4839, March 18, 1891.

THESE improvements relate to stoppers or covers for chemical fire extinguishers, with a view to prevent the escape of gas produced by the action of the carbonate or other solution, through the accidental application of heat or from some other cause when not in use. One of the arrangements is shown in the accompanying illustrations



IMPROVEMENTS IN CHEMICAL FIRE EXTINGUISHERS.

which will explain themselves. India-rubber or other pliable material is employed for making the joint at the mouth of the vessel, and is indicated in the drawings by the thick black lines.

The patentee makes five claims and illustrates five different devices.—B.

Improvements in Apparatus for Drying and Disinfecting Cereals and other Granular or Sub-divided Materials. G. Borgarelli, Turin, Italy. Eng. Pat. 5486, March 28, 1891.

THIS refers to an apparatus for drying grain in bulk by passing it slowly down a vertical chamber over partitions or diaphragms, which at the same time admit of air being passed through in the opposite direction.

Each diaphragm consists of a number of ridged parallel surfaces like small roofs or inverted troughs, with openings at the top capable of being regulated by means of slides worked from the outside. Or the openings may be on the sloping sides of the ridged surfaces in the manner of louvres, and the ridges are placed crossing each other in alternate diaphragms, whilst the openings through the tops or sides are also disposed in a way to cause the grain to descend in zig-zag fashion. From a plate over the uppermost diaphragms in the chamber depends a number of hopper openings through which the grain is admitted, and hoppers are similarly provided under the lowest partition for its removal. Above the lower hoppers the chamber is encircled by an air-belt which admits air into the chamber through various holes, and there are arrangements for heating the air as well as the upper part of the chamber itself. Disinfecting gases or vapours may be admitted at the same time.

The claim is for the arrangement of tiers, as described, and the specification is accompanied by one sheet of drawings.—B.

Improvements in Apparatus for Separating Liquids from Solid Matters suspended therein. J. Sawrey and H. Collet, London. Eng. Pat. 5529, March 31, 1891.

IN an upright cylindrical vessel a number of partitions of hopper-like shape are arranged, with perforations through their conical sides, and each centre opening provided with a long spout approaching the centre hole of the next lower hopper. The liquid enters near the lower end of the vessel, and on rising through the perforations allows the solid matters suspended therein to settle in the hoppers and slide down their inner sides, collecting in the bottom of the vessel, where they can be withdrawn.—B.

Improved Apparatus for obtaining Products of Distillation or Separating Volatile Liquids. L. J. P. Pontallié. Eng. Pat. 22,253, December 19, 1891.

THE object of the invention is to obtain the separation of liquids from a mixture of vapours, upon the principle of passing such vapours through vertical narrow spaces,

* Any of these specifications may be obtained by post by remitting *sd.*—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

whereby those which are less volatile condense at a lower level than those which are more volatile. One arrangement of the apparatus upon this system is shown in the accompanying figures, which will make the matter clear.

Fig. 1.

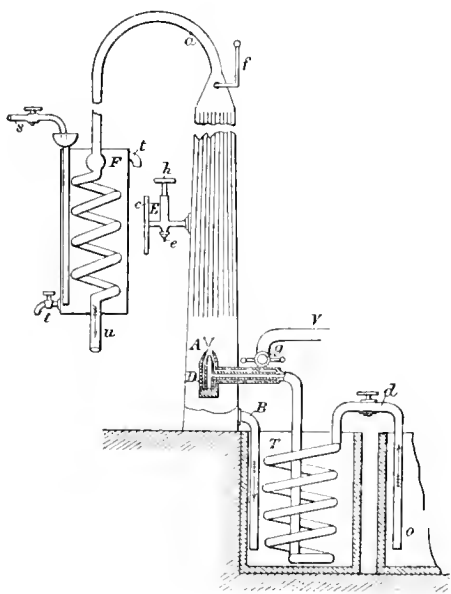


Fig. 2.



APPARATUS FOR DISTILLING AND SEPARATING VOLATILE LIQUIDS.

The injector D receiving steam through the valve *g* and pipe V draws the liquid from the tank O into the atomiser A, whence it reaches the narrow cooling spaces in the column above. Part of the heated spray and vapour passes through the column and is delivered by the pipe B into a condensing coil at F, whilst that part which is condensed in the lower part of the upright column runs off through the pipe C into the cistern T. Through this cistern passes a coil of pipes connected with the suction from the cistern O, by which means the distilling liquid takes up heat before reaching the atomiser. E and f are thermometers, and h is a tap for regulating the temperature, which is to be maintained at the boiling point of the distillate near the thermometer f.

Fig. 2 shows a cross section of the condensing column, the cooling spaces being more contracted as they near the upper end.

The apparatus is said to separate rapidly and accurately alcohol, benzene, toluene, &c.

One sheet of drawings and five claims.—B.

II.—FUEL, GAS, AND LIGHT.

The Luminosity of Coal-Gas Flames. Vivian B. Lewes.
Proc. Chem. Soc. 1892, No. 105, 2—8.

THE author has quantitatively studied the actions which lead to loss of luminosity in a Bunsen flame.

The volumes of varying mixtures of nitrogen and oxygen required to render 16·3 candle coal-gas non-luminous in a Bunsen burner are shown in the following table:—

Gas.	Volume of Mixture required.	Composition of Mixture.		Volume of Oxygen present in Amount required.
		Nitrogen.	Oxygen.	
1 vol.	2·30	1	Nil.	Nil.
1 vol.	2·30	5	1	0·38
1 vol.	2·27	4	1	0·45
1 vol.	2·02	3	1	0·50
1 vol.	1·19	2	1	0·50
1 vol.	1·00	1	1	0·50
1 vol.	0·50	Nil.	1	0·50

It is evident that until the percentage of oxygen reaches the amount present in the atmosphere, the diluting influence of the nitrogen is so strong that it prevents the oxygen having any practical effect in destroying luminosity; but that as soon as the quantity of oxygen present has risen above 25 per cent., then its activity has so far overcome the diluting influence of the nitrogen, that the latter has ceased to exercise any retarding influence on it.

In the case of other gases, the results are as follows:—

1 vol. of coal gas requires	0·5 vol. of oxygen.
"	1·26 vol. of carbon dioxide.
"	2·30 vol. of nitrogen.
"	2·27 air.
"	5·11 carbon monoxide.
"	12·4 hydrogen.

It is shown by experiment that dilution has the effect of destroying luminosity by greatly increasing the temperature necessary to decompose heavy hydrocarbons with liberation of carbon, so that at the temperature existing in a flame a volume of gas which undiluted will deposit 0·22 grm. of carbon, when diluted with 2·3 vols. of nitrogen, will only deposit 0·0013, but the higher the temperature, the less is the retarding action.

Experiments are next described in which the effect of the surrounding air on a flame is examined, and it is shown that, although the air introduced into a Bunsen is capable of bringing about certain changes in the flame when already burning in air, yet that it is quite unable by itself to keep the flame burning.

When a Bunsen burns under normal conditions, it has a bluish central zone, but if the air supply be largely in excess of that required for non-luminous combustion, the flame becomes smaller and fiercer with formation of a green central zone, which marks the change from a combustion in which the diluting influence of the nitrogen is still playing a certain part in causing non-luminosity, to a combustion in which the oxygen present having exceeded 0·5 vol. for each volume of gas, the nitrogen has ceased to exert any retarding influence.

By means of a platinum, platinum-rhodium thermocouple, the temperature was determined in various parts of a non-luminous Bunsen flame, burning 6 cubic feet of coal-gas per hour:—

Point in Flame.	Flame rendered Non-luminous by			Luminous Flame from Bunsen.
	Air.	Nitrogen.	Carbon Dioxide.	
$\frac{1}{2}$ inch above burner.	54	30	35	135
$1\frac{1}{2}$ inch above burner	175	111	70	421
Tip of inner cone ...	1,090	444	393	913
Centre of outer cone.	1,533	969	770	1,328
Tip of outer cone ...	1,175	1,151	951	728
Side of outer cone level with tip of inner cone.	1,333	1,236	970	1,236

A determination was made of the temperatures existing during the normal and also the "green centre" combustion of a Bunsen:—

	Blue Inner Cone.	Greenish Inner Cone.
	° C.	° C.
Tip of inner cone	1,090	1,375
Centre of outer cone	1,533	1,600
Tip of outer cone	1,175	1,545
Side of outer cone level with the tip of inner cone.	1,333	1,511

Analyses of gases extracted from luminous flames at the points at which the temperatures had been determined show that in the inner zone there is a rapid diminution in the quantity of hydrogen as the gases ascend in the centre of the flame, a slow diminution in the quantity of the unsaturated and saturated hydrocarbons, and a large increase in the quantity of carbon monoxide in the first half of the flame. Analysis also revealed the fact that the outer non-luminous zone of a flame is not an area of complete combustion, but a portion of the flame in which the rapid entrance of air cools, dilutes, and finally puts out the flame, allowing not inconsiderable amounts of methane, carbon monoxide, acetylene, and even hydrogen, to escape unburnt.

The undoubted presence of acetylene in the products escaping from the flame, and the fact that the incomplete combustion of hydrocarbon gases always gives rise to the formation of this compound, suggested the idea that it might play an important part in the changes taking place in the interior of a flame, and experiments were made to ascertain if any appreciable quantity were formed during the destruction of the hydrocarbons in the flame gases.

It would seem that in the interior of the luminous flame the hydrocarbons are at once attacked by the small proportion of air which penetrates into the inner zone, and that their incomplete combustion gives rise to acetylene, which, by the time the top of the inner non-luminous cone is reached, constitutes over 70 per cent. of the unsaturated hydrocarbons present, some of the acetylene, however, having probably been formed by the interaction of methane and carbon monoxide. A small proportion of some more stable unsaturated hydrocarbon may remain undecomposed and penetrate into the luminous zone, but the chief effect is due to the acetylene which is decomposed by the higher temperature, and the liberated carbon being for a moment heated to incandescence gives luminosity to the flame.

The author therefore regards the formation and decomposition of acetylene as the main cause of luminosity in a hydrocarbon flame, and if it be necessary, for purposes of simple description, to divide the luminous flame into zones, he thinks it would be most accurately regarded as consisting of three, viz.:—

1. The inner zone, in which the temperature rises from a comparatively low point at the mouth of the burner to about 1,000° C. at the apex of the zone; in this portion of the flame various decompositions and interactions occur, which culminate in the conversion of the heavier hydrocarbons into acetylene, carbon monoxide being also produced.

2. The luminous zone in which the temperature ranges from 1,000° C. up to a little over 1,300° C. Here the acetylene formed in the inner zone becomes decomposed by heat with liberation of carbon, which at the moment of formation is heated to incandescence by the combustion of the carbon monoxide and hydrogen, thus giving luminosity to the flame.

3. The extreme outer zone. Here, combustion being practically completed, the cooling and diluting influence of the entering air renders a thin layer of the flame non-luminous, finally extinguishing it.

This description of a luminous flame is of necessity far from complete, as it leaves out of consideration the causes which lead to the formation of the acetylene and the numerous interactions which take place between the products of combustion and the carbon in the upper zone of the flame.

The various actions which tend to cause the loss of luminosity in a Bunsen burner, in the author's opinion, may be summarised as follows:—

1. The chemical activity of the atmospheric oxygen, which causes loss of luminosity by burning up the hydrocarbons before they, in their diluted condition, can afford acetylene.

2. The diluting action of the atmospheric nitrogen, which, by increasing the temperature necessary to bring about the partial decomposition of the hydrocarbons, prevents formation of acetylene, and in this way will by itself cause non-luminosity; in the normal Bunsen flame it acts by doing this until destruction of the hydrocarbons by oxidation has taken place.

3. The cooling influence of the air introduced, which is able to add to the general result, although the cooling is less than the increase in temperature brought about by the oxidation due to the oxygen in the air.

4. In a normal Bunsen flame the nitrogen and the oxygen are of about equal importance in bringing about non-luminosity, but if the quantity of air be increased, then oxidation becomes the principal factor, and the nitrogen practically ceases to exert any influence.

In the discussion which followed, Professor Smithells directed Professor Lewes' attention to the controversy on the cause of delumination of flames which had taken place between Blochmann and Heumann (Annalen, 207, 167; Ber. 14, 1250, 1925, 2210); also to Walde's observations (Phil. Mag. (1838), 13, 88), in which delumination was effected by introducing luminous flames into atmospheres containing gases neutral to combustion. Walde sought to establish a relationship between diffusibility and deluminating effect. The abnormally great effect of carbon dioxide in destroying luminosity had been generally attributed, not to its high specific heat, but to its power of taking up carbon.

In a paper, which is in the press, it would be clearly demonstrated, he thought, that there are four distinct regions in a flame, however many gradations of chemical change there may be. He considered that the most important point in the paper which they had heard was that relating to the presence of acetylene in the flame. In his own experiments with ethylene he had also found that during luminous combustion scarcely any other hydrocarbons than acetylene are present in the aspirated gases. He was not satisfied, however, with Professor Lewes' proof of the escape of acetylene from ordinary luminous flames; whilst there was no *a priori* evidence against such an occurrence, unless the extraction of acetylene had been effected otherwise than by introducing cold aspirating tubes into the flame, it might be that the production of acetylene was a consequence of the method of experiment—it being well known that acetylene escaped freely from flames in contact with metallic surfaces. Accepting it as proved that the formation of acetylene in flames was an important

factor in the origin of luminosity, the question was by no means worked out. It remained to discover exactly what became of the acetylene.

Professor Lewes, in reply, said that the theory that carbon dioxide acted in destroying luminosity by converting ethylene into carbon monoxide and methane was, he thought, disproved, both by the experiments on the effect of heat in restoring luminosity to the flame and by the thermal changes taking place, as shown by the temperature of the diluted flame.

Undoubtedly Sir Humphry Davy went rather too far in his theory of luminous flames; but in a paper on the subject by him, in the *Phil. Mag.* for 1817, he says, "The intensity of light of flames depends principally upon the production and ignition of solid matter in combustion," also "Flame is gaseous matter heated so highly as to be luminous," and "when in flames pure gaseous matter is burnt, the light is extremely feeble," so that it seems hardly just to insist that he considered solid matter absolutely essential to luminosity.

The determination of the combustible gases escaping unburnt from the outer zone of non-luminous flames, had been made by taking a platinum tube 2 mm. in diameter, bent into a ring, and pierced on the inside with minute holes; this ring was placed round the flame, but not in contact with it, and the products of combustion were aspirated through this, so that the acetylene could not be due to the action of the tube.

The speaker regarded the conversion of the hydrocarbons into acetylene as the chief cause of luminosity in flame, because acetylene was practically the only heavy hydrocarbon present in that part of the flame where luminosity commenced, and as it was known that acetylene was an endothermic compound, which could be decomposed by detonation, it seemed highly probable that it would be readily decomposed by heat and liberate carbon.

The Baltimore Meeting of the American Institute of Mining Engineers. Eng. and Mining J. 1892, 229.

THE SIMULTANEOUS PRODUCTION OF AMMONIA, TAR, AND HEATING GAS. ALPHONSE HENNIN.

It is well known, said A. Hennin, that under certain conditions ammonia is found in the gas produced by the distillation of coal. For many years little or no importance was attached to its presence, and no attempt was made for its recovery. A. W. Hofmann was the first to establish a relation between the percentage of nitrogen in the coal and the proportion of ammonia in the coal-gas. If all the nitrogen in the coal could be converted into ammonia the value of this product would, itself, give handsome profits on the operation. Indeed, a coal containing $1\frac{1}{2}$ per cent. of nitrogen would produce per ton the equivalent of 164 lb. of ammonium sulphate, worth, at the present prices, 5 dols. In 1877, Dr. H. Grouven, of Leipzig, discovered that in a large excess of superheated steam, when the necessary conditions of temperature, time, and contact are supplied, combined nitrogen is transformed into ammonia.

Between these theoretical actions, however, and the establishment of an economical manufacturing process there were many difficulties to overcome. The practical operation had to be so conducted as to maintain the proper heat, make the conditions for the decomposition of ammonia as unfavourable as possible, and at the same time to produce such a gas as is required in the metallurgy of iron and steel, where rapidity of heating and melting with the lowest percentage of waste is of prime consideration. Mr. Hennin states that he has found that when high-pressure steam is moderately superheated and evenly distributed and diffused in the glowing mass in a gas-producer, a limited supply of air drawn into the generator is sufficient to maintain the temperature needed to admit continuously from 1 lb. to $1\frac{1}{2}$ lb. of high-pressure steam per pound of coal, and that this proportion of steam is ample to provoke the necessary reactions which transform into ammonia 50 per cent. to 60 per cent. of the total nitrogen of the coal and still to produce a gas of the following composition: CO_2 10.50 per cent.; O 1.00 per cent.; CO 20.00 per cent.; methane

and homologous compounds 4.50 per cent.; hydrogen 38.00 per cent.; nitrogen 26.00 per cent.

This gas is rather high in carbonic acid, but the total of combustible matter is considerable and the efficiency of the gas in a regenerative furnace is very high. It burns with a sharp, white-bluish flame, not without luminosity, and heats more rapidly and more economically than the ordinary Siemens gas. With well-designed producers and the proper plant, when the art of managing and controlling the heat in the different zones has been mastered, there is no difficulty in producing regularly, with the proper amount of steam, from each ton of coal, 70 lb. to 80 lb. of sulphate of ammonia, 130,000 cub. ft. to 150,000 cub. ft. of heating gas of high quality, and, in addition, some 15 gals. to 20 gals. of tar, according to the nature of the coal (this *Journal*, 1888, 735-737).

PATENTS.

An Improved Method and Apparatus for the Removal or Prevention of Smoke and Fog, and the Purification of Air in Towns and other Places, for the Heating and Ventilation of Houses and other Structures, for the Melting of Snow, and for the Extinguishing of Fire. E. Oades, Wokingham. Eng. Pat. 19,041, November 24, 1890.

For carrying out some of the objects mentioned above two sets of pipes or mains are laid under the roadway, and are provided with suitable traps or gratings through which the air or fog is drawn by means of pumps placed in any convenient position; branch pipes leading into the different apartments, and into the chimneys or fireplaces of the adjoining buildings are connected with each of the two mains. The fog and smoke pumped in from the street and from the buildings is passed into furnaces or stoves of special construction, where the smoke is consumed, and the fog or other suspended matter dissipated.

The ventilation of sewers might also be effected with an apparatus of this kind, the foul air being rendered harmless in passing through the furnaces; it is desirable, however, that separate mains, quite independent of those connected with the buildings, should be provided for this purpose.

The smoke from ordinary coal fires may be consumed without the employment of mains, by causing it to pass through a small gas stove packed with asbestos and placed in a convenient position above the grate; the hot air from the stove may be passed between two corrugated plates, forming an overmantel, so that the greater part of the heat would be utilised.—F. S. K.

Improvements in Gas-Producing Apparatus for Thermal Motors. G. F. Redfern, London. From "La Société Anonyme des Moteurs Thermiques Gardie," Nantes, France. Eng. Pat. 19,047, November 24, 1890.

The improved gas producer is specially applicable for use with the gas engine previously described (Eng. Pat. 2649 of 1889), its principal feature being that the gas is produced under pressure (up to several atmospheres); this is effected by having air-tight doors to the ash-pit and to the openings communicating with the hearth. The fuel (coal or anthracite) is added continuously by means of a hopper, which is provided with an air-tight cover above, and at the lower part with a large cock. The air necessary for the combustion of the fuel is forced under the grate with the aid of a steam injector, the heat of the generated gas being used for the production of steam for working the gas producer. There are four claims and two sheets of drawings.—F. S. K.

Improvements in the Generation and Combustion of Gas for Smelting and Heating Purposes, and in Appliances connected therewith. J. Hargreaves, Widnes. Eng. Pat. 1386, January 26, 1891.

SOLID fuel, such as coal, coke, or charcoal, is fed into a closed chamber and is there ignited; part of a measured quantity of a mixture of hot air and steam (or hot air alone)

under pressure is then brought into contact with the ignited fuel, so that a combustible gas is generated in the chamber. This gas is then led to the melting hearth, and is there burnt with the aid of the remainder of the definite quantity of heated air, the flame passing over the substance to be heated or melted. A chamber filled with chequer brickwork, which serves as a heat regulator and air and steam superheaters, are employed in connexion with the rest of the apparatus.—F. S. K.

Improvements in the Manufacture and Distribution of Gaseous Fuel, and in Arrangements and Apparatus therefor. J. W., A. R., and J. Ormiston, Glasgow. Eng. Pat. 1909, February 3, 1891.

THE apparatus employed for the production of the gaseous fuel consists of a large cupola or chamber, like that of a blast furnace, which is provided with twyers, charging appliances, &c., in the usual way. Instead of ordinary coal, any carbonaceous materials which contain a large proportion of earthy matter, such as poor shales, or mixtures of such minerals, may be employed. A certain amount of limestone, blast-furnace slag, or other suitable substance is mixed with the charge in order to form a fluid slag with the earthy matters; this slag is tapped off at the bottom of the furnace when necessary, without interrupting the process of gas-making.

The advantages claimed for this method of producing gas are, amongst others, that carbonaceous materials hitherto regarded as valueless may be employed, and that the labour involved in removing the "cinder" or ashes is entirely done away with.

The gas may be distributed by means of underground tunnels pierced through rock or dense strata, and communicating with vertical shafts or branches at suitable points.—F. S. K.

Improvements in Apparatus for Carburetting Gas or Air, or for Distilling, Evaporating, or Concentrating. F. Lennard, East Greenwich. Eng. Pat. 3916, March 4, 1891.

THE apparatus here described is for use in cases when it is desired to distil off the volatile constituents of a liquid, and at the same time to utilise the vapours for carburetting air or gas. The liquid to be distilled is first warmed by the hot vapours produced at a later stage of the operation, and then caused to flow down a series of vertical tubes which are heated by steam or hot air; in this way a large surface is exposed, and the more volatile constituents are readily vaporised. When air or gas is to be carburetted it is admitted under pressure, and caused to pass upwards through the heated vertical tubes down which the liquid is flowing.—F. S. K.

Improvements in the Purification of Water-Gas, or other Producer Gas from Sulphur Compounds. C. F. Claus, London. Eng. Pat. 4279, March 10, 1891.

THE gas to be purified is passed through iron cylinders or boxes, filled with iron or copper; the metal may be employed in the form of granules or scrap, but it is preferable to prepare it in a spongy condition by reducing it from the oxide with hydrogen or water-gas. The iron cylinders or boxes are either set in brickwork, so that they can be heated from the outside, or else they are lined inside with brickwork so that they may be heated by hot gases internally, such heating being necessary when the process is first started. The hot gas, at a temperature of from 500°–700° C. as it leaves the producer, is passed through two or more purifiers, and is there deprived of its sulphur compounds; the heat of the gas and that generated by the chemical action is sufficient to maintain the requisite temperature when the process is in full operation. When the purifier is spent, or partly spent, it is disconnected and cold or hot air is passed through it until the whole of the

sulphide of the metal has been converted into oxide; the oxide is then reduced to metal by treating it with water-gas at a suitable temperature, and the purifier is then ready for use again.—F. S. K.

An Improved Method of and Apparatus for the Purification of Smoke in Chimneys. E. R. Salwey, Bristol. Eng. Pat. 4565, March 14, 1891.

See under XVIII.—B., page 260.

Improvements in or relating to Gas Generators for Motor Engines. A. J. Boulton, London. From "Compagnie des Fonderies et Forges de l'Homme" and A. Leucachez, Paris, France. Eng. Pat. 4798, March 17, 1891.

THE object of this invention is to obtain generator gas which can be employed in the place of ordinary coal-gas for feeding motor engines; for this purpose certain improvements have been made in the ordinary apparatus in order to produce a richer gas.

The air for supplying the blast of the generator is first passed through a tubular superheater, in which its temperature is raised to 200°–300° by the hot generator gas; it is then passed under pressure into a hollow chamber situated under the generator, and partly filled with hot water, which, coming from the cylinder of the engine, is caused to spray against the metallic portion of the grate, whence it falls to the bottom of the chamber. The air, thus saturated with water and superheated, is now forced through the generator, and in this way a combustible gas, rich in hydrogen, is produced. This gas is first passed through the air superheater, whereby it is cooled, and then through a scrubber or washer of the usual form. It sometimes happens that the grate loses its brightness to a certain extent owing to the loss of heat which is involved in producing the generator-gas; this difficulty is overcome by surrounding the grate with a coil- or ring-burner, fed with gas under pressure from a separate gasometer.

—F. S. K.

Improvements in Means of Consuming Smoke. S. Hoyle and A. Haslam, Radeliffe. Eng. Pat. 4912, March 19, 1891.

By this invention a box or chamber is provided extending beneath and up the back of the fire-bridge and communicating with the furnace, above the fire-bars, by a set of parallel passages; below the bars, by a wide opening. In working, heated gases are drawn in through these inlets and issue at a grided outlet just behind the top of the fire-bridge; there they come in contact with the smoke and consume it.—D. A. L.

Improvements in the Art of Manufacturing Illuminating Gas. W. H. Munns, London. From E. de Beauharnais, New Bedford, U.S.A. Eng. Pat. 5212, March 24, 1891.

CRUDE petroleum is allowed to drip through a perforated cover on to ground corn-cobs, on the surface of which a small quantity of ashes, made from the wood and bark of the white ash-tree, is placed. After leaving the oil in contact with this mixture for about 24 hours, it is mixed with rain-water and introduced into a U-shaped retort together with heated air and steam; the gas produced in this way passes along one horizontal limb of the retort, and, at the bend, comes into the current of a jet of steam, which is directed towards the outlet of the other limb, and which accelerates the passage of the gas from the retort; the gas is then carburetted in the usual manner.

It is stated that the gas produced from petroleum treated as described above is a very superior illuminating gas, but what the chemical effect of this treatment may be is not known.—F. S. K.

Improvements in Carburettors. M. Merichenski, London.
Eng. Pat. 7188, April 25, 1891.

THE carburettor consists of a square, rectangular, or cylindrical vessel made of glass, glazed earthenware, or some other suitable material; it is packed with a light absorbent wood, crushed into a mass and saturated with oil. The vessel is divided by partitions in such a way that the gas to be carburetted passes through as great a length as possible of the saturated wood. A portion of the last channel through which the gas passes is filled with charcoal, or with mineral wool, so that it acts as a cooling or condensing chamber, in which the gas is freed from surplus carbon. The apparatus is charged with oil at intervals as required, either from a can or from a reservoir. The carburettor is designed to be introduced locally in buildings; it is stated that by its use the illuminating power of ordinary coal-gas is raised from 12 to 50 per cent., and that the carbon monoxide and sulphurous gases are wholly consumed.

—F. S. K.

Improvements in or Relating to Magnesium Flash Lights.
R. Haddan, London. From F. H. F. Engel, Hamburg, Germany. Eng. Pat. 7487, April 30, 1891.

See under XXI., page 267.

Process of and Apparatus for the Manufacture of Gas.
W. Fairweather, Glasgow. From "The Acme Liquid Fuel Company," New York, U.S.A. Eng. Pat. 21,881, December 15, 1891.

THIS invention relates to the manufacture of heating and illuminating gas from hydrocarbons, from hydrocarbons and water, and from hydrocarbons and hydrogen.

The hydrocarbon is first heated by means of a steam coil, then passed into a vaporiser, and finally superheated; the fixed gas obtained in this way may then be mixed with superheated steam. When hydrogen is employed it is mixed with the hydrocarbon vapour before the latter is superheated. For details the original must be consulted.

There are 50 claims and two sheets of drawings.—F. S. K.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

On Picene. R. Lescipan. Bull. Soc. Chim. 1891, 6,
258—259.

AMONGST the products resulting from the action of ethylene bromide on naphthalene in presence of aluminium chloride was a hydrocarbon described by Roux as boiling at 450°, and crystallising in scales melting at 300°. In taking up the further study of this substance the author found much difficulty in freeing it from dinaphthyl and naphthalene derivatives, but after several distillations and crystallisations the melting point rose to 337°, and the substance thus purified was found to resemble the hydrocarbon termed picene described by Burg. Its close affinity to picene was shown by the formation and analysis of the bromide, a substance melting at 294°, insoluble in chloroform, but soluble in xylene. Burg gives $C_{22}H_{14}$ as the formula for picene.—G. H. B.

The Melting Points of Mixtures of Hydrocarbons.
L. Vignon. Compt. Rend. 1891, 113, 133—136.

THE melting point of mixtures of naphthalene and diphenyl-naphthalene and phenanthrene, naphthalene and triphenylmethane, diphenyl and phenanthrene, diphenyl and triphenylmethane in proportions varying from 1 molecule of the one to 4 molecules of the other is in all cases lower than the mean of the melting points of the two bodies

composing the mixture. In each case a minimum melting point is reached, corresponding to the following molecular proportions:—

	Melting Point.
Naphthalene and diphenyl..... $C_{10}H_8$, $(C_{12}H_{10})_2$	50° C.
Naphthalene and phenanthrene..... $(C_{10}H_8)_2$, $C_{11}H_{10}$	53° C.
Naphthalene and triphenylmethane..... $C_{10}H_8$, $CH(C_6H_5)_3$	53° C.
Diphenyl and phenanthrene..... $(C_{12}H_{10})_2$, $C_{11}H_{10}$	64° C.
Diphenyl and triphenylmethane..... $(C_{12}H_{10})_2$, $CH(C_6H_5)_3$	50° C.

In the majority of these cases the mixture consists of 2 molecules of the more fusible and 1 molecule of the less fusible hydrocarbon. Mixtures of anthracene with diphenyl, triphenylmethane, phenanthrene, and naphthalene do not show such regularities. The melting point of the mixture is higher than the mean of those of the components and rises fairly regularly with an increase in the proportion of anthracene.—C. A. K.

PATENTS.

Improvements in Apparatus for Carburetting Gas or Air, or for Distilling, Evaporating, or Concentrating.
F. Lennard, East Greenwich. Eng. Pat. 3916, March 4, 1891.

See under II., preceding page.

The Manufacture of Charcoal from Sawdust, Wood Shavings, and the like, and the Treatment of Wine, Alcohol, Brandy, Cider, Beer, and other Matters therewith. F. L. Calmant, Paris, France. Eng. Pat. 3978, March 5, 1891.

See under XVII., page 257.

An Improved Coke Furnace or Oven. K. Lares, Karwin, Austria. Eng. Pat. 17,371, October 12, 1891.

THE coke oven described in this patent with the aid of five sheets of drawings is designed for working with large charges, the main object of the invention being to combine steady working with rapid coking, and at the same time to prevent as much as possible the deterioration of the oven.

The gases from the combustion chamber pass through a series of flues, and are thus brought into contact with the outer surfaces of the side walls, of the hearth, and of a part of the crown of the furnace; the air necessary for their complete combustion is admitted through suitable passages.

—F. S. K.

Improvements in Apparatus for Distilling and Rectifying.
S. Pitt, Sutton. From "A Savalle, Sons & Co." Paris, France. Eng. Pat. 21,708, December 11, 1891.

See under XVII., page 257.

IV.—COLOURING MATTERS AND DYES.

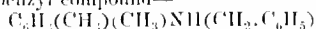
Preparation of α -Trinitrotoluene. C. Häussermann.
Zeits. f. angew. Chem. 1891, 661—662.

TOLUENE can of course be directly converted in a single operation into the 1 : 2 : 4 : 6 trinitro-derivative, but it is more advantageous to start with the *o*-*p*-dinitrotoluene, which is prepared by allowing a mixture of 75 parts of 91—92 per cent. nitric acid and 150 parts of 95—96 per cent. sulphuric acid to run in a thin stream into 100 parts of *p*-nitrotoluene while the latter is continuously stirred and the temperature maintained between 60°—65°; as soon as the acid has been run in, the mixture is heated for half all

hour at 80° to 85°, and when cold the excess of nitric acid is removed; the residue is a homogeneous crystalline mass of *o-p*-dinitrotoluene, solidifying at 69·5°. To convert this into the trinitro-derivative, it is dissolved by gently heating with four times its weight of 95–96 per cent. sulphuric acid, and while keeping cool is mixed with $\frac{1}{2}$ times its weight of 90–92 per cent. nitric acid; it is then digested at between 90–95°, with occasional stirring, until the evolution of gas ceases in about four or five hours. The operation is then stopped, and when the product is cool the excess of nitric acid is separated from it; the residue, after washing with hot water and very dilute soda, without further purification, solidifies at 79° to an almost white, radiating crystalline mass, which by recrystallisation from hot alcohol yields trinitrotoluene in brightly sparkling crystals, melting at 81·5°. 100 parts of dinitrotoluene yield 105 parts of the trinitro-derivative. 1:2:1:6 Trinitrotoluene can also be obtained from ordinary commercial dinitrotoluene, melting between 60°–64°, but when this is used the reaction is more violent; 10 per cent. more nitric acid is required and 10 per cent. less product obtained. It should be borne in mind when washing trinitrotoluene that it is not quite insoluble in hot water, and moreover that it is decomposed by dilute alkalis or alkaline carbonates.—D. A. L.

Action of Benzyl Chloride on Meta-xylidine. Jablen-Gonnet. Bull. Soc. Chim. 1891, 6, 21–22.

BENZYL chloride acts on meta-xylidine at 160°–165° C. to form the benzyl compound—



a yellow liquid, boiling at 200°–210° C., insoluble in water, soluble in alcohol and in benzene. The product forms unstable salts, readily decomposed by water and which are soluble in alcohol. Alkyl iodides and acetyl chloride react with benzyl meta-xylidine to form alkyl and acetyl compounds respectively, which are under investigation.

—C. A. K.

A New Method of Preparing Amido-alizarin. C. Lauth. Bull. Soc. Chim. 1891, 6, 836.

BETS-AMIDO-ALIZARIN may be readily prepared by the action of dimethylaniline on nitro-alizarin. One part of nitro-alizarin is dissolved in four parts of dimethylaniline, and either one part of syrupy dimethylaniline hydrochloride or 0·75 part of hydrochloric acid is added. The mixture is gradually heated to 150° C. on an oil-bath, and maintained at that temperature until a test-drop, when dissolved in caustic soda, forms a pure blue solution. The operation is then arrested, and the mass is washed with warm dilute hydrochloric acid to remove the dimethylaniline. The crystalline residue consists of impure amido-alizarin. It may be obtained quite pure by re-solution in caustic soda and re-precipitation by hydrochloric acid. The reduction of nitro-alizarin may be effected by dimethylaniline alone, although not so readily, as well as by aniline itself in presence of an excess of sulphuric acid.—H. T. P.

PATENTS.

The Manufacture and Production of Improved Dyestuffs suitable for Dyeing Vegetable Fibre with or without a Mordant. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen-on-the-Rhine, Germany. Eng. Pat. 4513, March 13, 1891. (Second Edition.) *6d.*

It has long been known (Beyer and Kegel, Ger. Pat. 38,310, 1885) that certain safranines, on diazotisation and combination with naphthol sulphonic acids, yield azo-compounds. Owing to their being unsuitable for dyeing purposes, the patent was abandoned. If, however, a diazotised safranine be combined with α - or β -naphthol, the azo-compound thus formed is converted into a valuable colouring matter by treating it with an acid, preferably hydrochloric or acetic acid. The safranines which yield good results are: Phenosafranine, Safranine T (obtained by oxidising a mixture of molecular proportions of tolylene diamine,

o-toluidine, and aniline), and Safranine A S (obtained by oxidising *p*-amidodimethylaniline, *o*-toluidine, and *p*-toluidine). The following example illustrates the method employed:—Dissolve 7 kilos. of Safranine T in 700 litres of water, cool to 0°, and diazotise by the addition of 2 kilos. of sodium nitrite in 20 litres of water and 23 kilos. of hydrochloric acid of 30 per cent. HCl. The solution thus obtained is run into 3 kilos. of β -naphthol dissolved in 165 litres of water and 25 kilos. of caustic soda-lye containing 35 per cent. of NaOH. After stirring for several hours, the blackish-violet precipitate formed is filtered off, washed, and pressed. To convert it into a colouring matter it is suspended in 400 litres of water, and 46 kilos. of hydrochloric acid are added. The hydrochloric acid salt formed is then filter-pressed and used preferably as a paste. The colouring matters obtained from the various safranines yield different shades, varying from dark violet to indigo blue. They can be employed either with or without mordants, and are fast to washing and light.—T. A. L.

The Manufacture and Production of New Mordant-dyeing Colouring Matters related to the Rosaniline Series. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen-on-the-Rhine, Germany. Eng. Pat. 4688, March 16, 1891. (Second Edition.) *8d.*

AN extension of the processes described in Eng. Pat. 4850 of 1884 (this Journal, 1885, 201) and of Eng. Pat. 5038 of 1884 (this Journal, 1885, 279). It has been discovered that by condensing certain hydroxy compounds with tetramethyl- or tetra-ethyl-diamidobenzophenone compounds, new bodies are produced, which by reason of their hydroxy groups are capable of combining with metallic mordants to give a variety of shades. The following dihydroxy compounds give good results:—(1:2) Dihydroxynaphthalene, (2:3) dihydroxynaphthalene (Eng. Pat. 15,803 of 1890; this Journal, 1891, 762), (2:7 or 2:2') dihydroxynaphthalene, pyrogallol.—T. A. L.

Manufacture of New Colouring Matters from Naphthyl-glycines. E. v. Portheim, Prague, Bohemia. Eng. Pat. 21,919, December 15, 1891. *6d.*

DIRECT dyeing cotton colouring matters are obtained by combining tetrazo-compounds of the diphenyl series with α - and β -naphthyl-glycines (O. Jolles, Ber. 22, 2372). The colours and properties of several of these dyestuffs are given in the following table:—

Diazotised.	Combined with	Colour.	Water.	Spirit.
Benzidine	α -glycine	Blue-red	Soluble	Soluble
Benzidine	β -glycine	"	Insoluble	"
Toluidine	α -glycine	Red	Soluble	"
Toluidine	β -glycine	Blue-red	Insoluble	"
<i>o</i> -Toluidine	β -glycine	Red	"	"
Benzidine sulphonic	α -glycine	Blue	Soluble	"
Benzidine sulphonic	β -glycine	"	Insoluble	"
Benzidine sulphonic acid ..	α -glycine	Blue-red	Soluble	"
Benzidinesulphonic acid ..	β -glycine	"	"	"
Benzidined sulphonic acid ..	α -glycine	"	"	"
Benzidinedsulphonic acid ..	β -glycine	"	"	"
Benzidine-sulphonichsulphonic acid ..	α -glycine	Blue	"	"
Benzidinesulphonichsulphonic acid ..	β -glycine	"	"	"

—T. A. L.

A New Manufacture of Colouring Matters. J. Muray, London. From "La Société L. Durand, Huguenin et Cie," Bâle, Switzerland. Eng. Pat. 22,623, December 28, 1891.

Blue colouring matters for mordanted wool are produced by condensing galloxyaniline with trimethylamine, isobutylamine, amylamine, diamylamine, dipropylamine, and diethylamine, the first three under similar conditions to those described in Eng. Pat. 18,526 of 1890 (this Journal, 1891, 133), that is, in a concentrated aqueous solution on the water-bath. The other amines are employed in an anhydrous condition, the condensation with dry galloxyaniline also taking place on the water-bath.—T. A. L.

VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

Improvements in Turkey-Red Dyeing. T. Baldensperger. Bull. Soc. Ind. de Rouen, 1891, 399.

In order to overcome the difficulties experienced in dyeing piece-goods with alizarin the author has proposed the following plan for dyeing them in the jigger. The prepared pieces first pass through the jigger, which is filled with cold water, to which a little lime-salts have been added. The solution is then heated to 50 °C., and a solution of alizarin in ammonia added in 2 or in 4 portions. The pieces are allowed to soak for half an hour, during which time the solution is heated to boiling, and then kept at the boil for a quarter of an hour longer. The bath is completely exhausted and the fabric dyed after 10 turns. The alizarin solution consists of 10 kilos. of 20 per cent. alizarin dissolved in 40 litres of water, and 1 kilo. of ammonia. The red obtained by this treatment is brighter and purer than that got without using ammonia, whilst 1 per cent. less alizarin reckoned on the weight of the material can be employed, since the ammonia solution has greater covering power. Attempts to employ a solution of alizarin in lime-water were unsatisfactory. The process can doubtless be employed for violet, garnet red, and other colours obtained in alizarin dyeing as well as in Turkey-red dyeing.—C. A. K.

Action of Water on Basic Salts of Copper. G. Rousseau and G. Tite. Compt. Rend. 1891, 113, 191—193.

See under VII., page 238.

New Crystalline Oxychlorides of Iron. G. Rousseau. Compt. Rend. 1891, 113, 542—544.

See under XX., page 262.

PATENTS.

Improvements in Means and Method of Dyeing or Colouring Wool, Silk, Hair, Fur, Feathers, and other Animal or Vegetable Fibres or Plain Cut Pile, Raised Pile, or Looped Fabrics composed thereof. H. A. Foster, Queensbury, and J. Frost, Huddersfield. Eng. Pat. 478, January 10, 1891.

THE materials specified in the title are coloured by impregnation with a soluble salt of lead "or other metallic salt whose sulphide gives the desired colour or shade," and treatment with hydrogen sulphide, in the gaseous state or in aqueous solution, or with a solution of an alkaline sulphide. A design "or ornamental effect" is then produced on them by printing a thickened solution of hydrogen dioxide. To produce coloured effects dyes are added to the hydrogen dioxide mixture, and the printed material

steamed, if necessary, to fix the dye; or the material may be dyed red, yellow, blue, or green, before or after being coloured with the lead sulphide, and then be printed with the suitably thickened hydrogen dioxide.—E. B.

Process for Clarifying and Bleaching Tannin Extracts or Tanning Liquors. A. Foelsing, Düsseldorf, Germany. Eng. Pat. 4385, March 11, 1891.

Tan. liquors obtained by the extraction of such tanning materials as chestnuts, oak-bark, and divi divi, are brought to a density corresponding to 4 B. at 17½ °C., and drawn off into a tank; to every 10,000 litres of such tanning-liquor, 500 grms. of oxalic acid, and 2 kilos. of "sodic chloride," dissolved separately, are added. The liquid is then heated to 60 °C. and subjected to electrolysis.

"The electric current, besides decomposing the oxalic acid and sodic chloride, produces between the two poles a voluminous deposit which consists chiefly of resin, cellulose, and colouring matter, that is to say, substances other than tannin."

The electrodes may be made of platinum wire netting mounted in frames. The strength of the current depends on the quantity of liquid to be clarified, and the time in which the clarification is to take place.—A. G. B.

Improvements in the Manufacture of Alizarin Colours, and in the Method of Employing same in the Process of Dyeing. H. N. F. Schaeffer, Lowell, U.S.A. Eng. Pat. 20,010, November 18, 1891.

A soluble mixture or compound of alizarin is prepared by drying the commercial paste and mixing one part of it by weight with two parts of borax. On the addition of hot water to this mixture, a perfect solution of the alizarin is produced, the latter, in the inventor's opinion, becoming combined with both the acid and base of the borax, forming a definite sodium boro-alizarate. The solution thus obtained may be employed at once in dyeing, the fibre being impregnated with it, and the mordanting salt subsequently applied, or "may and preferably will be" evaporated to dryness and stored ready for use or packed for transport.

The colours produced by the interaction of sodium boro-alizarate and a mordanting salt are more brilliant and intense than those usually obtained in dyeing.

Instead of alizarin, anthrapurpurin and its homologues and allied dyestuffs may be employed in the above process.

—E. B.

ERRATUM.

This Journal, 1892, page 31, col. 1, 25 lines from the bottom, for diblazyl-*m*-phenylenediamine read dibenzyl-*m*-phenylenediamine.

VII.—ACIDS, ALKALIS, AND SALTS.

The Action of the Alkaline Bases on the Solubility of Salts of the Alkalix. R. Engel. Bull. Soc. Chim. 1891, 6, 15—17.

The author has previously examined the action of carbon dioxide on the solubility of certain neutral carbonates, and that of hydrochloric acid on the solubility of a large number of metallic chlorides, and has shown that one molecule of hydrochloric acid precipitates one molecule of monovalent and half a molecule of divalent chlorides from solution in all cases where the chloride does not combine chemically with the hydrochloric acid. The action of the hydrates of potassium and sodium on the solubility of their respective

chlorides is, that one molecule of the hydrate precipitates half a molecule of the chloride from its saturated solution; or that the precipitation of one molecule of the salt is effected by one molecule of the oxide K_2O or Na_2O . Tabulated results are given showing that the above relationship, although not absolutely correct, is approximately so with solutions containing varying amounts of the chloride and the hydrate. In the case of very soluble salts, such as iodide or nitrate of potassium, the precipitation is more rapid, and does not always amount to one molecule of the salt for one molecule of the hydrate. In the case of sodium nitrate, one molecule of sodium hydrate precipitates 0.71 molecules of the salt.—C. A. K.

The Action of Ammonia on the Solubility of Ammonium Chloride. R. Engel. Bull. Soc. Chim. 1891, 6, 17.

THE presence of ammonia at first hardly decreases the solubility of ammonium chloride at all and then increases it, as shown by the results obtained. This in the opinion of the author points to the formation of compounds of ammonia with ammonium chloride such as have been described by Troost.—C. A. K.

Action of Water on Basic Salts of Copper. G. Rousseau and G. Tite. Compt. Rend. 1891, 113, 191—193.

WATER transforms a number of neutral metallic salts into basic salts, and in some cases the oxide is formed, as in the case of antimony chloride and of certain borates. The authors have ascertained that both basic acetates of copper are transformed completely to oxide on heating with water in sealed tubes at 160° C. for 20 hours. Basic sulphate is completely transformed into oxide by heating with water at 240° to 250° for about 50 hours. Basic chloride was slightly decomposed only after 48 hours' heating at 210° to 260° C., and basic phosphate showed no change on heating for several days at 275°.—T. L. B.

New Crystalline Oxychlorides of Iron. G. Rousseau. Compt. Rend. 1891, 113, 542—544.

See under XX., page 262.

PATENTS.

Improvements in Apparatus connected with the Manufacture of Sulphate of Ammonia. R. Dempster and J. Dempster, Manchester. Eng. Pat. 12,661, August 13, 1890.

WITH a view of conveniently removing the sulphate of ammonia a pump is placed within the saturator, the suction pipe extended to the bottom of this vessel, and the delivery pipe connected to the drainers.

The patentees state they make no claim to anything described by Wilton in Eng. Pat. 19,225 of 1889 (this Journal, 1890, 623).—K. E. M.

Improvements in or Appertaining to Apparatus for the Manufacture of Carbonates of Soda. J. J. Howitt, Runcorn. Eng. Pat. 3657, February 28, 1891.

FOR carbonating ammoniated brine the patentee makes use of a high tower with perforated floors, through which two long vertical rods are passed. By means of these rods every floor may be raised up on one side, so as to enable the gases to pass through the column by a circuitous course. The water used for cooling the tower by trickling down outside is further used for cooling the carbonic acid before entering the tower.

The mother-liquor from the carbonating tower containing principally chloride of ammonium, is decomposed by lime and distilled in an ammonia-distilling tower, the main improvement of which consists in the substitution of

corrugated or ribbed caps for the ordinary plain hoods. The ammonia gases from the distilling tower pass through a cooling apparatus consisting of an annular chamber cooled inside and outside. It is supplied with a number of floors communicating with one another in such a manner as to cause the gases to pass through nearly the entire "annulus" before reaching the next floor. The ammonia, deprived of practically all steam, is then used for saturating fresh brine.

For details of the apparatus the drawings accompanying specification must be consulted.—K. E. M.

Improvements in the Treatment of a certain Material (Mineral) containing Phosphate of Lime for the Purpose of obtaining the Latter in a Highly Concentrated Condition as Dicalcic Phosphate, together with Certain Bye-Products. J. Simpson, Liverpool. Eng. Pat. 3785, March 3, 1891.

NATURAL phosphates or slags sufficiently free from lime are treated with hydrochloric acid of preferably 10° Tw. The resulting solution is decanted off from the insoluble residue. The latter may be used for the manufacture of cement, the former containing phosphate of lime is imperfectly neutralised with milk of lime, so that the precipitated dicalcium phosphate may not contain any free lime. The solution is now completely neutralised with lime, any excess of which may be utilised by an addition of fresh "phosphatic solution."—K. E. M.

Improvements in Apparatus used in the Manufacture of Sulphate of Ammonia. C. Marriott, Redcar. Eng. Pat. 4730, March 17, 1891.

THE invention consists in conveniently removing the sulphate of ammonia from the saturators by "self-acting means." From under a bell-shaped vessel, through which the ammonia gas enters the saturator, the sulphate of ammonia is continuously carried away by means of an endless apron entering the back of the saturator and travelling up its inclined front. The mother-liquor drains back into the separator. The crystals are removed from the apron by a scraper or other suitable means.—K. E. M.

Improvements in the Manufacture of Salt in Blocks or Cakes. P. J. B. Vincent, Paris, France. Eng. Pat. 6388, April 14, 1891.

SALT is fused and run into moulds to cool with a view of obtaining salt in blocks, which are said to be unaffected by climatic influences, and afford great facilities for transport.—K. E. M.

Improvements in the Production of Chlorine. J. Kolb, Lille, France. Eng. Pat. 6500, April 15, 1891.

THE pot gases, and especially the roaster gases from the salt-cake furnaces contain a certain proportion of sulphurous and sulphuric acids, which soon destroy the decomposing material used in the Deacon process. The mixed gases from the pot and the roaster may be purified by passing them through a series of externally heated cylinders charged with salt. As shown by Hargreaves, sulphurous acid is hereby converted into sodium sulphate, and chlorine or hydrochloric acid is given off. The gases, which still contain a small amount of sulphurous acid, are passed finally through a cylinder charged with bricks, previously saturated with magnesium chloride and copper chloride. The chlorine now evolved oxidises the sulphurous acid into sulphuric acid, which in its turn is retained by the bricks in the form of magnesium sulphate. Dealing with pot gases alone, the latter cylinder by itself is found efficient.

—H. A.

Improved Process and Apparatus for the Manufacture or Production of Bleaching Powder. C. Kellner, Vienna, Austria. Eng. Pat. 20,037, November 18, 1891.

The apparatus consists of a vessel provided with trays, with alternately placed slits. A vertical shaft passes through the vessel, carrying arms to pass over each tray. Dry slaked lime is introduced on the top shelf and is raked by means of the arms on the shelves below; in its downward movement it meets a current of previously washed chlorine which enters from below. "By this means the chlorine combines with the hydrate of lime, and chloride of lime or bleaching powder ready for use passes out at the bottom of the apparatus." A sheet of drawings illustrates the specification.—H. A.

Improved Process and Apparatus for the Manufacture or Production of Hydrogen and Chlorine from Hydrochloric Acid. C. Kellner, Vienna, Austria. Eng. Pat. 20,060, November 18, 1891.

The invention refers to the electrolysis of a hot solution of hydrochloric acid, whereby chlorine is given off at the anode and hydrogen at the cathode. The apparatus consists of a number of superposed receptacles made of acid-proof material and tightly joined together on the outer walls. Each of these receptacles is divided into longitudinal cells, formed by ribs extending both from the bottom and the top of the receptacles, and either meeting (in which case the ribs are perforated), or else separated by means of interposed diaphragms. These cells contain horizontally placed electrodes, arranged in alternate order, and in such a way that all cells situated vertically over one another should contain a similar pair of electrodes. A solution of hydrochloric acid is introduced in the uppermost receptacle, and flowing through the compartments runs by means of a lateral overflow pipe or overflow wall into the receptacle below, and traversing this, overflows at the opposite end into another receptacle, by which means the acid is caused to circulate through the whole apparatus, leaving the bottom division as weak acid. The gases evolved flow in separate streams through ascension pipes, connecting the respective superposed cells; these pipes are placed at the alternate ends of the cells, thus forcing the gases to take an opposite course to that of the liquid. The liquid is heated by means of indirect steam, conveyed in a coil of lead piping.

The description is given of a round apparatus, composed of superposed receptacles, each of which is divided by an annular rib (attached to the bottom of the next higher receptacle) into an inner circular chamber and an outer annular one, containing the respective electrodes.

In a modified apparatus the electrodes are placed vertically in a common trough, and the alternate rows of anodes and cathodes are separated from one another by means of perforated partitions. The electrodes are fixed to a supporting bar which forms a gas-tight joint with each cell. The hydrochloric acid enters the apparatus through a false bottom, under which it is heated with steam; it ascends through the cells and leaves through two lateral openings on the upper part of the vessel. The gases evolved are led away by means of ascension pipes, which pass finally through the top bar.

Two sheets of drawings accompany the specification.

—H. A.

Improvements in the Manufacture of Chlorine from Hydrochloric Acid Gas. "La Société A. R. Péchiney and Cie," Salindres, France. Eng. Pat. 22,320, December 21, 1891. By Internat. Conv. July 2, 1891.

INSTEAD of passing a mixture of hydrochloric acid gas and air (or oxygen, or either of these) through the cast-iron tubular apparatus, as used in the Deacon—or in the De Wilde and Reichler process—the inventors propose to pass the gases through any of the well-known hot blast stoves of Cowper-Siemens, Whitwell, and others. It is expected that a higher temperature with less wear and tear on the apparatus will be attained, as also the possibility of using the cheaper decomposing substances, such as De Wilde and Reichler's mixture.—H. A.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

The Composition of Chinese Red Glazes. H. Seger. Thonind. Zeit. 1891, 15, 853.

THE author having dealt with the general points in connexion with the preparation of Chinese red cuprous oxide glazes in a previous paper (Chem. Zeit. Rep. 1890, 14, 354 and 368), gives the composition of the glazes best suited for the so-called "Seger-porcelain," as follows:—

	Dark Red Glaze.	Light Red Glaze.	Blue Iridescent Glaze.
White porcelain glaze.....	75.00	70.00	70.00
Zettlitz kaolin .....	..	5.00	5.00
Oxide of copper	0.15	0.5—1.0	1.00
Oxide of tin	1.00	2.00	2.00
Oxide of iron	0.50	..	1.00
Baryta glaze.....	23.35	22.00	21.00
	100.00	100.00	100.00

Composition of the baryta glaze—
 $0.5 \text{ Na}_2\text{O}$ } $2.5 \text{ SiO}_2, 0.5 \text{ B}_2\text{O}_3$
 0.5 BaO }

In each case the heating of the mixture is effected in a reducing fire, and the product then ground up. The blue iridescent glaze becomes especially marked if the glaze is covered for a second time with the baryta glaze and then burnt. The most beautiful colours are obtained with other porcelain and earthenware glazes, when the difference in the melting point is very great, i.e., when the earthenware glaze is very fusible.—C. A. K.

The Composition of Sub-Glaze Colours for Soft Porcelain. H. Seger. Thonind. Zeit. 1891, 15, 891; and Chem. Zeit. Rep. 1891, 15, 347.

THE sub-glaze colours are produced by means of thick oil and turpentine, or of glycerol on burnt porcelain. After painting, and before putting on the final colourless glaze, the coloured porcelain must be heated to about the melting point of silver in order to drive out the oil or glycerol.

1. *Blue Colours.*—These are produced by cobalt oxide or phosphate; the latter gives clear transparent tones. 183 parts by weight of cobalt phosphate and 103 parts of commercial aluminium hydrate are ground together, dried, heated, again ground, and then washed with water. Lighter tints are got by using a larger proportion of alumina or by the addition of zinc oxide, but in this case the resulting colour is opaque. For *light blue*, 40.6 parts of pure zinc oxide, 69 parts of cobalt phosphate, and 103 parts of ignited alumina are used. A *very light blue*, closely resembling Turkish blue, results by employing a mixture of 71 parts of oxide of zinc, 17.2 parts of cobalt phosphate, and 103 parts of ignited alumina. For a *black-blue*, equal proportions of cobaltous and nickel oxides are used. The addition of chromic oxide gives green tints; for *dark blue-green*, 165.6 parts of cobalt oxide, 76.2 parts of chromic oxide, and 154.5 parts of ignited alumina are required. *Light blue-greens* are got by using either 40.6 parts of oxide of zinc, 56.4 parts of cobalt chromate, and 103 parts of ignited alumina, or 71 parts of zinc oxide, 14 parts of cobalt chromate, and 51.5 parts of ignited alumina. The cobalt chromate is prepared by the precipitation of 154.8 parts of anhydrous cobalt sulphate, by 97.1 parts of neutral potassium chromate; the precipitated chromate is washed, dried, and ignited.

2. *Green Colours*.—Nickel and chromic oxides are used. Nickel oxide alone gives *olive green*. 149.6 parts of nickel oxide and 76.2 parts of chromic oxide give a *dark green*. Pure chromic oxide give a *chrome-green*, and the so-called "Victoria Green" gives a bright green in a reducing fire.

3. *Red Colours*.—These are produced by means of gold, as already described by the author. (Chem. Zeit. Rep. 1891, 15, 281.)

4. *Black and Grey Colours*.—Chrome iron ore or an artificial ore prepared by heating 40 parts of ferrous oxide and 76.2 parts of chromic oxide in a reducing fire, is used. If the proportion of iron in the above mixture is doubled, a *brown-black* glaze results. By the addition of 20 parts of cobalt oxide to the mixture, a *blue-black* is obtained. *Grey colours* are got by diluting with porcelain mixture, or by adding 5 parts of iridium sesquioxide and 95 parts of porcelain mixture.

5. *Brown Colours*.—Both iron and manganese oxides are too readily dissolved by the glaze. The following mixtures gives the best results:—

Parts by Weight.	Dark Brown.	Red Brown.	Light Red Brown.	Yellow Brown.
Ferrie oxide	80.0	80.0	84.0	80.0
Chromic oxide	76.2	76.2	76.2	76.2
Enbith alumina	206.0	..	51.5	103.0
Zinc oxide .....	..	194.0	241.0	324.0

6. *Yellow Colours*.—Antimony is destroyed. The best yellow colours are got by using 141 parts of uranium oxide, and 150 parts marble, or 40 parts ignited rutile and 40.6 parts oxide of zinc.

All the above mixtures must be fired in the finishing oven for soft porcelain, as this aids the development of the colours. Also special attention should be paid to the thorough washing of the porcelain mixture. To make the colours more proof against the heat of the fire, they are ground up intimately, after being heated, with 33.3 per cent. of the porcelain mixture.—C. A. K.

Cuprous Oxide Sub-Glaze Colours for Soft Porcelain.

H. Seger. Thonind. Zeit. 1891, 15, 908.

Cupric oxide is not suitable for the production of sub-glaze colours on soft porcelain when an oxidising fire is employed, owing to its volatility which causes it to spread, but when a reducing fire is used this volatilisation does not occur. Instead of using pure cupric oxide the author recommends the following mixture which produces a red colour:—

	Parts by Weight.
Cupric oxide	7.5
Tin oxide	10.0
Barvta glaze $\left(\begin{smallmatrix} 0.75 \text{ Na}_2\text{O} \\ 0.75 \text{ BaO} \end{smallmatrix} \right) 2.5 \text{ SiO}_2, 0.75 \text{ B}_2\text{O}_3$	82.5

—C. A. K.

Composition of Glass suitable for Chemical Apparatus.

R. Weber. Zeits. f. angew. Chem. 1891, 662—665.

See under XXIII., page 267.

PATENTS.

Improvements in the Manufacture of Glass. T. C. J. Thomas, London. Eng. Pat. 4391, March 11, 1891.

The inventor formerly obtained a patent (Eng. Pat. 12,076 of 1886; this Journal, 1888, 35) for the use of oxygen in the manufacture of glass, the oxygen being blown through the molten metal and thus burning away carbonaceous matter and removing other impurities. The present invention consists

of an arrangement whereby the oxygen is collected and stored for use after being blown through the molten glass. The glass pot in which the "frit" is melted is provided with a cover furnished with two openings for the passage of the supply pipe and the outlet pipe. The outlet pipe passes to a gasoneter.—V. C.

Improvements in the Production of Glass-Making Material. W. Walker, London. Eng. Pat. 5324, March 25, 1891.

1x Eng. Pat. 2019 of 1891 (this Journal, 1891, 643) the inventor has described a process for the production of silicates for glass-making, by heating together sand, calcium chloride, and common salt. In the present process lime is substituted for calcium chloride when the latter cannot be readily or cheaply obtained.—V. C.

Improvements in the Method of and Apparatus for Manufacturing Glass Plates, Sheets, and Films. W. P. Thompson, Liverpool. From R. S. Pease, Minneapolis, U.S.A. Eng. Pat. 20,438, November 24, 1891.

This invention is a further extension of the principal of that described in Eng. Pat. 20,439 of 1891 (this Journal 1892, 163).

The plunger which serves as a "bait" to draw out a film or sheet of the molten or plastic glass when raised from the tank in which it had been dipped is in the improved process caused to form such a film or sheet, both during the upward and the downward stroke. For this purpose the bottom of the receptacle for the molten glass is furnished with gates. The metal backings of the gates are brought to a sharp edge where they bear against the plunger, making a close joint. When opened these edges serve as gauges to determine the thickness of the sheet or film. The thickness is further regulated and made uniform by rollers, between which, and the plunger, the adhering plastic glass is compressed. If desired the rollers may be used for figuring or marking the plates. When the sheets or films have been drawn downward to a sufficient distance the gates of the receptacle for molten glass are thrown upwards and against the plunger thus severing the sheets and preventing further escape of the molten glass.

The above process allows four films or sheets to be produced at a complete stroke of the plunger, two on the downward and two on the upward part of the stroke (see following abstract).—V. C.

Improvements in the Method of and Apparatus for Producing Cylinders, Pipes, and other Tubular or Hollow Bodies of Glass. W. P. Thompson, Liverpool. From R. S. Pease, Minneapolis, U.S.A. Eng. Pat. 20,440, November 24, 1891.

A "BAIT" of suitable form (see preceding abstract) is allowed to dip into a receptacle containing molten glass and provided with a raised central boss, of such dimensions that it is just covered by the "bait." While the "bait" is being drawn, air pressure is supplied through a tube or blowpipe communicating with the central boss, which is hollow. In this way the glass taken up by the "bait" is blown out to the required diameter. The diameter being once attained the air pressure is adjusted so as just to keep the body at this diameter.

The enlarging operation though not absolutely essential is highly desirable, since it enables a much smaller bait to be used and the drawing operation can be commenced under much more favourable conditions than would otherwise be the case.—V. C.

Process of Making Rose or Orange-Red Stained Glass. F. Welz, Klostergrab, Austria. Eng. Pat. 21,350, December 7, 1891.

ROSE-COLOURED glass is produced by adding selenium to the contents of the melting-pot, the depth of tint depending on the quantity of selenium used and also upon the ingredients of the glass, whether for hard or soft glass.

The orange-red colour is produced by mixing cadmium sulphide with the selenium before adding to the contents of the melting-pot, the amount of the yellow tint depending on the proportion of cadmium sulphide. In this process it is not necessary to re-heat the articles after being manufactured and to dip them in a colouring mixture, as in the ordinary process of making red glass.—V. C.

Improvements in Filtering Tubes with Ball Filtering Material for Purifying Molten Glass. M. Epstein, Berlin, Germany. Eng. Pat. 21,826, December 14, 1891.

This invention attains a *continuous* delivery of purified molten glass by the following device:—Into a melting-pot receiving the glass dips a tube with openings near the bottom. As the level of the molten glass in the melting-pot rises the glass flows in, and clay balls, till then resting on the bottom of the tube, are floated up on the surface of the molten glass till they reach a grid placed across the tube, against which they are retained in position by the upward flow of glass. As the level of the glass in the melting-pot rises the liquid passes by upward filtration through the interstices of the clay balls. As long as the level of liquid in the melting-pot is maintained sufficiently high, a supply of the filtered glass can be drawn off for use from the filtering tube. The number of working hours of the furnace is much increased by this invention, owing to its avoiding the necessity for re-charging, and the wear and tearing of plant is diminished.—V. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Influence of the Presence of Gypsum in the Raw Materials of Portland Cement. Erdmenger. Zeits. f. angew. Chem. 1891, 593—595.

GYPSUM is often used in the manufacture of Portland cement to retard the rate of setting, the addition of 0.5 to 2 per cent. to the finished cement sufficing for this purpose. Discretion is necessary in its use, as the addition of a comparatively small excess may lead to blowing and cracking. The same danger occurs when the gypsum is added to the raw materials instead of to the finished cement. It seems probable that much of the blowing may be due to the calcium oxide of the gypsum unduly increasing the total amount of lime in the cement. Should, however, the proper relation between the basic and acid constituents of the cement be maintained by increasing the proportion of clay, much larger quantities of gypsum may prove harmless. It must not, however, be forgotten that a portion of the lime will remain as calcium sulphide (which gives the cement a dark colour that deepens as the amount increases), from which calcium sulphate, with all its well-known tendencies to cause blowing, may afterwards form. One characteristic of cement made from raw materials containing gypsum is the tendency of the clinker to break up more readily than ordinary well-burnt cement. The following table shows the results of some experiments on the effect of

gypsum added both to the raw materials and to the finished cement:—

Percentage of Gypsum in Raw Material.	Tensile Strength (Kilos. per Sq. Cm. at 28 Days)	
	Without the Addition of Gypsum to the Finished Cement.	With 2 per Cent. of Gypsum added to the Finished Cement.
Nil	20.5	24.0
1.5	21.0	24.0
2.5	22.0	..
4	23.5	..
5	23.0	..
10	24.0	..
15	18.0	..

The age of the briquettes differed slightly in some instances from the normal period of 28 days, but not sufficiently to affect the value of the results. The tests were made in all cases on a mixture of 1 part of cement and 3 parts of sand by weight. A steady increase in strength occurred after the lapse of periods longer than that quoted. High and progressive results were also obtained with neat cement. Although the figures given in the original paper are thus favourable, it must be noted that the longest period of experiment was four months, save in the case of the cement containing an addition of 10 per cent. of gypsum, which at seven months showed a tendency to retrograde. Further experiments with cement made from a raw material containing an addition of 20 and 50 per cent. of gypsum showed that the product was unsound, and possessed a strong tendency to blow. The same raw material was used throughout, save that as the percentage of gypsum increased the quantity of lime was correspondingly diminished. The percentage of gypsum added is reckoned on the mixture ready for burning, and not on the quantity of cement to which it was added.—B. B.

PATENTS.

Method of Manufacturing Artificial Stones with Glass Surfaces. C. Breuer, Banzlau, Germany. Eng. Pat. 3532, February 26, 1891.

ARTIFICIAL stone with a glass surface is made by casting a concrete mixture upon the back of a sheet of glass placed face downwards in a mould with hinged sides. The back of the glass may be previously roughened and toughened, or coloured, etched, or otherwise decorated glass, in one sheet, or several pieces may be employed. Before the concrete is fully hardened, it may be grooved on the surface to aid the adhesion of mortar. The method is cheaper than that in which plate glass is attached to blocks of artificial stone as practised at present.—B. B.

Improvements in the Manufacture of Portland Cement. G. H. Skelsey, Hull. Eng. Pat. 3797, March 3, 1891.

THE patentee claims to manufacture Portland cement from hard chalk, such as is found in the neighbourhood of Hull, and usually considered valueless for this purpose, by grinding the chalk in an edge runner with specially constructed heavy runners, before it goes into the wash mill.

—B. B.

A New Manufacture of Materials suitable for Building, Paving, and other Purposes, from Waste Pieces or Debris of Slate. "The Société Anonyme des Ardoisiers de Deville" and V. V. der Heyden, Deville, France. Eng. Pat. 4750, March 27, 1891.

100 PARTS by weight of crushed slate are mixed with 7 parts of a mixture of equal parts of "colophonium" and tar or pitch, and the whole heated to 125° C. One half or one quarter per cent. of "olibanum" may be substituted for a similar amount of "colophonium," a portion of which may be replaced by Venice turpentine to modify the properties of the composition. 8 parts of lime, 4 parts of gelatin, and 1 or 2 parts of albumen may be used as the cementing material to add to 100 parts of the ground slate instead of the mixture described above. In this case the mixture is first made in the cold and then heated to 100° C. The composition may be moulded into blocks, slabs, or pipes, or used for making artificial slates, either alone or as a coating to wood, paper, or sheet metal. It may be used as a pavement after the addition of fine ballast; for this purpose the surface may be roughened or grooved. Ornamental effects may be produced by the incorporation of pigments. The material is said to be strong and water-proof. Joints can be made in it by simply heating the touching surfaces. The name patented for the material is "Ardoisine."—B. B.

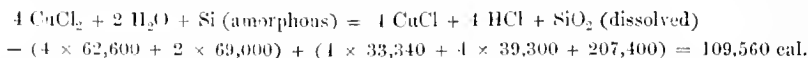
Metallised Plates or Fabric of Asbestos or other Fibrous Material for Roofing and other Purposes. R. Graf, Westphalen, Vienna, Austria. Eng. Pat. 8831, May 25, 1891.

PLATES or fabrics made of asbestos or such like fibrous material are inconveniently porous and liable to disintegration. The remedy proposed by the patent consists in covering the asbestos plates or fabric with electrolytically deposited metal (copper or aluminium for instance), the article to be coated having first been rendered conductive by a film of graphite. Should the asbestos fabrics contain a cementing material such as glue, starch, or chloride of zinc, which is affected by free acids, the metal covering must be deposited from a neutral solution. The material to be coated may be manufactured so as to be waterproof by the following method: 50 parts by weight of fibrous asbestos are mixed with 10 parts of pounded asbestos felt waste, 10 parts of zinc oxide, and 300 to 500 parts of water; to which is added in succession, the mixture being constantly stirred, 7 parts by weight of zinc chloride solution (50° to 60° B), 10 parts of a solution of soap ("1 part by weight of best quality soap to 10 of water") 2 parts of a solution of alum ("3 parts by weight of alum to 21 of water"), 0.3 part of soda dissolved in 2 parts of water, and 0.8 part of lead acetate dissolved in 2 parts of water. The mixture thus prepared is moulded into plates, which are then metallised as described above.—B. B.

X.—METALLURGY.

Calorimetric Investigations of the state in which Silicon and Aluminium exist in Cast Iron. F. Osmond. Compt. Rend. 1891, 113, 474—476.

Silicon.—Troost and Hautfeuille (Compt. Rend. 81, 264) obtained the following results on dissolving silicides of iron in bichloride of mercury and measuring the quantity of heat liberated:—



Say 3,910 cal. per gram. of Silicon, and $3,910 - 760 = 3,150$ cal. for one gram. of silicon replacing one gram. of iron in the reaction.

	Heat liberated.		Difference.
	Found.	Calculated from Composition of Silicide.	
Silicide containing 3.5 per cent. Si and 0.6 per cent. C.	Calories. 970	Calories. 170	0
Silicide containing 7 per cent. Si and 0.4 per cent. C.	1,050	1,125	- 75
Silicide containing 12 per cent. Si and 0.4 per cent. C.	1,185	1,295	- 110
Silicide containing 14 per cent. Si and 0.4 per cent. C.	1,270	1,425	- 155

If the law indicated by these figures hold good for lower values than 3.5 per cent. of silicon, then it is obvious that silicon when present in very small proportion must be dissolved by iron with absorption of heat. The experimental verification of this inference has been undertaken by the author, who had at his disposal a series of samples obtained from R. A. Hadfield well suited for the purpose. The following table gives the analyses of the samples:—

Mark of Sample.	895 A.	898 D.	898 G.	898 I.	Ferro-silicon of Commerce.
Carbon	0.135	0.190	0.240	0.155	2.080
Silicon	0.200	2.100	4.100	7.340	11.720
Sulphur	0.074	0.060	0.042	..	0.020
Phosphorus	0.014	0.039	0.054	..	0.050
Manganese	0.110	0.150	0.200	0.270	4.320

The first three samples were forged and reheated; two others were not forgeable and were merely cast. The analyses and the calorimetric tests were made upon fine filings passed through a sieve of 80 meshes (to the centimetre?). The solvent used for the calorimetric tests was a saturated solution of the double chloride of copper and ammonia (500 cc. to each 1.5 gram. of metal). The results obtained were as follow:—

Mark of Sample.	898 A.	898 D.	898 G.	898 I.	Ferro-silicon.	
Heat liberated by 1 gram. of metal (a correction being made for carbon.)	Cal. 765	Cal. 843	Cal. 907	Cal. 926	..	
Excess of heat compared with sample 898 A.	found....	0	78	142	161	..
	calculated	0	60	123	225	..
Difference between "found" and "calculated."	0	+ 18	+ 19	- 64	..	
Time required for solution in minutes.	3	5	5	11	..	

In conformity with the inference drawn from Troost and Hautfeuille's experiments the difference between the quantities of heat found and calculated changes sign for a certain content of silicon.

The calculated amount of heat was arrived at from the formula—

The time required for the solution of the samples increases as the percentage of silicon in the samples increases. The sample of ferro-silicon containing 11.7 per cent. of silicon

was attacked with difficulty by the solvent, and after one hour a residue remained equal to 59 per cent. of the weight of sample taken, which was found to contain nearly the whole of the silicon present.

From these experiments it is evident that silicon can combine with iron with accompanying liberation of heat, but the compound formed is dissociated by an excess of iron and only exists when the silicon occurs to a sufficient degree in the alloy. Analogous examples are furnished by the solution of salts in water.

Aluminium.—The samples used were also obtained from R. A. Hadfield. They were treated in the same way as the samples of siliceous iron. The following was the composition of the samples:—

	898 A.	1167 A.	1167 G.	1167 L.
Carbon	0.140	0.150	0.210	0.220
Silicon	0.207	0.180	0.180	0.200
Sulphur	0.080	0.100	0.090	0.080
Phosphorus	0.050	0.040	0.030	0.030
Manganese	0.140	0.180	0.180	0.220
Aluminium	0.000	0.210	2.100	6.200

The following calorimetric results were obtained:—

	Cal.	Cal.	Cal.	Cal.
Heat liberated by 1 grm. of metal (a correction being made for silica and carbon)	751	779	883	1,054
Excess of heat compared with 898 A.	0	19	132	303
Excess of heat compared with 898 A.	0	10	113	293
Difference between "found" and "calculated"	0	+ 9	+ 19	+ 10

The calculated excess of heat was arrived at from the reaction—



$$- 6 \times 62,600 + 475,600 + 6 \times 33,340 = 300,040 \text{ cal.}$$

say 5,480 cal. for 1 grm. of Al, (=27.4) and 5,480—760 = 4,720 cal. for 1 grm. of Al, replacing 1 grm. of Fe in the reaction.

The above results show that the discrepancy between the amounts of heat found and calculated is in each case small, and the relative difference becomes of less importance the higher the percentage of aluminium in the sample. But this difference is always of the same sign. Moreover all the samples, up to 10 per cent. of aluminium (which was the alloy richest in aluminium that was used in these experiments) dissolved with equal rapidity in the solution of the double chloride of copper and ammonium.

It follows, therefore, that aluminium under the conditions in which it is used in the metallurgy of iron, dissolves in cast iron with absorption of heat. If then, as practical men affirm, a liberation of heat actually takes place, this cannot be ascribed to an exothermic combination of the two metals, but must be due to the reduction by the aluminium of the dissolved oxide of iron, and probably also to the formation of an allotropic modification of the iron. That modification which is produced normally at about 850° when iron is cooling, is found not to take place in the presence of a sufficient quantity of aluminium, and consequently the modification should occur at the moment of adding the aluminium.—H. S. P.

Volatility of Nickel in Presence of Hydrochloric Acid.

P. Schützenberger. *Compt. Rend.* 1891, **113**, 177—179.
HYDROCHLORIC acid gas would seem to play a part analogous to the part played by carbon monoxide in its action on nickel. If pure chloride of nickel, previously sublimed in a current of nitrogen, be reduced in dry

hydrogen, a volatile product is obtained containing nickel, as may be shown by heating the after part of the reduction tube to dull redness, when a deposit of nickel chloride is obtained. To ascertain whether this was to be accounted for by some of the chloride being mechanically conveyed away by the hydrochloric acid formed during reduction, the hard-glass reduction tube was half-filled with the anhydrous chloride, after which came a long layer of closely packed glass wool. To the end of the reduction tube was then attached a narrow glass coil, giving a path of four metres to the gases escaping from the reduction tube; from this coil the gases passed through a straight glass tube, entering through a wad of glass wool. Nickel chloride carried mechanically from the reduction tube could not possibly reach the second straight tube with such an arrangement, and no condensation whatever was noticeable in the coil, which was kept at the prevailing atmospheric temperature; yet on heating the second straight tube to redness a deposit of nickel chloride was obtained. Analogous results are obtained on passing dry hydrochloric acid gas over finely-divided nickel. The true composition of the volatile compound has not yet been ascertained, though the author seems inclined to consider it a hydrochloride of nickel.

Iron and zinc give a similar reaction. (Compare this *Journal*, 1890, 808; 1891, 644 and 836.)—T. L. B.

On the Volatilisation of Iron and Nickel by Carbonic Oxide. J. Garnier. *Compt. Rend.* 1891, **113**, 189—191.

IN connexion with recent publications concerning volatile carbonic oxide compounds of metals (see this *Journal*, 1890, 808; 1891, 644 and 836, and preceding abstract), the author makes the following observations:—

The gases escaping from a charcoal blast furnace in normal action give a perfectly blue flame on burning, but if the temperature of the furnace be allowed to fall somewhat, the escaping gases form a thick smoke and burn with a white flame, ferruginous matter being deposited. The explanation would seem to be, according to the recent observations of Berthelot, that carbonyl compounds are formed and evolved at the lower temperature which cannot exist at the higher temperature. As the cooling of such furnaces sometimes causes a deposit of zinc, the whitening of the flame has been attributed to zinc, but this could not be the case in the furnaces at which the present observations were made. Further, the instance of manufacturing iron-nickel alloys is quoted, where nickel and cast iron are melted together in plumbago crucibles; on removal from the furnace an immense shower of sparks escapes, which, it is suggested, may be due to volatile carbonyl compounds.—T. L. B.

Behaviour of Hydrogen towards Lead and other Metals. G. Neumann and F. Streintz. *Monatsh.* 1891, **12**, 642—660.

See under XI., page 247.

The "Ore Process" in the Basic Open-Hearth Furnace. Dr. Leo. Dingl. *Polyt. J.* **282**, 13—17, 41—45, and 81—85.

AFTER a historical review of the development of processes of steel manufacture in open-hearth furnaces, the author describes the experiments made by M. L. Imperatori on the further substitution of ore for scrap in the modern process.

The method adopted as a result of these experiments was to mix finely-powdered ore with just sufficient powdered coke to reduce it to metal without carburising it, damp the whole, shape it into briquettes or blocks by hydraulic pressure, thoroughly dry, and smelt. The ore used should be roasted free from carbonic anhydride and water and should not contain less than 50 per cent. of iron; it should be as free as possible from silica and lime; sufficient lime may however be introduced to form a mono- or bi-silicate with any silica present. About 22—25 per cent. of powdered coke

or 26—35 per cent. of coal are required for rich Elba ore. The blocks weigh about 20—30 kilos. each; they are air-dried under cover for 7 to 8 days, then brought near the furnaces and thoroughly dried; they acquire a certain solidity from the conversion of a portion of the sesquioxide of iron in the ore into the hydrated oxide $\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ which acts as a cement. These blocks are not generally smelted alone; they may be introduced into an iron bath in a Siemens furnace, or mixed charges of pig iron, blocks and scrap may be worked. In the latter case the pig iron is first charged in, a layer of blocks is then added, and the whole is covered with scrap; the charge melts in about an hour, when quantities of 30—40 blocks are repeatedly introduced at intervals of 12—15 minutes. When the bath is at work it is covered with a slag which is black at first, but gradually turns a light green, and contains very little iron. It is rarely necessary to add ore to the bath to soften the metal, this result being attained by adjusting the composition of the blocks so that no carburised iron is produced and a slight excess of oxide is available for the decarburisation of the bath. The decarburised metal is so hot that the end of an iron pole thrust into it is melted in a few seconds, and, on adding ferrosilicon and ferromanganese to the bath, the resulting steel may at once be tapped.

In working open-hearth furnaces in the usual manner the experimenter's ordinary charges consisted of about 30 per cent. of flawed ingots, rail-ends, scale, &c., from the preceding charge, about 35—40 per cent. of pig iron, and 30—35 per cent. of other matters, chiefly scrap. The first experiment with ore blocks was made with the object of substituting them for this 30—35 per cent. of scrap. 1,050 kilos. of ore (from Elba), 380 kilos. of powdered coal, and 25 kilos. of lime in the form of milk of lime were well incorporated, consolidated with heavy stamps into 62 blocks, dried for 10 days in the air and for 24 hours near the furnace. 800 kilos. of grey Bilbao pig iron were now charged into the furnace, and on this the 62 blocks were placed; the charging occupied 20 minutes, and only one of the blocks broke up during the operation. In an hour the blocks became spongy, and in 1½ hours from the commencement of the charging 800 kilos. of steel scrap were placed on the half-molten sponge; one hour later, a sample taken consisted of a fine-grained steel; the slag was glassy, light green in colour, and contained prills of soft metal; three hours after charging, 50 kilos. of ore were thrown into the centre of the bath, the temperature being sufficiently high, and 20 minutes later 30 kilos. more were added; 10 minutes afterwards the metal was soft. 3 hours 49 minutes after charging, 25 kilos. of ferrosilicon with 14 per cent. of silicon and 25 kilos. of ferromanganese containing 40 per cent. of Mn were thrown in; five minutes later 30 kilos. of ferromanganese with 72 per cent. of Mn were added and the charge tapped. The product consisted of five flawless ingots weighing 407 kilos. each and 81 kilos. of scrap, &c., thus affording a yield of 557 kilos. of iron for the 1,100 kilos. of ore. The composition of the metal was: Carbon 0.252 per cent., silicon, 0.250 per cent., phosphorus 0.060 per cent., sulphur 0.100 per cent., manganese 1.090 per cent. The product was tough and could be rolled with facility. Test pieces of rails made from this metal, weighing 36 kilos. per metre and placed on supports 1.10 metres apart, were uninjured after receiving three blows from a ram of 600 kilos. weight falling from a height of 8 metres, the test pieces being three times bent back at the point of impact. A test piece, 160 mm. long and 16 mm. diameter, had a breaking strength of 56 kilos. per square millimetre, an elongation of 20.10 per cent., and a diminution of sectional area of 41 per cent.

The high percentage of sulphur was principally due to the coal used, and could have been reduced by weathering the blocks for a longer time, the sulphur under these conditions being oxidised to sulphate, which is decomposed in the furnace. When working on an acid hearth, weathering the blocks affords the only means of eliminating the sulphur.

In another experiment an attempt was made to render the blocks more compact by substituting coke for coal, so that the whole charge of blocks might be introduced at once into the furnace. An excess of coke (28.2 per cent.) was

however used with the result of making the mass very infusible, prolonging the operation for 10 hours, and necessitating the addition of a considerable quantity of spiegeleisen to promote fusion. The introduction of the whole charge of blocks at once also proved prejudicial. The yield was however, very good (56.1 per cent. of the ore), and the product was a good quality of ingot iron. The slag was very acid and poor in iron. In view of the refractory character of blocks prepared with coke, a number of trials was made with single blocks, and from these it appeared that by decreasing the amount of coke added, and substituting a little dolomite for the lime, the time of reduction could be reduced by one-half and a readily fusible slag obtained. This depends on the formation by the excess of oxide of a fusible silicate of iron $3\text{FeO} \cdot \text{SiO}_2$ which combines with magnesia, forming a very fusible double silicate, which is subsequently reduced by the carbon in the pig iron.

For the next charge a batch of 120 blocks were accordingly compounded of 2,625 kilos. of powdered ore, 551 kilos. (21 per cent.) of powdered coke, 131 kilos. (5 per cent.) of dolomite, and 10 per cent. of water. Five tons of Bilbao pig iron were charged into the furnace, then 4 tons of small scrap; this operation occupied two hours. In 3 hours 20 minutes from the commencement the metal was incompletely fused; the blocks were now added in small quantities at intervals of 10—15 minutes; 3 hours 10 minutes later the bath was completely fused, and a sample taken out consisted of a hard high-carbon steel. 7 hours 30 minutes after starting, 230 kilos. of lump ore were added in portions, and a sample taken out was found to be completely decarburised. One hour later, 70 kilos. of ferrosilicon containing 11 per cent. of silicon and 100 kilos. of ferromanganese with 40 per cent. of manganese were added; the metal was not however tapped till half an hour later, in consequence of an accident; it was then a homogeneous ingot iron, almost too soft for rails. The composition was: Carbon 0.17 per cent., silicon 0.095 per cent., phosphorus 0.1013 per cent., sulphur 0.074 per cent., manganese 0.531 per cent. The yield from the 2,855 kilos. ore introduced was 1,635 kilos. of iron (57.2 per cent.)

The preceding experiments were all conducted in an acid-lined furnace, but experiments are in progress on the smelting of ore blocks on the basic hearth. Ores poor in silica may be expected to yield good results and a product free from sulphur and phosphorus. Five per cent. of lime in fragments is mixed with the ore to eliminate the sulphur, but the addition of milk of lime or other substances which might prevent the intimate contact of the ore and fuel must be avoided. Phosphorus is gradually removed from the bath during the oxidation period when the bath is being decarburised. It is preferable to substitute well-washed powdered caking coal for coke, and a high pressure should be used in consolidating the blocks; the temperature of the furnace should be rather high, so that the reduction (of the Elba ore) occurs according to the equation—



the slag should be periodically removed to prevent re-absorption of the sulphur.

The Imperatori process appears to require a larger consumption of fuel than the ordinary process, but the amount of this excess has not been clearly ascertained.

The remainder of the paper is taken up with an account of the basic open-hearth process as practised in England, and with a description of the Hilton-Eston modification of the Batho furnace.—S. B. A. A.

On the Durability of Aluminium. C. Winkler. Zeits. f. angew. Chem. 1892, 69.

THE author published results a number of years ago (Deutsche Industriezeit. 1877, 64) showing that with continuous use the losses in three spoons of different composition were as follows:—

	Per Cent. per Year.
Silver spoon	0.403
Aluminium spoon	0.630
German silver spoon	1.006

The silver and aluminium spoons have been in daily use now for 16 years; the third spoon, however, has not been used with the same regularity. The loss during the 16 years has amounted in the case of the silver spoon to 8.78 per cent., a result rendered too high by continual polishing; the aluminium spoon has lost 5.85 per cent., a result which may be taken as correct, since this spoon has been rubbed merely with a soapy flannel as attempts at polishing were useless; lastly, the loss in the case of the third spoon has amounted to 5.62 per cent., a result decidedly low, seeing that this spoon has not been regularly used.

It thus seems evident that, as regards durability, there is not very much to choose between silver and aluminium, whilst German silver wears away more easily than either. Hence Lübbert and Roscher's statement (see *Zeits. f. angew. Chem.* 1892, 7) is assumed to be without foundation.

—T. L. B.

Direct Production of Iron and other Metals from their Ores. N. Lebedieff. Swed. priv. 1890, 16 and 20; *Chem. Zeit. Rep.* 1891, 15, 350.

THE process consists in combining the oxides of the metals with strong bases either by fusing the finely-ground ore with potash, soda, limestone, dolomite, &c., or, as in the case of chromium and of manganese by roasting a mixture of the ore and the above bases in a furnace, with access of air, the mass being repeatedly well mixed during the operation. The addition of sodium chloride or of saltpetre aids the process. Also some compounds of the metallic oxides with alkalis, such as the aluminates, can be prepared by a wet method. The fusion can be carried on either in blast furnaces, open hearths, or reverberatory furnaces. The charge consists of ore mixed with basic oxides as stated, to which mixture wood-charcoal or coke and sufficient siliceous material to form a slag with the resulting metal, are added. To prevent the furnaces from being attacked they should be lined with some neutral material. For the reduction of iron and other easily reducible metals the coke may be replaced by reducing gases such as carbon monoxide, hydrogen or hydrocarbons. In this case the fusion is conducted in reverberatory furnaces heated either in the usual way or by regenerative fires, into which the gases are led by pipes which pass to a certain depth in the fused mass; or else the pipes pass into the furnace through the side walls and are connected on the other hand with high-pressure generators or gasometers. As the fusion proceeds and the metal separates, small quantities of the ore mixed with the basic oxides are added from time to time so as to form a thin covering over the molten mass. In cases where the metallic oxides will combine with the basic oxides by direct fusion, the preparation of the ore and the fusion can be carried on in one and the same furnace. Readily fusible metals are tapped as they separate, whilst the more difficultly fusible, such as iron and chromium, are removed from the furnace when a sufficient quantity has accumulated and separated from the alkaline salts by treatment with water or acids after cooling, when the metal remains behind in the form of small plates. Another method is to add to the reduced mass some substance which will lower the melting point of the metal and thus allow of its being tapped; for instance this may be effected in the case of iron by the addition of cast iron rich in carbon.—C. A. K.

Conversion of Cast Iron into Wrought Iron and Steel. N. Lebedieff. Swed. priv. 1891, 18; *Chem. Zeit. Rep.* 1891, 15, 350.

THE author employs the above method of working (see previous abstract) for the conversion of cast iron into wrought iron and steel and for the purification of other metals from impurities such as carbon, sulphur and silicon. To effect this the compound of the metallic oxide with a strong base is fused in a reverberatory furnace and the cast iron then added to the fused mass. The latter melts and under the influence of the basic oxides the carbon, sulphur and silicon are oxidised, whilst the metal originally added as oxide separates in the free state. Small quantities of the

ore are added from time to time as the process proceeds; stirring aids the reduction. The choice of the basic oxides depends upon whether the pure metal or an alloy is required. In the former case a compound of ferric oxide and a basic oxide is mixed with the cast iron; whilst in the preparation of wrought iron or of steel containing chromium, manganese or aluminium, the oxides of these metals are employed in addition.—C. A. K.

On Certain Ternary Alloys. Part III., C. R. Alder Wright and C. Thompson; Part IV., C. R. Alder Wright, C. Thompson, and J. T. Leon; Part V., C. R. Alder Wright. *Proc. Roy. Soc.* 49, 156, 174; 50, 372.

THE experiments described in these three papers are in continuation of those previously abstracted (*this Journal*, 1890, 944). The later results are expressed in accordance with a system of graphical representation proposed by Sir G. G. Stokes in a note embodied in Part IV., in which the composition of a given mixture of three substances is expressed by the position of the centre of gravity of three weights placed respectively at the three corners of an equilateral triangle, and representing the relative masses of the three constituents. With certain pairs of metals, e.g., lead and zinc, each will only dissolve the other to a limited extent when molten, so that a mixture of the two (outside of certain proportions) separates into two binary alloys, one containing mainly lead with a little zinc, the other chiefly zinc with a little lead, the exact proportions varying slightly with the temperature. If the weight representing the heavier metal, lead, be placed at the left of the base of the triangle, and that representing the lighter one, zinc, at the right, the compositions of these two alloys are respectively indicated by two points situated on the base line not far from the two corners respectively. If a third metal, e.g., tin, be added to the mixture, such that this third, or "solvent" metal will mix in all proportions with either of the other "immiscible" metals separately, the composition of the entire mass is indicated by a point within the triangle raised above the base to an extent proportionate to the amount of tin added (the weight representing tin being placed at the apex of the triangle), and inclining to the left hand side or to the right according as lead predominates over zinc, or *vice versa*. The mixture thus formed is a "real" alloy if it remains uniform in composition when well intermixed and allowed to stand molten for some time; but in many instances this is not the case, the mixture separating into two different ternary alloys, a heavier one where lead predominates, whilst some tin and a little zinc are present, and a lighter one mainly consisting of zinc but also containing some lead and tin. The points indicating these two alloys consequently lie respectively to the left and right of the point representing the entire mass, or "ideal" alloy employed. The line joining them is termed a "tie line" or "tie;" necessarily, the point indicating the "ideal" alloy used is situated on this line nearer to the one or the other of the "conjugate points," according as one or the other alloy is formed in larger quantity. By employing a series of mixtures with the "solvent" in gradually increasing proportions, two branches of a "critical curve" are traced out by the positions of the left-hand and right-hand members of the various pairs of conjugate points deduced. These two branches tend to run one into the other, meeting at a point termed the "limiting point" where the system of tie lines ultimately vanishes. The critical curve thus indicates the boundary between "real" and "ideal" alloys; all points lying inside the space included between the base of the triangle and the critical curve correspond with ideal alloys, whilst all points inside the triangle but outside the critical curve correspond with real alloys. If the tie lines slope downward to the left, the "solvent" is contained in larger proportions in the heavier alloy than in the lighter one, and *vice versa* if they slope downward to the right.

A number of the earlier experiments appeared to indicate that the positions of any two conjugate points (with respect to the point representing a given ideal alloy from which the two alloys indicated by these points are formed) are to a

slight extent variable with the relative proportions in which the heavier and lighter immiscible metals are contained in the ideal alloy used. This matter has been carefully investigated, with the result of demonstrating that the apparent variation is simply due to the great difficulty experienced in obtaining a sufficiently thorough and complete intermixture of metals melted in a crucible. The error introduced is sensibly least when the two ternary alloys formed are produced in approximately equal volumes, or at any rate when the heavier one does not predominate, which would render thorough intermixture more difficult. By substituting for molten metals substances fluid at the ordinary temperature (more especially mixtures of chloroform and water as "immiscible" substances, with glacial acetic acid as "solvent"), it was found that *absolutely invariable conjugate points* were obtainable with all proportions of materials forming mixtures representing different points on a given tie line, when thorough intermixture was brought about by shaking vigorously for some time in a stoppered bottle. A critical curve was thus traced out for water, chloroform, and acetic acid, such that the ties uniformly sloped downwards to the left (chloroform). The position of the limiting point was not the point of the curve reaching the greatest elevation above the base, but was situated *lower down on the left-hand side*; at this point the ratio of water to chloroform was sharply that indicated by the formula $2\text{C}(\text{HCl}_3, 5\text{H}_2\text{O})$. "Ideal" mixtures situated anywhere near this point were found to be excessively sensitive to temperature variation, a difference of a few tenths of a degree making a wide difference in the composition of the two ternary mixtures formed, and in some cases making all the difference as to whether the mixture remained an "ideal" one, or became "real"; in all cases the effect of temperature variations was such as to be included in the general rule, *the critical curve for a higher temperature lies inside that for a lower one*.

Exactly the same peculiarities (*mutatis mutandis*) are found to characterise the curves obtainable with suitable metallic mixtures; the same rule as to effect of temperature variation always applies, so that the sensitiveness of the mixture to temperature is very considerable for ideal alloys near the critical point, although towards the base of the curve comparatively little effect is producible, even by a difference of 50° or 100° . Certain differences, however, are noticeable with particular metallic mixtures, as regards the general characters of the critical curves and tie lines; with some ternary alloys the ties always slope to the left (e.g. lead—zinc—silver and bismuth—zinc—silver); with others, always to the right (e.g. bismuth—zinc—tin); with two (and two only, out of a dozen under examination, viz. lead—zinc—tin and lead—aluminium—tin) the lower ties slope in one direction (to the left) and the upper ones in the opposite direction; this appears to be due to the existence of a tendency towards the formation of definite atomic compounds, on the one hand of tin and lead, SnPb_3 , on the other of tin and zinc, or tin and aluminium, respectively SnAl_3 and SnZn_4 . With most ternary mixtures no marked irregularity in the contour of the critical curve is noticeable, but in some cases notable exceptions to the rule exist; thus alloys of lead—zinc—silver, and bismuth—zinc—silver exhibit remarkable bulges (inwards and outwards) in both branches of the critical curve, the situation of which, and the positions of maximum bulge, lead to the deduction that two definite compounds of zinc and silver exist, respectively Ag_2Zn_3 and Ag_4Zn_5 . No such bulges, however, are noticed in the corresponding alloys where aluminium replaces zinc.

In any given curve containing lead as one of the two immiscible metals, substitution of bismuth for lead invariably depresses the critical curve, *ceteris paribus*; so that the bismuth-containing alloys furnish critical curves lying *inside* the respective analogous curves obtained with lead-containing alloys. Precisely the opposite effect appears to be produced by the substitution of aluminium for zinc.

The exact positions of the various limiting points, it was found, could not be arrived at by direct experiment on account of the sensitiveness to temperature variation near these points, and because the two alloys formed differed but little in density, and therefore did not readily separate from one another. Close approximations, however, were deducible

by means of two graphical methods suggested by Sir G. G. Stokes. The limiting points thus deduced never coincided with the point in the critical curve where the elevation above the base line was a maximum, but always lay more or less lower down, on one side or the other, on the left-hand side; when the upper ties sloped downwards to the left (e.g., lead—zinc—silver, bismuth—zinc—silver, chloroform—acetic acid—water), on the right-hand side if they sloped downwards to the right (e.g., lead—zinc—tin, bismuth—zinc—tin). The two immiscible metals were present at the limiting points in ratios close to those indicated by definite atomic formulae; but the formulae varied according to the nature of the solvent metal, being wholly different with tin as compared with silver, thus—

With lead—zinc—tin alloys the ratio was near..... PbZn_2

With lead—zinc—silver alloys the ratio was near... Pb_2Zn

With bismuth—zinc—tin alloys the ratio was near... BiZn_{10}

With bismuth—zinc—silver alloys the ratio was near BiZn_2

Full details of the methods of investigation and analysis employed are given in the papers, together with numerous tables of values obtained and plottings of the critical curves and tie lines thence deduced.—C. R. A. W.

The Baltimore Meeting of the American Institute of Mining Engineers, February 16—20, 1892. Eng. and Mining J. 1892, 227—229.

THE COPPER MINES OF VERMONT: II. M. HOWE.

THE ancient slates of the Appalachian range contain a series of large beds of iron pyrites extending from Alabama to the St. Lawrence. These deposits occur in the form of enormous lenses, and though they have many of the characteristics of fissure veins, are not generally thought to be such, but to be true ore beds, their irregularities being due to folding and distortion during metamorphism. In the majority of cases, although there are marked exceptions, these lenses pinch out in depth. In the Southern States the upper part of the ore body has been decomposed and the copper leached out. Below the gossan is found a rich layer of copper ore, resulting, perhaps, from the reprecipitation of the leached copper. Below this again is the region of undecomposed sulphides, which become impoverished as depth increases.

In the Northern States both the gossan and richer portion are eroded, leaving the undecomposed sulphides exposed at the surface. The sulphides continue in depth without loss of their percentage of copper, and in some cases are said to have been enriched. In the Elizabeth mine the ore has been worked down on the pitch for 1,500 ft., and in places some 60 ft. in width. At the Union mine, while the ore body does not extend continuously to a great depth, yet continuations of new lenses are found by cross-cutting when the lense pinches.

Although at present the pyrrhotite ores are placed at a disadvantage with the pyritous ores, as far as utilisation for acid-making is concerned, they contain a larger proportion of copper, and when the gigantic sulphur beds of Louisiana are developed they will be on a par, at least, with the pyritous ores.

THE MAGNETIC ORES OF ASHE COUNTY, N. C.:

H. B. C. NITZE.

These iron ore deposits, situated in an area of crystalline rocks and embracing an extent of 150 square miles, are practically undeveloped, though some small prospecting has been carried on, and one small Catalan forge, making a very superior tough iron, is in operation. The ores are principally magnetites, suitable for the manufacture of Bessemer pig iron, though hematites and red specular ores of excellent quality are also found, but in very limited quantities. Mr. Nitze divides Ashe County into three main belts—the Ballou or River belt, the Red Hill or Poison Branch belt, and the Titaniferous belt.

The Ballou belt has been opened at several points, showing thick beds of ore material running from 41·36 per

cent. metallic iron to 60·48 per cent., and extremely low in phosphorus and sulphur, but high in silica. The Red Hill or Poison Branch belt has been opened at numerous points along its outcrop, showing large bodies of ore. In addition, the bodies have been traced over unopened ground by the dipping needle. The ore generally is good in character, although certain portions are high in sulphur. The Titaniferous belt is extensive and persistent, and shows large quantities of ore, but the percentage of titanate acid from 8·8 per cent. to 9·7 per cent. condemns it for blast furnace use.

TITANIFEROUS IRON IN THE BLAST FURNACE.

R. W. Raymond suggested that for the benefit of iron workers the boundaries of the titaniferous ores, which seem to run in a belt from the large developments in the South, through New Jersey, New York, and into Canada itself, should be determined. Raymond stated that the Durham furnace had been paying a rental for 20 years on a magnificent body of iron ore which was absolutely useless to it on account of its high percentage of titanate acid, although it was extremely low in phosphorus. The titanate acid ran as high as 14 per cent. It was well known to metallurgists, he said, that titaniferous ores could be treated in the blast furnace by carrying large quantities of alumina in the slag; but at Durham, where they relied upon the Trenton dolomite as a flux, the alumina was not obtainable. Many of the metallurgists of the Lehigh Valley had found accretions of nitro-cyanide of titanium in their furnaces, showing that where titanate acid occurred in small quantities it was accumulative. In the late T. Sterry Hunt's classification of crystalline rocks the titaniferous ores had been placed as characteristic of a certain era, and although this hypothesis has not been proved conclusively, it was in his (Raymond's) opinion most likely to be correct. The aluminous and titaniferous slags, Dr. Raymond said in reply to a question, ran poorly and were difficultly fusible. They were sometimes used to "heal" a damaged hearth.

President John Birkinbine stated that the titaniferous iron deposits of Northern New York and Canada were bounded on either side by bodies free from that element. Titaniferous bodies, strange to say, were placed in the most inviting of positions; huge outcrops enticed the miner. It was Birkinbine's opinion that the salvation of the titanium difficulty lay in the use of large hearths removable while in blast if necessary. This has been done on a small scale, he said, and why not on a large one.

Dr. Raymond thought the remedy, if any, would be the employment of some of the modern direct open-hearth processes. Howe, however, coincided with Birkinbine. Birkinbine continued by saying that magnetic concentration reduced materially the amount of titanate acid in the product. Dr. Eggleston said that this was true, but that he had made a number of experiments, which showed plain jiggling would effect the separation of certain titaniferous minerals from magnetite.

Improvements in the Manufacture of Galvanised Iron.

J. W. Richards. Eng. and Mining J. 52, 24, 1891, 677.

The author has found that the presence of small quantities of aluminium in the galvanising bath leads to the deposition of a highly crystalline as well as a permanently brilliant and adhesive coating of zinc. The aluminium is best added to the bath in the form of a zinc alloy containing 2 per cent. of aluminium, 4 oz. of this alloy being added to the galvanising bath for every ton of zinc.

Calculation of Slag Components.

G. Murray. Eng. and Mining J. 1892, 281.

See under XXIII., page 270.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Behaviour of Hydrogen towards Lead and other Metals.
G. Neumann and F. Streintz. Monatsh. 1891, 12, 642—660.

In order to explain some physical phenomena which take place at the negative plate of a secondary battery, it was assumed in a previous paper that lead has the power of absorbing hydrogen; the authors attempted to put this assumption to the test of experiment under conditions similar to those existing in a secondary battery, but no trustworthy conclusions could be drawn from the results.

They then examined the behaviour of molten lead, and found that it has the power of absorbing 0·11—0·15 vol. of hydrogen. Several other metals were examined as regards their power of occluding hydrogen, and the results are given in a table.—F. S. K.

Determination of Electrolytic Dissociation of Salts by Solubility Experiments.

A. A. Noyes. Technology Quarterly, 1891, 4, 259—291.

THE effect which one salt exerts on the solubility of another has been the subject of numerous investigations. These, however, yielded nothing more than a mass of empirical results, until Nernst showed that the electrolytic dissociation theory offered an explanation of this phenomenon of solutions. The author has already (Zeits. f. Phys. Chem. 6, 241) tested by experiment the validity of Nernst's theory, and has generally found it to hold good. Such discrepancies as did occur were probably due to the incorrectness of the dissociation values used in the calculations, i.e., to the assumption that dissociation and molecular conductivity are proportional. Now, just as the solubility of one salt in presence of another can be calculated if the values of the dissociation be known, so conversely can the degree of dissociation be determined from the values of the solubility experimentally obtained. Up to the present time electric conductivity is the only physical property of a solution which has been used to furnish a measure of the dissociation of the substances dissolved in it. Although this method, as used by Ostwald and others, gives reliable results in the case of organic acids, the author believes that it cannot be depended on in the case of better conductors, such as most metallic salts and strong acids and bases. These considerations have led the author to study the dissociation of the chlorides of various metals by methods depending on their solubility. He arrives at the following general results.

The effect of 11 different chlorides on the solubility of thallous chloride was investigated, each in four distinct concentrations, and the dissociation of each was calculated from the solubility effect. The three alkali-metal chlorides, potassium, sodium, and ammonium, were found to be equally dissociated, their dissociation increasing from 65 per cent. in the case of a solution of 0·2 normal strength to 89 per cent. at 0·03 normal. The dissociation of hydrochloric acid was slightly greater (73 per cent. to 89 per cent.). With a single exception all the bivalent-metal chlorides investigated (Mn, Ca, Ba, Zn, Mg, and Cu) proved, like the univalent-metal chlorides, to be equally dissociated. Their dissociation is about 5 per cent. less than that of the alkali chlorides. Cadmium chloride forms the exception spoken of, its dissociation being 33, 43, 53, and 60 per cent., as against 62, 69, 78, and 82 in the case of solutions of the other chlorides of corresponding concentration. The results were confirmed by corresponding experiments with lead chloride.—D. E. J.

PATENTS.

Manufacture of Porous or Spongy Plates, applicable for Use in Secondary Batteries, &c. F. T. Williams and J. C. Howell, Llanelly. Eng. Pat. 2573, May 23, 1883. (Second Edition.)

This invention relates to the formation of porous blocks of lead or its alloys by removing in a perforated kalle, such as

is used in the separation of lead and silver, some of the molten metal which has been allowed to cool slowly until it is just crystallising out. The liquid metal drains through the perforations, and the mass which remains sets into a porous block, which can be cut up into battery plates or be used for the manufacture of white lead.—G. H. R.

Improvements in Extracting Precious Metals from Ores or Minerals containing them, and Apparatus therefor. J. B. Hannay, Dumbarton. Eng. Pat. 11,966, September 22, 1890.

In Eng. Pat. 14,061 of 1886 (this Journal, 1887, 673) a process is described for extracting gold from refractory ores by the combined action of chlorine, a cyanide, and electric currents. In the present patent, chlorine is dispensed with, the electrolyte being kept in a state of circulatory agitation by means of a screw or propeller. Gold or silver ores are reduced to a fine powder and mixed to the consistency of a fluent sludge with water containing not more than 2 per cent. of potassium cyanide.

Apparatus is illustrated and described for effectively carrying this method into effect (see below, Eng. Pat. 19,181 of 1890).—E. T.

An Improved Process and Apparatus for Extracting Gold from Minerals containing it. J. B. Hannay, Dumbarton. Eng. Pat. 19,181, November 25, 1890.

This patent is for an improvement in apparatus for effecting the process described in Eng. Pat. 11,966 of 1890 (abstracted above). The negative electrode is of mercury, immediately under a propeller mounted on a vertical shaft passing through the bottom. The positive electrode is a hollow inverted cone of carbon mounted immediately over the propeller. By the action of the latter, the sludge is drawn through the hole in the cone and driven up round the sides to once more enter the hole at the top and continue the circulation.—E. T.

A New or Improved Dry Couple or Element for Electrical Purposes. H. Birkbeck, London. From O. Genrichsen, Copenhagen, Denmark. Eng. Pat. 20,838, December 20, 1890.

In this cell, the carbon is placed in the centre, with its lower half surrounded by a mixture of pyrolusite and graphite. Between this layer and the zinc, which is in the shape of a cylinder surrounding the whole, is the solution of sal-ammoniac, of which the absorbent material is siliceous marl. There is then a thin horizontal layer of siliceous marl, made firmer by the addition of plaster of Paris. Above this there is a very deep layer of sawdust or such material. The cell is closed at the top by layers of plaster of Paris and asphalt or resin. A hole is left through the two top layers, and, if desired, a long bent tube may be attached to it, so that any gases liberated must pass through a great length of absorbent material contained in it, the tube itself being wholly contained in the cell.

—E. T.

Improvements in the Production of Lead Plates or Electrodes for Secondary Batteries, and the Connections, Straps, or Lugs to the same. P. J. Davies, London. Eng. Pat. 21,031, December 24, 1890.

This patent is for mechanical means of producing such deeply-grooved plates as are used for Epstein electrodes. The grooves may be formed by casting in moulds, by pressure between dies, by rolling or ploughing out. The moulds or dies are formed of a number of steel laths fastened together, those which have to form the grooves in the electrodes being, of course, wider than the others. Rolls are made in a similar way by stringing together washers, those for forming the grooves being of larger diameter than the others. Very numerous drawings are given illustrating the details.—E. T.

Improvements in Galvanic Batteries for Producing Constant Currents. W. Wensky, Berlin, Germany. Eng. Pat. 49, January 1, 1891.

This cell is designed for the production of constant currents for a considerable length of time. A plate of copper placed horizontally is covered with copper subchloride. Above this is supported, between suitable osmose cloths, first a layer of powdered zinc and then a zinc plate. The electrolyte is a 40 per cent. solution of zinc chloride containing 1 per cent. of mercury perchloride. A number of such cells are made up into a single vertical block by the help of rubber rings. In the decomposition of the subchloride, copper is deposited on the copper plate, and zinc chloride formed.—E. T.

Improvements in Electric Cells or Batteries. H. T. Eagar, Canterbury, and R. P. Milburn, Newcastle-on-Tyne. Eng. Pat. 899, January 17, 1891.

An electrolyte suitable more especially to those cells which contain aluminium as one electrode (Eng. Pat. 6924 of 1890), is composed of sodium bichromate, 3 oz.; water, 120 oz.; sulphuric acid (commercial), 8 oz.; hydrochloric acid, 15 grains. The proportions may be varied, and a suitable quantity of ammonium bichromate used instead of the sodium salt.—E. T.

Improvements in Primary Batteries. S. W. Maquay, London. Eng. Pat. 1035, January 20, 1891.

This patent relates to the raising and lowering of battery elements by means of a chain and roller or sprocket wheels, and also to clamps for holding the zinc plates and allowing of their rapid replacement.—E. T.

Improvements in Galvanic Batteries. F. Poudroux, Paris, France. Eng. Pat. 3198, February 21, 1891.

In an outer jar is placed a cylinder of carbon, and within this a porous pot containing a zinc cylinder; inside this a second porous pot containing a carbon rod. The inner carbon is bathed in water, 20 parts; potassium nitrate, 2; manganese dioxide, 1; sodium bichromate, 3; sulphuric acid, 2 parts. The solution round the zinc consists of water, 20; sal-ammoniac, 3; potassium nitrate, 2 parts. Surrounding the outer carbon is a solution of sodium bichromate with one-tenth part by weight of sulphuric acid. It is claimed for this cell that it will last a very long time without attention, and that by the employment of a solution containing no acid, the zinc very seldom requires amalgamation.—E. T.

An Improved Galvanic Battery. W. H. Manns, London. From G. A. Smith, Halifax, Canada. Eng. Pat. 3417, February 25, 1891.

This invention consists in a battery composed of zinc and carbon elements so connected to a plate working vertically on guide bars, that by means of a lever placed on the outside of the enclosing case the plates can be raised out of or immersed in the electrolyte.—G. H. R.

Process for Clarifying and Bleaching Tanning Extracts or Tanning Liquors. A. Voesting, Düsseldorf, Germany. Eng. Pat. 4385, March 11, 1891.

See under VI., page 237.

A New or Improved Solution or Electrolytic Fluid for Galvanic Batteries. W. J. Engleline, Byfleet. Eng. Pat. 4781, March 17, 1891.

The invention consists of a solution for galvanic batteries composed of sulphuric acid, hydrochloric acid, bichromate of soda, and water.—G. H. R.

Improvements Relating to the Production of Porous Materials, and to the Manufacture of the same into Electrodes or Plates for Electric Batteries. H. H. Lake, London. From E. A. G. Street, and A. W. Desruelles, Paris, France. Eng. Pat. 1781, March 18, 1891.

This invention consists in making plates for batteries by mixing intimately one of the oxides of lead, or manganese, with "any suitable calcareous or porous material" which is not attacked by the electrolyte to be used. The mass is made into a paste with albumen and moulded into plates, which are then heated to coagulate the albumen.

—G. H. R.

Improvements in Apparatus for Preparing Bleaching Solution and Bleaching Powder by Electrolysis. E. E. Lever, Altrincham. Eng. Pat. 11,620, July 8, 1891.

An arrangement of tank and electrodes is described for effecting the decomposition of brine or sea-water. The tank may be made of cast iron preferably, with a porcelain porous partition between the two compartments. The chlorine is led into a chamber containing lime to form bleaching powder. The whole vessel may be warmed by steam.—E. T.

Improvements in or Connected with Accumulators or Secondary Batteries. H. Hauser, Madrid, Spain. Eng. Pat. 14,702, August 31, 1891.

According to this invention the plates are composed of a number of troughs arranged horizontally one over the other in a frame, and connected at their ends to its vertical sides, one of which is prolonged and forms the terminal. The troughs, which are made of an alloy of lead and antimony, are filled with the active material, which is preferably some oxide of lead.—G. H. R.

Obtaining a Fluid for Primary Batteries, and Utilising the Waste Products of such Batteries. H. H. Leigh, London. From J. B. Gardiner, Nyack, U.S.A. Eng. Pat. 16,487, September 29, 1891.

This patent is to reduce the cost of working by the employment of a cyclic method. A chromic acid cell is given as an example. Lead chromate is treated with sulphuric acid, giving chromic acid—*Part A*—and lead sulphate—*Part B*. The chromic acid is used in the battery, and when spent is treated with an alkaline carbonate, evaporated, and ignited; potassium chromate and zinc oxide are thus obtained. The latter is of immediate commercial value; the former is treated with *Part B* above—lead sulphate—with the production once more of lead chromate and potassium sulphate. The lead chromate may now go through the whole cycle again.

The method may be modified as follows: Chromate of lime and sulphuric acid give chromic acid and sulphate of lime. The spent chromic acid after use in the cell is treated with the sulphate of lime produced alone, or with carbonate of lime, dried, and ignited, with the production of chromate of lime once more and zinc oxide. The principle can be applied to a great number of salts.—E. T.

Improvements in Electric or Galvanic Batteries, and in Materials therefor. D. J. N. Lamb, Boston, U.S.A. Eng. Pat. 17,430, October 13, 1891.

The "active" material consists of a mixture of granules of potassium bichromate, copper sulphate, sal-ammoniac, manganese peroxide, lead shot, &c., some or all of which are rendered impervious to moisture by a coating of resinous or waxy material. A special form of cell is also described, in which this active material seems to surround zinc and carbon alike. The electrolyte may be water.—E. T.

Improvements in and Relating to Electric Batteries. B. Scheithauer, Halle-on-the-Saale, Germany. Eng. Pat. 17,994, October 20, 1891.

Oxygen is introduced into each cell of the battery in order that it may combine with the hydrogen formed at the negative plates, and so prevent polarisation.—E. T.

Improvements in Secondary Batteries. M. Waddell, J. B. Entz, and W. A. Phillips, Bridgeport, U.S.A. Eng. Pat. 18,431, October 27, 1891.

The positive electrode is made of copper wire surrounded with copper oxide, which is held on with a braiding of fine copper wire, the whole being covered with a braiding of cotton. Two such wires placed side by side are doubled on themselves and then turned backwards and forwards into a mat, one wire thick, with the four ends at the top. This mat is held in shape by stout insulated wires round the edges and along the faces. The negative electrode is a perforated sheet of iron doubled round the positive like the zinc of a Grove cell. The solution is sodium and potassium zincate. The binding wires mentioned above, which hold the mat in shape and also insulate the positive plate from the negative, are covered with a cotton braiding impregnated with whiting and silicate of soda. When immersed in the potassium solution the covering becomes very stiff and glassy. The iron negative electrode may be plated with nickel, tin, or any other suitable metal.

—E. T.

Improvements in Electric Accumulators or Storage Batteries. W. P. Thompson, London. From N. H. Edgerton, Philadelphia, U.S.A. Eng. Pat. 19,158, November 10, 1891.

The lead plates of the electrodes are placed, without metallic contact, in thin flat metal cells or cases, which are filled with active material such as a lead oxide. The cases appear to be water-tight boxes reaching to the top of the containing cell. Three such electrodes, each with its case, are placed in each cell, the centre one of one cell being joined to the two outer ones of the next. "The object sought, being the polarising of the battery, that is to say, the construction and arrangement, to develop an increased voltage or tension of electrical energy."—E. T.

Improved Process and Apparatus for the Manufacture or Production of Hydrogen and Chlorine from Hydrochloric Acid. C. Kellner, Vienna, Austria. Eng. Pat. 20,060, November 18, 1891. 11d.

See under VII., page 239.

Improvements in the Manufacture of a Hard Insulating Material. R. Pape, Berlin, Germany. Eng. Pat. 20,107, November 24, 1891.

Three parts of soapstone are incorporated with 2 parts of powdered chalk, or magnesite and chalk, by means of rotating rollers or drums, until the material has a soapy touch. Such prepared chalk can be compressed into denser masses which have a very fine gloss, and can be worked up with tools without crumbling and without easily blunting the tools. For use as an insulating material the prepared chalk is mixed, gradually and with constant kneading, with 3 parts of resin, or shellac dissolved in alcohol until a dough is obtained; this is dried, powdered, warmed, with constant stirring, to 30° C., and finally compressed in suitable hot moulds.—A. G. B.

Improvements in Secondary or Storage Batteries. H. H. Lake, London. From I. J. Roberts, New York, U.S.A. Eng. Pat. 21,142, December 8, 1891.

In this battery the electrodes are iron and carbon plates separated by a porous partition of vulcanised fibre. The

electrolyte is chloride of iron, and on charging sesqui-chloride of iron is formed in the anode, or carbon, compartment; while iron is deposited on the iron plate. On discharge the chloride of iron is reformed.—G. H. R.

Improvements in Voltaic Cells or Batteries. H. H. Lake, London. From E. A. Clark, Boston, U.S.A. Eng. Pat. 21,870, December 15, 1891. 6d.

THE electrolyte is arranged in the form of a pad composed of layers of paper, or other porous material, which enclose the sulphate of copper, or other salt, used with a copper zinc couple. Moistening the pad sets the battery in action.

—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

The Solid Products which result from the Oxidation of Drying Oils. A. Lévache. Compt. Rend. 1891, 113, 136—139.

CLOEZ has shown that the products of the oxidation of drying oils consist of fatty acids together with a neutral insoluble body, to which Mulder has given the name of *Linorin*. When these oxidation products are treated with solvents, such as petroleum ether, ether, oil of turpentine, acetone, ethyl acetate, or carbon bisulphide, in the cold, the action is very slight, but on boiling the oxidised oil with a small quantity of the solvent, the solid product becomes more transparent, swells up, and gets broken up into fragments which form an elastic mass. If an excess of solvent be used it becomes coloured yellow, and when evaporated leaves a solid sticky residue, which softens at a very low temperature. The insoluble portion is a friable, elastic mass. Mineral essences do not dissolve any portion of the oxidised oil, but only break it up forming an opaque greyish mass of a cohesive nature.

The author points out the similarity between the physical properties of the oxidation product of drying oils and those of caoutchouc, and considers that the soluble portion of the former could be employed with advantage in an analogous manner to caoutchouc for manufacturing purposes.

—C. A. K.

On the Polymers of Ricinoleic Acid. Scheurer-Kestner. Comp. Rend. 1891, 113, 201—203.

THE author has already shown that Turkey-red oil, prepared by treating castor oil with monohydrated sulphuric acid, contains polymers of ricinoleic acid (see this Journal, 1891, 471).

Polymerisation may be effected also by heating with water alone. The acid product, obtained by heating with water at 150° C., has, when freed from glycerol, an oily consistency, and is heavier than ricinoleic acid; according to the molecular weight it is a mixture of ricinoleic and diricinoleic acids. With increase of temperature polymerisation is carried further, as far as tetra- and penta ricinoleic acids.

Diricinoleic acid and its congeners resist saponification by soda, decomposition not being effected below 100°. The molecular weights were determined with acids dried by calcium chloride, the solvent used for products up to diricinoleic acid being acetic acid, and for products above this benzene.—T. L. B.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

New Method of Examining Chrome Yellows. M. Lachaud and C. Leprieux. Bull. Soc. Chim. 1891, 6, 235—237.

See under XXIII., page 269.

Varnishes. Dr. Hugo Müller. Nature, 1892, 45, 241—245.

AFTER pointing out that mastic varnish is simply a surface-varnish, and should never be mixed with oil varnishes, he proceeds to speak of fat or oil varnishes, which are of greater importance than mastic varnish. They are compounds of the harder resins, such as amber and the different kinds of copals, with linseed oil, and diluted with oil of turpentine. They form in reality the vehicle or medium for modern oil-painting, and consequently furnish ultimately the matrix in which the particles of the colour are embedded and held together. Next to the stability of the colours, it is then the durability of this varnish medium, in combination with dry linseed oil, on which the permanency of the oil-painting mainly depends. On the assumption that the valuable qualities of the hard resins are maintained in the varnishes derived from them, it is understood that artists' varnishes are prepared only from the hardest and most tenacious kinds of resins. Unfortunately, these are the most unmanageable and the least soluble, and require the highest degree of heat to bring them into fusion for the purpose of effecting the combination with the linseed oil and oil of turpentine, in the process of making varnish. Even the most powerful solvents, such as acetone, ether, benzene, chloroform, aniline, and phenol, have only a limited solvent action upon amber or the harder semi-fossil kinds of copal; and their solution can only be effected after they have undergone a profound change by fusion or otherwise. In opposition to what is generally stated, neither amber nor the semi-fossil hard copals are fusible in the ordinary sense of the word; for they require to be kept at a high temperature, in suitable vessels, for a considerable time before they become gradually liquefied by the action of the heavy oily products of their own decomposition. Amber and copal, when thus once melted, are completely changed; they are now fusible at a low temperature; they have become readily soluble in ordinary solvents, and miscible with heated linseed oil; but at the same time the original hardness of the resin is greatly reduced, and the colour has become of a more or less dark tint.

It remains to be proved whether much is gained by using the very hardest resins, instead of softer and more tractable kinds which yield lighter-coloured varnishes; and this is a subject which, in Dr. Müller's opinion, deserves investigation. Varnish-making is still a secret trade, and the nature of varnishes, more than any other artists' materials, is involved in much obscurity. There are no chemical methods known for ascertaining the nature or proportion of the ingredients used in their preparation, and as time is the most important factor in proving the quality of varnishes, direct practical experimental tests may be misleading.

A new process for making varnish, said to be in use on the Continent, consists in heating the resins with the solvents in autoclaves under high pressure; and there are also processes recommended which seem especially adapted for those who wish to make their own varnishes on a small scale. These latter depend on the peculiar change which the hard copals undergo when exposed for some time, in a state of very fine powder, to the action of hot air, whereby the resin is rendered more soluble without becoming much discoloured. Professor Church (*Chemistry of Paints and Painting*) (this Journal, 1892, 185) describes such a process, in which the finely-powdered resin, after having been exposed for some time to the action of air at a temperature of 220° C., is first dissolved in chloroform, then mixed with oil of turpentine, and after the chloroform has been distilled off, the resulting solution is gradually incorporated with the

drying linseed oil. Although 220° C. is repeatedly mentioned as the temperature to which the powdered resins have to be exposed, Dr. Müller suggests that this must be a mistake. Neither amber nor the copals will endure this temperature for any time without melting and becoming of a dark brown colour, or otherwise decomposed.

On the other hand, Dr. Müller has found that the various kinds of copal, which, by exposure in a finely-powdered condition for some weeks to the action of hot air in a steam closet, have become readily soluble in chloroform or acetone, are nevertheless almost entirely precipitated again on adding oil of turpentine or benzene to such a solution, and no amount of digestion, either with or without linseed oil, will re-dissolve them. Amber thus treated behaves in a similar manner, but the amount rendered soluble in chloroform or acetone is much smaller. It would, then, appear that this matter requires some further elucidation before this new process can be made readily available.

There are no special tests for ascertaining the quality of a varnish. Spreading a thin layer on a sheet of glass, and then observing the character of the film produced on drying, seems all that can be done. It ought to become dry to the touch within eight or ten hours, and not become fissured even when exposed to sunshine during a year; nor should the surface become dull during the appearance of "bloom," caused by the minute exudation of solid fatty acids originating from the linseed oil employed in its preparation.

As the drying of the solution of resins in a volatile solvent depends solely on the volatilisation of the solvent, this process is accompanied by a shrinkage of the body of the varnish which sets up a tendency to breaking-up of the surface. Linseed oil, on the other hand, becomes dry or solid in consequence of combining with a large quantity of oxygen, and this is attended by an increase in bulk. It follows that as long as a sufficient proportion of oil is in combination with the resin the tendency to crack is compensated, but if the artist, from habit or other reasons, uses with his colours a medium deficient in oil, he encounters the risk of the body of his paintings becoming fissured in the course of time, and readily subject to the destructive action of the atmosphere.

There is still much to be learned with regard to the chemical processes involved in the so-called drying of linseed oil, and this subject deserves a thorough re-investigation in the light and with the means of modern chemical research. It is, for instance, a well-known fact that linseed oil under certain conditions becomes itself a most powerful oxidiser—so much so that canvas or paper soaked with it will become destroyed in the course of time; and it seems that this effect is especially marked when oil of turpentine has been used along with it. It is quite conceivable that this activity of linseed oil may be one of the agents at work in the deterioration of oil-paintings; but whatever dangers may arise from this, the use of linseed oil cannot be dispensed with. It is otherwise with oil of turpentine, for which a very much superior substitute might be found in the higher members of the benzene series, which could now be obtained at a sufficiently moderate cost if a demand for them should arise. These hydrocarbons, whilst indifferent to the action of atmospheric oxygen, possess greater solvent power than any other, and on this account they are also well adapted for the preparation of varnishes. But for this latter purpose a still more suitable vehicle will be found in the amylac acetate, which dissolves even the hardest copals almost entirely after having been previously finely powdered and kept for some time in a hot closet. In this way excellent varnishes may be produced.

On the Durability of Modern Pigments in Oil. A. P. Laurie. J. Soc. Arts, March 11, 1892, 383—387.

PROFESSOR CHURCH, in his recent book on the "Chemistry of Paints and Painting" (this Journal, 1892, 185), has drawn up a selected palette of 25 pigments suitable for oil-painting. He divides them into two groups.

Section I. contains:—

Flake white.	Vermilion.
Cadmium yellow.	Madder carmine.
Cobalt yellow.	Light red.
Yellow ochre.	

Viridian.	Raw umber.
French ultramarine.	Cappagh brown.
	Ivory black.

Section II. contains:—

Raw sienna.	Purple madder.
Naples yellow.	Madder brown.
Baryta yellow	

Green oxide of chromium.	Cobalt blue.
Terre verte.	Prussian blue (insol.).
Malachite.	Burnt sienna.
Emerald green.	Caledonian brown.

This selected palette is the outcome of many years of experimenting and of useful observation of the behaviour of pigments. It is also sufficiently complete to supply all that is needed in painting a picture. On the other hand, it cannot be regarded as final. Doubtless, as knowledge increases, certain pigments will be excluded from this list, and others introduced.

The pigments which require careful preparation and careful testing before being finally included, are cadmium yellow, cobalt yellow, vermilion, madder carmine, French ultramarine, Naples yellow, baryta yellow, purple madder, madder brown, malachite, emerald green, Prussian blue—all these pigments are artificial except malachite, which is of little importance; and much will depend on the method of preparation, careful washing, exclusion of dangerous impurities, and freedom from gross adulteration. The other pigments in the list are permanent, if genuine; and therefore all that is necessary is to look out for adulteration.

To take then the yellow pigments mentioned in the first column, and to begin with *Cadmium Yellow*, careful readers of Prof. Church's book will find that he refers to only one shade of this yellow as being perfectly safe, an orange-yellow shade. The pale cadmiums are notoriously fugitive, and contain free sulphur, while the deep orange cadmiums seem apt to change into the yellow varieties.

The endeavour has been made to obtain a cadmium of a pure light yellow, which shall contain no such objectionable constituent as free sulphur, and shall also be molecularly stable. Some lately prepared was subjected to a dull red heat before grinding. This ought to increase molecular stability, and would, of course, prove destructive to pale cadmium, made the usual way. The pigment is probably worthy of a trial as it ought to be stable.

Cobalt Yellow (Aurcoline).—This pigment (a nitrite of cobalt and potassium) is prepared from a recipe very similar to the one given by Prof. Church. After thorough washing and grinding in oil it appears unaffected by 12 months' exposure out of doors towards the south; so that as far as the tests go, confirmation is afforded of Prof. Church's good opinion of it.

Yellow Ochre.—Attention was directed to a most objectionable adulteration of yellow ochre with lead chrome yellow. Out of seven samples of "Oxford ochre" sent by wholesale dealers in pigments, two contained chrome yellow. One of the two consisted very largely of whitening, tinted with chrome and mixed with a small quantity of a pale ochre. The result was a sample which looked as bright as the best samples of genuine Oxford ochre. Prof. Church mentions adulteration with yellow lake—no such case has yet been met with.

Vermilion.—Many English samples were found to contain alkaline sulphide, and genuine Chinese vermilion was preferred. The following are the percentages of ash found in different samples of Chinese vermilion obtained direct from China:—

(1.)	(2.)	(3.)	(4.)	(5.)	(6.)
0.1	0.1	0.06	0.12	0.06	0.04

Some of the English vermilion can be very much improved by washing with weak acid, as the following analysis shows :—

	Per Cent.
Ash before washing.....	0.52
Ash after washing.....	0.14

All vermilion, including the best Chinese vermilion, blacken in sunlight, but are probably stable pigments when exposed to the diffused light of a room or gallery.

Madder Carmine.—The madder lakes experimented on were of the author's own making. They were prepared by dyeing well-washed alumina with artificial alizarin, and again thoroughly washing. A purple, a ruby, and a rose madder were prepared. After a year's exposure the purple had, possibly, lost a little, the ruby was unchanged, and the rose was very slightly faded, and had become purpler in tint. They were all, practically, unaltered, but with a slight advantage in favour of the ruby madder.

The only other pigment open to question in this palette is French ultramarine. No experiments on this pigment were made.

Naples Yellow.—No difficulty was found in preparing a real Naples yellow, that is a compound of oxide of lead and antimony of a fine colour, but it was not exposed for a sufficient time to test its durability.

Baryta Yellow, or Lemon Yellow.—Church points out that lemon yellow is often a strontium, not a barium chromate, and that the barium chromate is much the most permanent of the two. Author therefore only experimented on the barium chromate, preparing it himself. It seemed to lose slightly in brilliancy after 12 months' exposure. As lead chrome and Prussian blue are known to be mutually destructive, it was thought as well to test a mixture of barium chrome and Prussian blue. A bright green was produced, only slightly dulled by 12 months' exposure. Here and there the Prussian blue seemed to have faded, causing the yellow to show up through it a little more, but they did not seem to have any mutual injurious action.

Brown Madder of author's own making was not tested for a longer period than six months, for that period it was not affected.

The two next pigments of doubtful stability were malachite and *Emerald Green*. Malachite is little used, and was not experimented on. Elsewhere the property which emerald green possesses of slightly dissolving in the linseed oil, and slowly diffusing through it after it is dry, is described. It is, of course, fatal both to cadmium yellow and vermilion, turning them black. For this reason, it is better rejected, or, if used, only occasionally by itself, and far away from any cadmium yellow on the picture. Author advises the introduction of cobalt green into the palette. It is a durable and beautiful pigment.

Prussian Blue.—It is very difficult to buy Prussian blue that has been properly washed. It is apt to contain as much as 0.3 per cent. of free sulphuric acid, and often large quantities of potassium ferrocyanide. English makers are, in the author's experience, peculiarly careless; and he has found it best to buy Prussian blue in Germany. It is troublesome to make. The blue he has obtained from there never contains more than 0.01 per cent. of free acid, so that it is easily washed sufficiently. He had some of a perfectly washed blue exposed for 12 months. It was found to be faded somewhat, and had become greener in tint. It must be remembered, however, that, in the dark, Prussian blue recovers; so that it should be stable in an ordinary room. It may be mixed with cobalt yellow with impunity. All the other pigments in this palette are of undoubted stability, and are beyond question.

In the course of the notes, more than once the effect of light on these pigments has been referred to. The method of testing this was as follows :—An attic window looking nearly due south was selected, and outside it a wooden frame was hung, into which glass plates (half-plate size) could be slid. After preparing, washing, and drying a pigment, it was ground in pure cold-pressed, sun-refined

linseed oil, and rubbed out on two glass plates, getting the two patches of colour to look as nearly the same as possible. Both were put away to dry, and thereafter one plate was slipped into the frame and the other put away into a plate box. In this way the plate outside was exposed to all the weather and sun for 12 months, from September to September. The pigments tested were :—

TWELVE MONTHS.

Ruby madder.....	Unchanged.
Rose madder.....	More purple, very slightly faded.
Purple madder.....	Perhaps very slightly faded.
Cobalt yellow.....	Unchanged.
Lemon yellow (barium).....	A little duller.
Vermilion (Chinese).....	Black, or dirty brown.
Prussian blue.....	Faded, greener.

SIX MONTHS.

Brown madder.....	Unchanged.
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These tests were of such exceptional severity, the exposure being outside, that probably none of these pigments should be removed from the selected palette, as they have practically (with the exception of vermilion) proved permanent. The reasons for not distrusting vermilion have been given elsewhere. As far then as the experiments have gone, the author would only exclude emerald green from this palette, provided the pigments mentioned are properly prepared, and with such restrictions, as the avoidance of impure vermilion and of pale cadmium yellow, as at present manufactured. Of the other pigments, the most affected by exposure (after vermilion) is Prussian blue. Of the other blues, of course cobalt blue is perfectly safe, but French ultramarine requires careful testing.

On the whole, this palette seems a very trustworthy one, and not at present open to much improvement. There are, however, various pigments excluded which are worthy of further trial, and may ultimately be re-introduced.

In all these experiments the pigments have been merely ground in pure oil. Different vehicles have a powerful influence on the durability of many pigments, and are worthy of special study.

The results may be briefly summed up as follows :—Linseed oil is permeable by moisture and gases, and consequently affords poor protection to pigments liable to be affected by moisture or certain gases.

The dissolving of resin in the oil, so as to make oil varnishes, such as copal-oil varnish and amber-oil varnish, has little or no effect in protecting the pigments, the moisture still penetrating.

Pure resin, when made into vehicles by solution in volatile liquids, and natural varnishes or balsams, such as Venice turpentine, *oleo de abezzo*, and others, do protect very effectively, excluding moisture and gases, and enhancing the durability of the pigment under adverse conditions.

(This probably accounts for the durability of most coloured lacquer work from Japan, when natural varnishes are used; and there is some historical evidence to show that balsam was largely used by both Flemish and Italian painters on vehicles.)

Certain pigments are soluble in linseed oil. For instance, verdigris is readily, emerald green slightly, soluble. Such pigments diffusing through the oil may be very destructive.

They are not soluble to the same extent, if at all, in resin. These results, the author hopes, may lead to the discovery of an improved medium, which will protect and isolate pigments ground in it, and so add to the durability of pictures.

In the discussion, Mr. F. Shields asked whether, in regard to the action of sulphuretted hydrogen in turning chrome yellow black, the lecturer had tried the effect of

strong electric light in reproducing the yellow colour, after it had been turned black. He imagined, as the arc light was extremely strong in active rays, that, after the exposure of a few hours to a strong arc light, one could definitely decide whether it were likely that the colour would be restored by sunlight. In the case of white, the electric light restored the colour sooner than the sunlight; at least such sunlight as they were able to get in the neighbourhood of London. His attention was first directed to this matter through some experiments tried by a friend in connexion with phosphorescence.

Mr. Laurie said the suggestion had not occurred to him, and it seemed a very good one.

Mr. Wollaston asked whether it would not be possible to produce a vermilion, by the aid of hydrogen sulphide under pressure, so as to avoid the alkaline sulphates.

Mr. Laurie said these Chinese vermilions were prepared by sublimating the sulphur and mercury together, and then one got the red sublimate on the top of the crucible; but he had not the faintest idea what would be produced by acting upon mercury and hydrogen sulphide under pressure.

PATENTS.

A Process for Printing on Celluloid, Ivory, Horn, and like Substances. A. A. C. de Coëtlogon, Paris, France. Eng. Pat. 5586, March 31, 1891.

A FINE close grain is produced on the surface of the material, either by hand or by mechanical means, such as the sand blast. The surface is then washed with water or alcohol, and covered with a varnish consisting of two parts of fatty varnish, one part of white copal varnish, and one part of rectified essence of turpentine or lavender, " &c." The varnish is rubbed off and thus made to penetrate into the graining while it is removed from the surface. An impalpable powder of equal parts of sulphate of magnesia and sulphate of baryta, with or without colouring matters, is now applied and allowed to remain on the surface for some hours, after which the surface is thoroughly wiped and subjected to any known satining process. Printing upon such a surface is as easily and effectively accomplished as upon paper.—A. G. B.

Improvements in Size. J. Shepherd, London. From A. Krizek and R. Esché, Geneva, Switzerland. Eng. Pat. 12,331, July 21, 1891.

4·375 kilos. of "amidin" are moistened with a portion of 93·875 kilos. of water; there is then added 0·100 kilo. of "acid of salicylicum," to which 1·375 kilos. of "sodium hydricum (hydrate of soda)" have been added, in small quantities; the remainder of the water is then stirred in little by little. An addition of 0·150 kilo. of "chrysoidin" and 0·125 kilo. of ether ("spiritus atheras") completes the manufacture. All the ingredients are used cold.

It is claimed that the new size produces the same effect as two to four coats of animal size.—A. G. B.

Improvements in the Manufacture of a Hard Insulating Material. R. Pape, Berlin, Germany. Eng. Pat. 20,407, November 24, 1891.

See under XI., page 249.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

The Weighting of Skins. W. Eitner. Der Gerber. 14, 27.

SKINS which have been weighted with sugar and dried in air easily mould and ferment; this is prevented by heating the skins to 50°—60° for 6—10 hours, the glucose changing to the less hygroscopic anhydride. The presence of sugar may be quantitatively ascertained by treating 1 gm. of the finely-divided leather with 10 cc. of water for five minutes; the solution is then shaken with freshly ignited magnesia until the liquid becomes pale, the filtrate is then treated with 2—3 drops of a 15—20 per cent. alcoholic solution of α -naphthol and twice its volume of concentrated sulphuric acid. When sugar is present a deep blue-violet colouration is produced, and on addition of water a blue precipitate is thrown down (Molisch's reaction). Epsom salts, barium chloride, and a mixture of Epsom salts and glucose are also employed as weighting materials. Skins yielding more than 3 per cent. of ash ought to be regarded as weighted.

—J. C. C.

PATENTS.

Improvements in and Relating to the Waterproofing of Leather. O. Brunner, Manchester. Eng. Pat. 3910, March 4, 1891.

THE waterproofing solution consists of 1 oz. of finely-divided Castile soap with 4 oz. of turpentine oil. Five ounces of such solution are said to be sufficient for the soles of two pairs of boots; it is spread over the surface of the soles with a brush, in successive coats. A fixing mixture of 2½ oz. of concentrated silicate of soda to 3 oz. of linseed oil is then applied, 5½ oz. of the mixture being required for the two pairs of soles. Each coat is allowed to dry before another is applied and the leather is finally exposed in a warm place for three or four days. A further fixing may be applied by immersing the soles in a solution of 1 oz. of bicarbonate of soda in 4 oz. of water for a quarter of an hour; but this is not necessary. The mixtures must be shaken immediately before use.—A. G. B.

Process for Clarifying and Bleaching Tannin Extracts or Tanning Liquors. A. Foesling, Düsseldorf, Germany. Eng. Pat. 4385, March 11, 1891.

See under VI., page 237.

Improvements in the Preparation of Peptone Extracts, and in the Application of the same to various Useful Purposes. M. P. Hatschek, London, G. A. Clowes, Needham, and L. Briant, London. Eng. Pat. 2207, February 6, 1891.

See under XVIII.—A., page 259.

XV.—MANURES, Etc.

The Sources of the Nitrogen of our Leguminous Crops. Sir J. B. Lawes and J. H. Gilbert. Jour. Royal Agric. Soc. 1891 [3], 2, 657—702.

THE scientific interest and the practical value of leguminous crops depend largely on the amount of nitrogen they contain, on the sources of this nitrogen, and especially on the great differences in these respects between them and the other agricultural crops. Thus, the grain crops, the root crops, and potatoes, all of which yield a comparatively small amount of nitrogen over a given area, and contain a com-

paratively low percentage of nitrogen in their dry substance, and which yield comparatively large amounts of non-nitrogenous products—carbohydrates—are especially benefited by the application of nitrogenous manures, although the increased produce is characteristically non-nitrogenous. Leguminous crops, on the other hand, which are characterised by their higher percentage of nitrogen, and which accumulate more nitrogen over a given area of land than any other crops, are comparatively little benefited by direct nitrogenous manuring.

Boussingault's experiments and those made at Rothamsted in 1858–59, in which the action of electricity and of microbes was excluded, showed conclusively that neither non-leguminous nor leguminous plants can fix free nitrogen under these conditions. And the evidence now at command still justifies the conclusion that, except in the case of the *Leguminosae*, free nitrogen is not available for agricultural plants. With regard to the *Leguminosae*, the authors have long admitted that the whole of their nitrogen could not be accounted for in a satisfactory manner. The results of Hellriegel and Wilfarth, showing that certain leguminous plants may acquire nitrogen brought into combination under the influence of lower organisms, were obviously of great importance, and led the authors to make experiments on similar lines. The first set of experiments (in 1888) included peas, yellow lupins, and blue lupins, which were grown:—No. 1 in washed sand with mineral manure, Nos. 2 and 3 in the same sand with minerals, but infected with soil organisms, No. 4 in soil. The peas, which grew well, gave very definite results, showing an increase of growth and considerably increased nitrogen fixation, under the influence of soil-extract seeding. The second series of experiments included peas, beans, vetches and lupins (as annuals), white clover, red clover, sainfoin and lucerne (as plants of longer life). The white clover experiment is still going on. A white sand was used which, after being well washed, was sufficiently sterilised by heating for some days in a water-oven. The results are very definite and striking and abundantly illustrate the fact that under the influence of suitable microbe-seeding there is nodule-formation on the roots, and coincidentally, increased growth, and gain of nitrogen. Where no soil-extract was given no nodules were found on the roots and the growth was very slight and contained only about as much nitrogen as was contained in the seeds sown. Noble's recent experiments indicate that there are several kinds of nodule organisms, and that those organisms are most beneficial to a given plant which have been obtained from the nodules of a similar plant. The observation made by Hellriegel, and at Rothamsted, that the extracts of all soils are not equal as regards nodule production, and the fact that the nodules on the roots of different plants differ widely from each other in form and in their distribution, seem to lend support to this view. Besides the strictly quantitative experiments above described, another set of experiments was made in which the same four annuals, and the same four plants of longer life, were grown in sand to which soil-extract was given and in soil, in pits so constructed that the plants could be taken up and their roots examined at three (or four) different periods of growth. It was found that when grown in sand infected with soil-organisms, the infection was more local and limited than was the case in soil; in sand the nodules were fewer, but of great size; in soil, smaller but more numerous. The analyses made with the nodules from the roots of annuals indicate that at the ripening period the nodules had lost both in dry matter and in nitrogen; in the case of plants of longer life, some of the nodules appeared to have become exhausted, whilst others, doubtless new and active, were richer in nitrogen.

The results of both sets of experiments make it probable that free nitrogen is fixed in the course of the development of the organisms within the nodules, and that the resulting nitrogenous compounds are absorbed and utilised by the host.

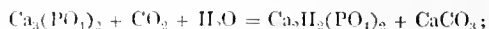
With regard to the practical aspects of the subject, Schultz of Lupitz has for years devoted a considerable area of poor sandy land to the growth of leguminous crops by means of kainite and phosphatic manures; and he found the land very much enriched for subsequent corn and other crops. The system is extending in Germany and is being

studied in Hungary. In this country Mr. Mason of Eynsham Hall, Oxfordshire, who commenced, in 1889, experiments with various *Leguminosae* in small plots, and afterwards in specially-built tanks, has now devoted about 200 acres to the practical application of facts recently brought to light regarding nitrogen fixation, his idea being to grow nitrogen-accumulating crops for home consumption and afterwards nitrogen-consuming crops for sale.

It is clearly established that there is a great gain of nitrogen under some conditions, and that the infection of the soil and of the plant is essential to success. It may also be concluded that the soil may be duly infected for one or more descriptions of plants but not for others. Land which is, so to speak, quite exhausted so far as the growth of one leguminous crop is concerned, may still grow very luxuriant crops of another description of the same family, but of very different habits of growth, and especially of different character and range of roots. This, though more or less due to other causes also, is nevertheless in some cases doubtless dependent on the existence, the distribution and the condition of the appropriate microbes. In any system involving a more extended growth of leguminous crops it will be necessary to have a considerable variation in the description of plant grown. It will generally be necessary to give liberal applications of potash and phosphate manures and to chalk or lime the land for the leguminous crop. Then the question would arise, how long the leguminous crop should occupy the land, to what extent it should be consumed on the land, or the manure from its consumption be returned; or under what conditions the whole or part should be ploughed in? Lastly, such a system would probably benefit light and poor soils more than the heavier or richer soils.—N. H. J. M.

Behaviour of Tricalcium Phosphate towards Carbonic Acid and Ferric Hydroxide. G. v. Georgievics.
Monatsh. 1891, 12, 566–581.

The author describes a large number of quantitative experiments on the action of carbonic anhydride, alone and in the presence of ferric hydroxide, on tricalcium phosphate. It was found that tricalcium phosphate, suspended in water, is decomposed by carbonic acid in accordance with the equation—



in most of the experiments this decomposition was far from being complete.

When carbonic anhydride is passed into water containing tricalcium phosphate and ferric hydroxide in suspension the calcium salt is decomposed, and the phosphoric acid combines with the iron; under certain conditions the whole of the phosphoric acid is thus withdrawn from the calcium salt.

These results have an important bearing on the question of the use of phosphatic manures, as they show that in the presence of a sufficient quantity of ferric hydroxide and carbonic anhydride, the whole of the phosphoric acid in the calcium phosphate applied to the soil may finally become converted into phosphate of iron. Alumina, which doubtless acts in the same way as ferric hydroxide, plays nevertheless a less important part in decomposing the calcium phosphate, because, being the most powerful silicate base, it is formed by the weathering of rocks in comparatively much smaller quantities.

These experiments also afford an explanation of the fact that lysimeter- and drainage-water invariably contain only traces of phosphoric acid. In what way the phosphoric acid combined with the iron or aluminium in the soil can again be brought into solution is, as yet, unknown, although the fact observed by Tuxen, namely, that the combined phosphoric acid is more readily soluble in water containing sodium salts than in pure water, points to a solution of the question.—F. S. K.

Manufacture of Superphosphate from Ferruginous Phosphates. Schucht. Zeits. f. angew. Chem. 1891, 667—671.

SEPARATING the phosphoric acid and preparing from it alkaline salts, also treatment with acid alkaline sulphates have been suggested as means of converting ferruginous natural phosphates into superphosphates. The author draws attention to the properties and behaviour of the substances which render these particular phosphates unsuitable for the preparation of superphosphates in the ordinary manner. He maintains that they can all be decomposed by sulphuric acid with more or less facility, according to the character of the phosphate and the strength of the acid, the iron passing into solution partly as acid phosphate and partly as sulphate, inasmuch as much as 2 per cent. of the latter can remain in solution with the acid calcium phosphate; but then the iron sulphate, as far as the excess of acid permits, by reacting with this calcium salt gives rise to calcium sulphate, which in its turn draws water from the phosphoric acid holding the iron phosphate in solution, and consequently the latter is rendered insoluble. A similar effect is produced when the natural phosphate is imperfectly decomposed, as the undecomposed calcium salts attack the phosphoric acid required by the iron to hold it in solution, and so "revert" it. The author is, therefore, of opinion that if sufficient sulphuric acid is used to ensure the complete decomposition of the phosphate, and that sufficient excess of phosphoric acid to keep the iron in solution is maintained, there need then be no fear of reversion. Alumina is not regarded as exerting any direct influence on the reversion, and ferrous salts are stated not to act on acid calcium phosphate, so that when a solution of the latter salt is mixed with a ferrous salt no precipitation takes place until oxidation from contact with the air or otherwise has ensued. In order to make use of this reaction for preventing reversion the author suggests the following method for the preparation of superphosphates from ferruginous natural phosphates. Decompose portions of the phosphate in the presence of ammonium sulphate with the total quantity of sulphuric acid, then reduce with sulphurous acid, and as this produces a large quantity of sulphuric acid, mix the remainder of the phosphate with the reduced mass. Experimentally a phosphate containing per cent., P_2O_5 , 30.7; CaO , 39.2; Fe_2O_3 , 4.2; Al_2O_3 , 1.9; MgO , 0.6; CO_2 , 5.0; Fe , 1.1; and SiO_2 , 1.8, was employed, and 750 grms. finely pulverised was warmed with 880 grms. of sulphuric acid $60^\circ B.$, until decomposition was complete, then 100 grms. of powdered ammonium sulphate were put in, and 220 grms. of water saturated in the cold with sulphurous acid, added, = about 10 litres of this gas, really an excessive amount of it. The mass, a thin magma, was reduced by heating in flat closed iron vessels fitted with a safety-valve. Subsequently the excess of sulphurous acid was got rid of and the remaining 250 grms. of phosphate mixed in. After two weeks the superphosphate contained 14.2 per cent. of phosphoric acid with 13.8 per cent. soluble in water; after four and six weeks the total phosphoric acid was 14.3, the soluble 13.8 per cent. It is advantageous to use the more readily decomposable phosphates for the subsequent decomposition. The author gives figures for the manufacture on a large scale and for the production of the sulphuric acid required; also suggestions for the storage and economy of the sulphurous acid. The author does not consider that this ferrous superphosphate will oxidise readily, firstly, because it is dry, and secondly, because the ferrous particles would be protected by the gypsum; the admixture of bone-meal would still further lessen chances of oxidation. As regards its behaviour towards plants the author considers that in the quantities sufficient to supply the phosphoric acid to a crop, there would not be enough ferrous iron present to exert an injurious action.

—D. A. L.

The Baltimore Meeting of the American Institute of Mining Engineers. Eng. and Mining J. 1892, 228.

THE PHOSPHATE DEPOSITS OF FLORIDA:
G. H. ELDRIDGE.

After a topographical and geological description of Florida in which he said that the formation was of the Tertiary age, divided into Eocene, Miocene, Pleiocene, Post Pleiocene, and Recent, Mr. Eldridge said that the principal portion, as far as the phosphate deposits were concerned, was Eocene, the age of the friable white limestone underlying the surface being determined, without question, by its fossils. A portion of the Median portion had been metamorphosed principally by alteration into phosphate of lime. The Miocene limestones were confined to a small territory in the vicinity of Tampa Bay and the upper western portion of the State. These limestones were always bedded, whereas the Eocene was never bedded. But the Miocene limestone itself had suffered alteration to phosphate of lime, differing but little from that of the Eocene. The Pleiocene covers a large section of the State, the constituents being clay, marls, and limestones.

Phosphate deposits in the Recent are in the course of a number of rivers, where it occurs as pebble phosphate. The Lafayette occurring at the northern border of the State was a formation very interesting, since it was the southern continuation of the red clays and marls which extend from the Potomac.

There are four classes of phosphates, he said—the hard rock, the soft rock, the land pebble and the river pebble. The gradations from the laminated variety strengthen the theory of deposition, especially as specimens of rock entirely similar in appearance were found at the Mammoth Spring in the Yellowstone, where they were deposited by the geyser mineral waters. The origin of the phosphates is in doubt, but phosphate of lime is found in many sea plants and animals. To account for these deposits through deposition and substitution there are four requirements—phosphate of lime, carbonate of lime, water, and a reagent to dissolve those minerals. Evidence goes to show that the surface waters in Florida carry to-day large quantities of carbonate of lime, carbonic acid, the real solvent, and humic acid, derived from the soils. These waters may have passed through fissures, and the phosphate of lime deposited as the carbonic acid was neutralised by the limestone. The age, however, was the Eocene. The boulders were formed by cavities in the limestone, being filled with phosphate of lime and the exterior casing being washed away.

XVII.—BREWING, WINES, SPIRITS, Etc.

The "Ginger-Beer Plant" and the Organisms Composing it: A Contribution to the Study of Fermentation—Yeasts and Bacteria. F. Marshall Ward. Proc. Roy. Soc. 1892, 50, 261—265.

THIS organism occurs in semi-transparent yellowish aggregations or as a deposit at the bottom of the fermentations. It consists essentially of a symbiotic association of a yeast and bacterium and as met with naturally is invariably associated with other yeasts, bacteria, and moulds.

The two essential organisms are both new species.

The yeast (*Saccharomyces pyriformis*) is an anaërobic bottom yeast forming spores and developing large quantities of carbon dioxide, but very little alcohol; it has also an aerobian form of pyriform cells, whence the proposed name. It inverts cane-sugar and ferments the products, but does not ferment milk-sugar. At suitable temperatures it forms spores in 24—48 hours.

The bacterium (*Bacterium vermiforme*) occurs in the fermentation as rodlets or filaments, curved or straight, and encased in a thick firm gelatinous sheath, and is markedly anaërobic, the best results being obtained by cultivating in carbon dioxide under pressure. The filaments or rods

eventually break up into cocci, which escape from the sheath, become free, and divide rapidly like ordinary bacteria.

The "ginger-beer plant" has been synthesised by mixing pure cultivations of the yeast and bacterium; the association of these two acts much more vigorously than each one separately.

Of the other organisms found in the fermenting liquid, two (*Mycoderma cerevisia* and *Bacterium aceti*) were always present, and the following very frequently: a pink yeast, a small acrobian top yeast, *Saccharomyces cerevisia*, three or four rare yeasts; *Oidium lactis*, *Penicillium glaucum*, *Dematium pullulans*, other torulae and bacteria.

A full account of this research will shortly be laid before the Royal Society. — A. L. S.

On the Presence of an Aldehyde containing Four Atoms of Carbon in "Eau-de-Vie de Piquette." J. A. Müller. Bull. Soc. Chim. 1891, 6, 796—800.

Is an "eau-de-vie de piquette," distilled from an inferior wine obtained by washing pressed grapes with water, the author has detected a substance resembling in odour α -croton-aldehyde. The piquette in question had been accidentally rather excessively exposed to air and possessed a very disagreeable flavour, whilst the spirit itself was undrinkable. The aldehyde supposed to be present was converted into the corresponding acid by digesting the spirit on the water-bath with moist silver oxide. The liquid after concentration yielded on treatment with strong alcohol, a caseous white precipitate, possessing the formula $C_{11}H_{19}O_5Ag$. The acid itself formed a syrupy, strongly acid liquid, consisting, so far as could be determined from the small amount of material at the author's disposal, of γ -hydroxybutyric acid, $CH_3OH \cdot CH_2 \cdot CH_2 \cdot COOH$. All attempts to prepare the silver salt of this acid from α -croton-aldehyde by treatment with silver oxide failed, either silver crotonate or some compound containing a smaller percentage of carbon being obtained. Theoretically, by the simultaneous oxidation and hydration of α -croton-aldehyde, only α - or β -hydroxybutyric acid, or a mixture of the two, is obtainable. On the other hand, iso-croton-aldehyde, if it exist, might yield γ - or β -hydroxybutyric acid. — H. T. P.

The Manufacture and Properties of Fig Wine. A. H. Vogel. Zeits. f. angew. Chem. 1891, 641—643.

In a recent communication (this Journal, 1891, 718) Charles describes a method for the detection of fig-wine in admixture with grape-wine, based on the fact that the former contains mannitol. In recent years, figs have been largely employed in Portugal for the manufacture, not so much of wine as of a species of brandy, and this fact has induced the author to repeat Charles' experiments in order to test their correctness. Fig-wine was prepared from ripe second-year fruit, according to the process indicated by Charles. The wine obtained possessed a most agreeable, refreshing, acid flavour, and differed in no way from the local red grape-wine, except that its colour was less intense. The disagreeable smell peculiar to fresh figs had entirely disappeared. The wine (rather more than one month old) gave the following results on analysis:—

Specific gravity	1.023	
Alcohol	1.05	per cent. by weight.
Acid	0.52	" (as H_2SO_4)

The brandy distilled from the wine possessed a most agreeable flavour and smell. The author was unable to confirm Charles' statement that the syrup obtained by evaporation of the wine solidifies to a crystalline mass on standing in a cool place for some time. No crystallisation whatever was observed, and it was only after extraction of the syrup with alcohol, decolourisation with chateaul, and evaporation of the alcoholic solution, that a quantity of crystals were obtained. The crystals were by no means pure, but were contaminated with a brown syrup which

rendered their quantitative estimation impossible. Some of the wine which had been kept for three weeks longer in corked bottles had the following composition:—

Specific gravity	1.020	
Alcohol	4.20	per cent. by weight.
Acid	0.50	" (as H_2SO_4)
Ash	0.59	"
Extract	6.92	"
Phosphoric acid (contained in the ash)	0.05	"

The ash contained much CO_2 . On testing for mannitol practically the same result was obtained as before. Another portion of wine which had been exposed to the air from the beginning became covered with a white film and deposited a voluminous light precipitate, whilst at the edges of the vessel numerous worms, 4—8 mm. in length and strongly resembling "cheese-mites," were observed. At the same time a strong cheesy odour was developed, resulting, no doubt, from the decomposition of the mannitol.

In view of these results, the author is of opinion that the mannitol test for the identification of fig-wine is unsatisfactory. On the other hand, the determination of extract might be of value, for only a sweet grape-wine (of equal specific gravity) could contain so high an extract. The ash of fig-wine also considerably exceeds that of any grape-wine. — H. T. P.

New Experiments on the Effect which a Treatment with Tartaric Acid has on Brewery Yeast. E. C. Hansen. Zeits. f. d. ges. Brauwesen, 1892, 2—6.

In a previous communication (Carlsberg Mitteilungen, 3, Heft. 1), the author has described experiments made to test Pasteur's method for purifying brewery yeast by growing it in a solution of cane-sugar slightly acidified with tartaric acid. Duclaux, Velten, and others have of late drawn attention to this method and assert that it is as efficacious as that of Hansen (cultivation from a single cell).

In the communication above referred to the author described experiments with a view to testing the value of this method, and found that not only was it quite useless, but even harmful, as it led to a considerable increase in the proportion of wild yeasts.

Velten has criticised these experiments, objecting that the mixture of yeasts used by Hansen contained considerably larger amounts of wild yeasts than would be present in a brewery product, and that the temperature at which the cultivations were made (25° C.) was too high.

In order to leave no shadow of doubt on these points, the author has made further experiments.

A yeast was obtained from a beer which had been brewed with pure yeast, the beer being perfectly satisfactory in every way. The yeast on being grown on gypsum blocks at 25° C. produced few, if any, spores during six or seven days, thus showing that either very few or no wild yeasts were present.

Two series of cultivations of the yeast in the slightly acidified cane-sugar solution were made; one at the ordinary room temperature (about 17° C.) and the other at 5° C.

In the experiments carried on at the room temperature the yeast was so altered not only after 4 or 5 cultivations but even after 3 cultivations, and that after a final cultivation in wort a yeast was obtained which on a gypsum block at 25° C. showed a plentiful spore formation after 3—4 days, thus proving that a considerable quantity of wild yeasts were present. From a microscopic examination these yeasts appeared to be chiefly *Pastorinus* and *Ellipsoides*. After only two cultivations in the acidified sugar solution and a final cultivation in wort the pure yeasts still remained in excess.

The second series of experiments at 5° C. gave similar results, except that, of course, owing to the low temperature, the time required for the successive cultivations was longer.

These experiments leave no doubt as to the accuracy of the statement previously made, that this method of purifying

yeast is not only useless but absolutely noxious; in fact there is no antiseptic known which when added to fermenting liquids will kill all the wild yeasts and leave only those suitable for the manufacture of beer; yet there is no doubt that if yeasts contaminated with bacteria be cultivated in a slightly acidified solution of cane-sugar, most of the bacteria will die and only yeasts remain.

These experiments, besides accomplishing their primary object, have given us a method for easily analysing brewery yeasts. If successive cultivations of the yeast be made in acidified cane-sugar solutions, as employed in these experiments, any wild yeasts present will, in the final cultivation, bear a much greater proportion to the brewery yeasts than in the original, and will be easily detected under the microscope.—A. L. S.

On the Influence of Oxygen and Concentration on Fermentation. A. J. Brown. Proc. Chem. Soc. 1892, 107, 33.

THE author describes experiments on the reproductive power of yeast, from which it appears that all fermentable nutritive solutions encourage the increase in number of yeast cells to some fixed point beyond which they will not reproduce themselves; and he shows that if a greater number of cells be introduced into a fermentable liquid than the liquid could originally develop, no increase in number of cells takes place. As under conditions like these fermentation still proceeds vigorously, a number of disturbing factors which complicate the results obtained under ordinary conditions may be eliminated by using non-multiplying yeast cells.

A series of experiments are described in which fermentations were conducted in presence of large amounts of oxygen, whilst at the same time duplicate experiments were made in which oxygen was excluded: the same number of non-multiplying yeast cells being used in both cases, and all the other conditions, such as temperature and agitation, &c., being kept constant. Under these circumstances it was found that both equal numbers of yeast cells and equal weights in presence of oxygen exercised more fermentative power than when unexposed to its influence. The author is unable to reconcile these results with M. Pasteur's theory of fermentation.

Experiments carried out with a fixed number of non-increasing yeast cells also showed that the amount of sugar fermented in a given time by them did not depend on the concentration of the solution, but that within the limits of 20 and 5 per cent. solutions of dextrose, approximately the same weight of sugar was fermented. When the strength of a solution reaches 30 per cent. of dextrose fermentation proceeds much more slowly.

PATENTS.

An Improved Method of Increasing the Formation of Cells during the Process of Fermentation. G. F. Redfern. London. From J. Hradil, Alt-Döbern, Germany. Eng. Pat. 3207, February 21, 1891.

THE above object is said to be attained by the addition of "vegetable mucilage" to fermenting liquids, the incomplete fermentation of which is ascribed to a deficiency of "mucilage." The mucilage in question is prepared by boiling certain parts of plants, such as quince and flax seeds, *plantago psyllium*, *fagaceæ*, unicellular *algæ*, and other plants, the tubers of orchids, the roots of althea, &c., with water for a long time. The extract thus obtained is strained and concentrated, or reduced to complete dryness by evaporation. Vegetable mucilage when dry forms a horny mass, which swells up in water to a transparent, non-adhesive jelly, but does not dissolve. This jelly may be added either to the liquid to be fermented or to the fermenting agent itself, some indifferent substance likewise being added, if necessary, to effect the more complete subdivision of the jelly. The amount of mucilage to be employed varies greatly according to circumstances. In the case of a potato mash 25–30 grms. may be used per 1,000 litres of wort.—H. T. P.

The Manufacture of Charcoal from Sawdust, Wood Shavings, and the like, and the Treatment of Wine, Alcohol, Brandy, Cider, Beer, and other Matters therewith. F. L. Calmant, Paris, France. Eng. Pat. 3978, March 5, 1891.

THE charcoal is made by carbonising sawdust or compressed shavings in crucibles. When completely carbonised the charcoal is quickly crushed and sieved and preserved in an air-tight vessel. The temperature of carbonisation varies from 600–1,000 C. according to the use for which the charcoal is intended. Different kinds of wood are to be carbonised separately as they are suitable for different purposes.—A. L. S.

Improvements in Apparatus for Distilling and Rectifying. S. Pitt, Sutton. From "A. Savalle, Sons, and Co.," Paris, France. Eng. Pat. 21,708, December 11, 1891.

THE apparatus consists of a horizontal cylinder, divided into communicating compartments by discs; a shaft passes through the cylinder to which is attached in each compartment a disc with a paddle and scraper.

The liquid to be rectified is introduced at one end and steam at the other, and the rectified vapours and the waste escape at other openings.—A. L. S.

Improved Means and Apparatus for Rousing, Aërating, and Attenuating Brewers' Wort during the Process of Fermentation. C. F. Jolliffe, St. Helens. Eng. Pat. 22,124, December 17, 1891.

At intervals the wort is pumped from the bottom of the fermenting vessels into trays with perforated bottoms placed over the fermenting vessels; by this means the wort is well roused.—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOODS.

Improvements in the Manufacture of Artificial Seltzer Water; Arrangement of the Syphon. M. de Pietra Santa. Compt. Rend. 1891, 113, 253.

THE Paris works employ the waters of the Dhuïs and of the Vannes, which are first subjected to repeated filtrations. The water is aerated by liquid carbonic acid by decreasing the pressure on the liquefied gas contained in cylinders from 12 or 14 to 8 or 9 atmospheres. The head of the syphon is composed of an alloy of pure tin, the use of lead being strictly prohibited. The central tube of the syphon is made of glass, and is held by means of copper in a cylindrical piston made of ebonite. The inside of the head of the syphon, as well as the supply pipe, are coated with a glaze of fine porcelain, so that the water has no contact with metal in any part of the syphon bottle.—C. A. K.

PATENTS.

Improvements in and relating to Sterilising Apparatus. E. Cohn, Berlin, Germany. Eng. Pat. 20,348, December 13, 1890. (Reprint.)

THE patent refers to various forms of apparatus for automatically closing bottles of which the contents have been sterilised. In its simplest form the device consists of a vertical bar passing through and connected with the lid of the sterilising box, and having at its lower end a V-shaped trough-piece by which the closing-pieces of the bottles can

be actuated. By regulating the position of the vertical bar relative to the lid, the closing of the bottles can be effected earlier or later than that of the sterilising vessel. A more complex form consists of a sterilising chamber containing a wagon running on rails within it, and provided with spaces for as many bottles as may be necessary. The closing-pieces of the bottles are actuated by closing-bars, motion to which is communicated by a vertical rack turned by toothed segments working on a shaft running from end to end of the apparatus, the outer end of which passes through the door of the sterilising chamber, and is there connected with a lever, by means of which both it and the bolts closing the door of the chamber are controlled. The position of this lever relative to the spindle and the locking-bars of the door can be regulated so as to vary the relation of the time of opening the door to that of closing the vessels. In another arrangement which is figured and described, the closing of the bottles is effected by drawing the wagon containing them along the rails on which it runs by means of a horizontal spindle working in a nut, so that rollers carried on the closing-bars pass under cams depending from the roof of the sterilising chamber, whereby the closing-bars are forced down, and the closing-pieces thus given the requisite vertical motion. In this form of apparatus an automatic safety-valve, which by opening permits of the final rush of steam being greater than it otherwise would be, is provided. The invention described in Gronwald and Oehlman's patent No. 206 of 1890 is expressly disclaimed.—B. B.

Improvements in Making an Extract of Coffee, and a Confection of the same, and in Preserving Liquid Coffee Extracts. E. Sonstadt, Cheshunt. Eng. Pat. 21,019, December 24, 1890.

CERTAIN improvements are described relating to an apparatus and method for the manufacture of coffee extract previously patented by the inventor (Eng. Pat. 3172 of 1889; this Journal, 1890, 539). The improvements are as follows:—

1. The exclusion of air from the digester and evaporator by means of a current of carbonic acid gas or nitrogen, the former being preferable.
2. The use of butter, &c. as an "aroma-absorbing agent," and the subsequent employment of the product thus obtained in the manufacture of a coffee-confection by admixture with sugar and concentrated coffee extract.
3. The substitution of asbestos, glass-wool, &c. for animal or vegetable wool as an aroma absorbent.
4. The use of a long, shallow digester (admitting of a more rapid and complete extraction of the coffee) in conjunction with a comparatively small boiler, from which the extract is drawn off from time to time (preferably).
5. The preservation of liquid coffee extract by sterilisation at 100° C.

Full details of the method of producing liquid and solid coffee extracts and confection, as well as drawings of the necessary apparatus, are given.—H. T. P.

Improvements in Making an Extract of Tea, and a Confection of the same, and in Preserving Liquid Tea Extract. E. Sonstadt, Cheshunt. Eng. Pat. 21,106, December 27, 1890.

THIS invention is an addition to a previous patent (Eng. Pat. 20,182 of 1889; this Journal, 1891, 65–66). The modified process and apparatus here detailed are precisely the same as those given for the preparation of coffee extract (Eng. Pat. 21,019 of 1890; see preceding abstract).

—H. T. P.

Improvements in the Preparation of Peptone Extracts, and in the Application of the same to various Useful Purposes. M. P. Hatschek, London, G. A. Clowes, Needham, and L. Briant, London. Eng. Pat. 2207, February 6, 1891.

THIS invention forms an extension of two preceding patents (Eng. Pat. 3363 and 18,399 of 1888; this Journal, 1888, 859 and 1890, 84). The method, formerly described, of preparing malto-peptone extract, although preferably em-

ployed, may be varied, more or less water, or simply hot or cold water alone being used, with or without the addition of antiseptics, for extracting the malt-culms.

"Malto-peptone extract is used for the following purposes:—1. As a yeast food and stimulant. 2. As an addition to bakers' ferment and sponges, and for producing buns, rolls, &c. 3. As a direct addition to bread, cakes, biscuits, chocolate, &c., and other liquid and solid foods in order to raise their nutritive values." "The extract may also advantageously be used, either alone or mixed with oil, glycerin, &c. as a substitute for yolks of eggs in tanning and dressing leather. Further, it may be employed as a nutrient in pharmaceutical preparations, either alone or in admixture with malt extract, cod-liver oil, &c." Meat-peptone may also be used for any of the above purposes, although it is not so suitable as malto-peptone.—H. T. P.

An Improved Process for the Manufacture of Artificial Mineral Waters. H. Hubener, Berlin, Germany. Eng. Pat. 2245, February 7, 1891.

THIS invention has for its object the manufacture of artificial mineral waters free from atmospheric air, and containing mineral matters of a nature more beneficial than those usually found in waters of this class. For this purpose the following ingredients are dissolved in every 1,000 grms. of air-free distilled water:—

	Grms.
Phosphate of soda "free from air"...	0.73
Sulphate of soda free from air.....	1.20
Carbonate of lime	0.15

and a small quantity of citrate of soda according to taste. Preferably the solution is sterilised and rendered perfectly free from air by boiling; or the air may be removed by suction. The air-free water is finally led into a closed vessel containing carbonic acid, and from thence to a machine in which it is charged with carbonic acid at $2\frac{1}{2}$ atmospheres pressure, and bottled in the usual way.

—H. T. P.

Process and Apparatus for Sterilising Liquids. O. Imray. From "Calberla, Fitz und Consorten," Berlin, Germany. Eng. Pat. 2816, February 16, 1891.

THE patented process is designed to sterilise milk and similar liquids continuously and in large quantity, by means of an apparatus of which all the parts are permanently connected during the operation. A device is also patented for removing the objectionable flavour of milk that has been heated in order to sterilise it. The apparatus consists essentially of a pasteurising vessel of cylindrical form, and having the whole of the steam, water, and air pipes, as well as the agitator, suspended from the lid, so that they can be removed at one operation for cleaning. The vessel is connected with a set of four vessels provided similarly with a supply of water, air, and steam, which act as germinators, the object being to develop those spores that have resisted the action of the first pasteurising apparatus, which suffices to destroy fully-developed bacteria. The milk having passed through these vessels is again pasteurised in an apparatus similar to that already described, and then flows into the final germinators of form similar to the first set. Thus there are two sets of both pasteurising and germinating vessels, and in consequence the milk undergoes two distinct treatments of each kind. In the case of the condensation of the milk being required for foreign transport, an ordinary vacuum apparatus is provided immediately after the final germinators. The last portion of the plant is a sterilising apparatus similar to the pasteurising apparatus, but fitted in addition with a rose-like device by means of which cool sterilised air is forced through the milk with the view of improving its flavour. The air is sterilised in a separate vessel into which an antiseptic fluid, such as essential or volatile oil, is sprayed in a contrary direction to the flow of the in-coming air. The bottom of the vessel is provided with a liquid seal for drawing off the antiseptic liquid without opening the vessel. The cocks and joints of the apparatus are fitted with casings filled with antiseptic materials.—B. B.

An Improved Process for Preserving Milk. J. Oakhill and R. H. Leaker, Bristol. Eng. Pat. 2944, February 18, 1891.

FRESH milk, contained in hermetically-sealed vessels, is gradually heated in a water-bath up to a temperature (about 200° F.) sufficiently high to destroy or render inert the micro-organisms present in the milk. The bath is then allowed to cool down, and the milk is finally cooled to 32° F. by placing the containing vessel in cold water or in a refrigerator.

"Milk thus treated remains in a sound and unimpaired state while the vessel remains unopened."

Drawings of apparatus accompany the specification.

—H. T. P.

Improvements in Apparatus for Drying and Disinfecting Cereals and other Granular or Sub-divided Materials. P. Bovgarelli, Turin, Italy. Eng. Pat. 5186, March 28, 1891.

See under I., page 230.

Improvements Relating to the Making-up or Packing of Baking Powders. W. P. Clotworthy, Baltimore, U.S.A. Eng. Pat. 18,491, October 27, 1891.

By this invention it is intended to avoid the rapid deterioration of baking powder, due to the gradual interaction of its acid and alkaline constituents during storage. For this purpose the acid and the alkaline carbonate or bicarbonate are packed in layers, a layer of starch or flour being placed between the two. Baking powders thus prepared will retain their aërating power for any length of time. It is convenient to make them up in packets containing sufficient for one pound of flour (see following abstract).—H. T. P.

Improvements Relating to the Making up or Packing of Baking Powders. W. P. Clotworthy, Baltimore, U.S.A. Eng. Pat. 18,499, October 27, 1891. (See preceding abstract, Eng. Pat. 18,491, 1891).

THE layer of starch separating the acid from the alkaline carbonate may be disposed with, the two constituents of the baking powder being simply packed consecutively in a suitable receptacle. The portions of acid and carbonate in immediate contact form a layer of neutral salt which effectually prevents further action.—H. T. P.

Improvements in Means for Preserving Meat, Fruits, and such like Perishable Articles in Store or in Transit. H. S. Elworthy, Sujampur, India. Eng. Pat. 19,817, November 16, 1891.

THE process consists in storing the meat, &c. to be preserved in a closed chamber charged with moist carbon dioxide or sulphur dioxide under pressure. The preservative influence of the gas employed may be increased by saturating it with some volatile antiseptic, such as cresote, which for this purpose is placed in the chamber in a dish, or sprinkled on a cloth, &c., or cotton wool, &c., soaked in the antiseptic may be placed in the gas inlet pipe. The carbon or sulphur dioxide is preferably employed in the compressed or liquefied state, a reducing valve being used to lower the pressure to the desired extent. Details of the necessary apparatus are given.—H. T. P.

Improvements in the Manufacture of Carbonated Waters. M. L. Orr, Blackrock, P. G. Hovenden, and J. Vass, Dublin. Eng. Pat. 19,927, November 17, 1891.

By means of this invention it is intended to more highly charge carbonated waters with carbonic acid. To this end the excess of carbonic acid, escaping through the automatic valve of the carbonating cylinder is passed into a strong

closed subsidiary tank containing the liquid to be carbonated. This tank is fitted with a valve made to open at a lower pressure than the valve on the carbonating cylinder, so that the air expelled from the water by the carbonic acid may readily escape. The liquid in the tank is maintained at a constant level by means of a floating ball which actuates either the inlet-tap or a water pump, which it throws in and out of gear. Any salts which it may be desired to add to the water are forced (in solution) into the tank by a second pump of suitable diameter. In operation, the water in the subsidiary tank becomes gradually charged with carbonic acid. It is then pumped into the carbonating cylinder and impregnated with a further quantity of gas in the usual way; and it is claimed that in this manner highly charged waters may be obtained at a comparatively low pressure.

—H. T. P.

Improved Method of and Appliances for Filling Sterilised Liquids into Vessels, and in Closing said Vessels Air-tight. H. D. Fitzpatrick. From G. H. Neuhass, J. F. H. Gronwald, and E. H. C. Oehlmann, Berlin, Germany. Eng. Pat. 20,086, November 19, 1891.

THE method patented consists in the use of an elastic rubber tube for filling the vessel intended to contain the sterilised liquid, which, after the vessel has been filled, can be drawn flat across the mouth, the stopper forced in, and the tube afterwards cut off. A separate elastic cover can be used instead of the end of the delivery tube, to avoid the gradual shortening of the latter which otherwise occurs. In order to prevent air leaking into the bottle after closure has been effected, the elastic tube may be tied up and cut off so as to form an elastic bag, which may be everted into the bottle and thus prevent the passage of any air to the liquid. Alterations in the external pressure are provided for by the expansion and contraction of the bag, and thus the formation of a space between the liquid and the stopper is avoided. The bag may be filled with a liquid not liable to change in contact with the air, and the stopper may be hollow to provide an additional reservoir of liquid. A hole-bored through the stopper allows the pressure of the atmosphere to be transmitted to the bag and its contents. Another form of the method described, consists in the attachment to the neck of the vessel to be filled, by means of washers and clamps, of a cylindrical cover with side tubulures for the introduction of the sterilised liquid, and provided with vertical plungers passing through stuffing boxes for inserting the stopper and wiring it down by any ordinary form of bow-fastening.—B. B.

An Improved Method of Preventing the Curdling of Albuminous Solutions. J. E. Alén, Gothenburg, Sweden. Eng. Pat. 20,419, November 24, 1891.

THIS invention relates to a method of preventing the curdling of samples of milk intended for analysis, and consists in adding to the milk a small quantity of a soluble chromate. 0.025 grm. of potassium bichromate per 100 cc. of milk suffices to preserve it at the ordinary temperature for 12 days, whilst 0.01 grm. per 100 cc. would probably prevent curdling for 24 hours. To preserve milk for 1—2 months, an addition of 0.1 to 0.2 grm. of the salt is necessary. A soluble compound of mercury may be employed instead of the chromate, or may be used in conjunction with the latter to increase the preservative action. Samples of milk collected during several days' working may be preserved by this process and finally united to form an average sample, thus avoiding the necessity of having each day's sample separately analysed.

—H. T. P.

An Improved Process of Manufacturing Kumyss Compounds or Kumyss Tablets. J. Carnrick, New York, U.S.A. Eng. Pat. 21,372, December 7, 1891.

THE object of this invention is to manufacture an artificial dry kumyss compound from which, by solution in water, an effervescent kumyss beverage may be readily prepared. To

this end, fresh milk, deprived of most of its fat, is subjected at 125° F. to the action of a digestive ferment, preferably pancreatine, for half an hour, or until 30 per cent. of the caseine has been digested and rendered soluble. The milk is then sterilised by heating to 190° F., and subsequently evaporated to dryness in a vacuum pan. During this operation sufficient cocoa-butter is added to replace the natural fat originally removed, and cane and milk sugars are also added in such proportions that the dry extract may contain 10 per cent. and 20 per cent. of them respectively. The dry residue is ground to a fine powder and mixed with sufficient bicarbonate of soda and citric acid to render it effervescent, lactic acid or a small quantity of a suitable ferment being also added to produce a further fermentation if desired. Finally, the mixture is moulded into tablets. These tablets when dissolved in water in a tightly-stoppered bottle yield liquid kumyss as a white opaque fluid "perfectly free from lumps or curds," and which, when the bottle is opened, forms "an agreeable effervescent, nutritious food-beverage adapted for the use of invalids and convalescents." If the bottled kumyss be kept for 2—4 days, fermentation sets in with the production of lactic acid, alcohol, and carbonic acid, whilst the caseine is rendered still more readily digestible.—H. T. P.

Improved Apparatus for Cooling Liquids. H. S. Elworthy, Sujanpur, India. Eng. Pat. 21,518, December 9, 1891.

THE apparatus for which the claim is made, and which is also applicable to the aerated water machine described in Eng. Pat. 19,815 of 1891, is illustrated by the accompanying diagrams.

Fig. 1.

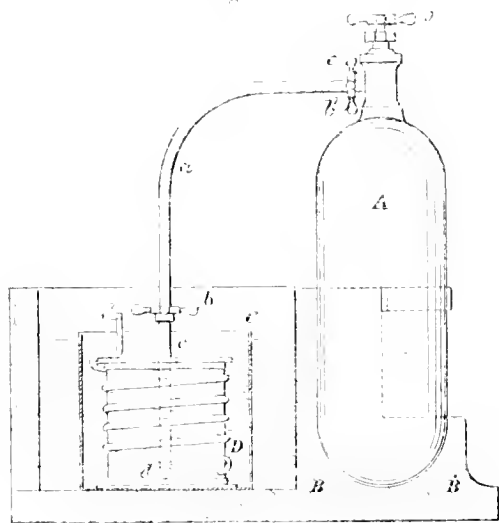
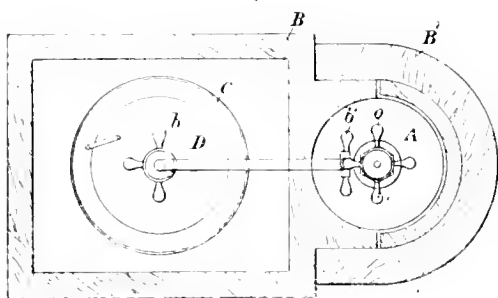


Fig. 2.



APPARATUS FOR COOLING LIQUIDS.

The tank B contains the liquor which is to be cooled. Within it is placed the receptacle C containing brine, which

surrounds another vessel D, closed at the top and fitted with a central tube finishing with a nozzle at the bottom. The vessel D is further encircled by a small spiral tube *e'* which enters the vessel at its lower end but is free to the atmosphere at the top. On a connexion being established between the central tube *cd* and the bottle A containing compressed gas, and the valve O being opened, the gas escapes through the nozzle into the vessel D, where it expands and produces intense cold, the coiled pipe *e'* allowing it to escape to the atmosphere, and, on its way, to abstract heat from the brine.—B.

(B.)—SANITARY CHEMISTRY.

Behaviour of Tricalcium Phosphate towards Carbonic Acid and Ferric Hydroxide. G. v. Georgievics. Monatsh. 1891, 12, 566—581.

See under XV., page 254.

Physiological Research on Carbon Monoxide. N. Grehan. Compt. Rend. 1891, 113, 289—290.

THE author's experiments show that one part of carbon monoxide in 10,000 parts of air may be detected by aspirating the air through dog's blood and testing the respiratory capacity of the blood before and after the experiment. By passing 200 litres of air containing 20 cc. of carbon monoxide through 50 cc. of blood the respiratory capacity was found to decrease from 23.7 cc. to 23.0 cc., showing, according to the experiments of C. Bernard, that 0.7 cc. of carbon monoxide had replaced an equal volume of oxygen in the blood. When the air was passed through the blood under a pressure of 5 atmospheres, the respiratory capacity was reduced much more—from 23.7 cc. to 17.2 cc., corresponding to an absorption of 6.5 cc. of CO. By passing the air under pressure in this manner the delicacy of the test becomes considerably increased, whilst it is also shown that the absorption of the carbon monoxide by the hemoglobin of the blood is dependent upon the pressure and is proportional to the weight of carbon monoxide contained in a given volume of air, and not to the percentage of contained gas.—C. A. K.

PATENTS.

An Improved Method of and Apparatus for the Purification of Smoke in Chimneys. E. R. Salwey, Bristol. Eng. Pat. 4565, March 14, 1891.

A cage loosely filled with asbestos wool or other suitable non-inflammable material is placed in the upper part of the chimney for the purpose of removing sooty particles, &c., from the smoke, more particularly that arising from the domestic hearth. When necessary the cage is either removed for cleaning or it is burnt clean *in situ* by means of a gas jet.—D. A. L.

Improvements in Means for Consuming Smoke. S. Hoyle and A. Haslam, Radcliffe. Eng. Pat. 4912, March 19, 1891.

See under II., page 234.

(C.)—DISINFECTANTS.

B-Naphthol Benzozate or "Benzonaphthol," a New Intestinal Antiseptic. Yoon and Berlioz. J. Pharm. Chim. 1891, 24, 179.

See under XX., page 264.

XIX.—PAPER, PASTEBOARD, Etc.

The Acid Action of Drawing Paper of Different Makes.
W. N. Hartley, F.R.S. Proc. Chem. Soc. 1892, No. 106,
19—22.

The author had experimented with various kinds of the best paper in use, both of old and recent manufacture, and had come to the conclusion that such papers were invariably acid, even those of the most excellent quality. The fact was accounted for as follows:—The fibre of which the paper is made is steeped in dilute sulphuric acid, and the subsequent washing with pure water does not entirely remove the acid from linen fibre, of which the best papers are made. He actually found nine linen to retain traces of acid after it had been steeped in frequently renewed pure distilled water for a period of three weeks. The acid seems to combine with the fibre, and the resulting compound is only slowly decomposed or dissolved by the action of water. Such linen gives a blue colour when an aqueous solution of iodine is dropped upon it. There was no intention to convey the idea that the paper contained free acid in such quantity that it could be easily removed by washing, or that it would affect litmus paper, which generally is not a sensitive agent. The samples of paper exhibited at the meeting were carefully tested in the following manner:—A pure and neutral solution of azolitmin prepared from litmus was allowed to drop upon the paper and soak into the fibres; the edges of the drops were then examined, and found to be red. The bulk of the liquid was then removed by a piece of the same paper, with the result that in every case a red spot was seen, which dried red. Another mode of testing was as follows:—A clear sable brush washed in distilled water was used for applying a wash of pure neutral azolitmin solution, as if it were a pigment, such washes turned red upon the paper.

Prof. Church, in his work on "The Chemistry of Paints and Painting," 290, published in 1890, remarks that he is unable to endorse author's statement that the best drawing papers have an acid action. He finds, in fact, that sized papers are generally neutral to test-papers, and that inferior papers are more often slightly alkaline than acid.

The papers examined by the author were all of the best quality, most of them being of Whatman's make. That no question may arise on this point, he has tested the samples named below in three ways: first, by dropping litmus solution upon the paper; secondly, by washing with a sable brush; thirdly, by steeping strips of paper in pure distilled warm water, and testing the water for acidity, and also for sulphates. The acid action was recognised by a pure litmus solution, by an ordinary laboratory preparation and by a carefully prepared solution of helianthin, though this last agent is not very sensitive.

The results are identical with those obtained on former occasions. The description of the samples and their actions is as follows:—

1. Whatman's hand-made paper, 96 lb., old make. Washes, acid; drops, acid; water, decidedly acid. Large precipitate with barium sulphate insoluble in dilute hydrochloric acid.

2. Whatman's double thick Imperial, 140 lb. Washes, acid; drops, acid; water, decidedly acid. Large precipitate of barium sulphate, as with No. 1.

3. Whatman's double elephant, hand-made. Washes, acid; drops, acid; water, strongly acid. Large precipitate of barium sulphate, as with No. 1.

4. Whatman's hand-made, 72 lb., 1887. Washes, acid; drops, acid; water, decidedly acid. Large precipitate of barium sulphate, as with No. 1.

5. Saunderson's hand-made. Washes, acid; drops, acid; water, decidedly acid.

6. Hollingworth's machine-made paper. Washes, barely acid; drops of strong litmus neutral in colour; water, very slightly acid, almost neutral.

7. Arnold's unbleached hand-made paper. Washes, acid.

No further tests for acidity were recorded.

It will be seen from these notes that there were good grounds for attributing an acid action to even the best of drawing papers. In other words, if a very sensitive solution of pure litmus be applied to paper in the same manner as a strong pigment, as for instance in delicate washes, the action is, in almost every case, distinctly acid; but if a drop of a strong solution be allowed to sink into the paper and dry up, its colour may be so slightly changed as to appear violet, leading to the inference that the paper is neutral. The strength of the solution of litmus, and the manner in which it is applied, must therefore be taken into account, because the quantity of the purple colouring matter in contact with the paper may be more than sufficient to overpower the red tint caused by the acid present in the moistened material. It is therefore extremely probable that there has been only an incomplete understanding as to the degree of acidity of the paper. Solutions of helianthin painted on the various samples of paper gave at first a pure yellow tint, which gradually changed to a colour intermediate between rose-colour and yellow. Very dilute solutions, washed on freely, showed after some minutes a pale rose-colour, mixed with a yellowish tinge. A sufficiency of acid yields a fine rose tint with such a solution. Hollingworth's paper did not show in any degree an acid action with helianthin, although it gave a slight indication with litmus.

The Acid Action of Drawing Papers. C. Beadle. Proc. Chem. Soc. 1892, No. 107, 34—35.

Prof. W. N. Hartley recently communicated a note on this subject (previous abstract) which raises questions of considerable technical importance. The fact of the "acidity" of papers need not be discussed, and Prof. Hartley's contention that an acid constituent in the paper has a serious effect on "water colours" applied to the paper the author is not in a position to criticise. He merely wishes to point out that Hartley is probably in error as to the cause of the acidity, which he takes to be a residue of sulphuric acid left in the "fibre" (rags) after the process of "souring" and washing.

The mill where the "Whatman" papers are made is situated at Maidstone, and the water used in the manufacture is the characteristically hard water of that district. The "souring" of the rags is followed by a long process of continuous washing in the "engine," and after some years' experience of paper making in the Kentish district the author is satisfied that no acid can survive this treatment.

On the other hand, the papers are sized with gelatin and alum and it is to the presence of the latter constituent that the "acidity" is, in his opinion, due. In a recent examination of one of these papers the author obtained, by treating with distilled water, an exhaust which showed "acidity" equal to 2.3 cc. normal H_2SO_4 per 100 grms. paper, using litmus as indicator in the titration, and yet this exhaust was basic to methyl orange. Sulphate of alumina, $Al_2(SO_4)_3$, being acid to methyl orange, the evidence is complete that the apparent "acidity" of the aqueous exhaust is due to the presence of a basic sulphate of alumina (this Journal, 1891, 202).

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Conversion of Gallic Acid and Tannic Acid into Benzoic Acid. C. E. Guignet. Compt. Rend. 1891, 113, 200—201.

A mixture of ammonia and zinc dust is heated in a flask fitted with cork and tube. So soon as the evolution of hydrogen is sufficiently regular a warm solution of gallic acid is added little by little. By keeping the temperature at

60° C. the gallic acid is completely converted after several hours. To extract the acid the mixture is boiled with potassium carbonate after the zinc has been precipitated as carbonate and the ammonia transformed into carbonate, evaporated to dryness, and taken up with alcohol, which dissolves the potassium benzoate. The same end may be attained by heating gallic acid with zinc and dilute sulphuric acid; in this case the benzoic acid is obtained in the form of yellowish insoluble particles. These are filtered off and washed free of zinc sulphate; the residue, consisting of benzoic acid and excess of zinc, may be treated with alcohol, or distilled directly. The sulphate of zinc solution contains also some benzoic acid, which may be separated as potassium benzoate by adding excess of potassium carbonate, evaporating to dryness, and extracting with alcohol. Tannic acid may be converted into benzoic acid under exactly similar conditions.

This reduction of gallic acid is in agreement with the synthesis by treating di-iodosalicylic acid with potash.

Catechu-tannic acid is likewise closely allied to benzoic acid. This tannin is intimately connected with catechin, which accompanies it, and gives the same derived products. Catechin dissolved in potash gives protocatechuic acid, which is one of the dioxybenzoic acids. The methods of reduction may thus very considerably facilitate the study of the tannins, such as the tannin of oak bark.—T. L. B.

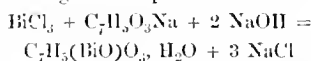
New Crystalline Oxychlorides of Iron. G. Rousseau. *Compt. Rend.* 1891, **113**, 542—544.

A concentrated solution of ferric chloride, containing over 80 per cent. of Fe_2Cl_6 , kept for some time at a temperature between 160° and 220°, gives rise to a crystallised oxychloride of iron, $2\text{Fe}_2\text{O}_3 \cdot \text{Fe}_2\text{Cl}_6 \cdot 3\text{H}_2\text{O}$. This compound in contact with boiling water is gradually changed into a hydrate $\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$, which is completely isomorphous with the oxychloride. The author has carried on the study of the decomposition of solutions of ferric chloride at temperatures higher than 220°. The solutions contained 85 to 90 per cent. of Fe_2Cl_6 , and were sealed in glass tubes with a fragment of marble. In the interval between 225 and 280° reddish-brown scales are deposited; their composition corresponds to that of the anhydrous oxychloride $\text{Fe}_2\text{O}_3 \cdot \text{Fe}_2\text{Cl}_6$. Between 300 and 340° brownish-black scales of a new oxychloride $3\text{Fe}_2\text{O}_3 \cdot \text{Fe}_2\text{Cl}_6$ are produced. These oxychlorides are only slightly soluble in dilute mineral acids. Heated in boiling water for 150 to 200 hours in presence of marble they lose all their chlorine, and are converted into brownish-red sesquioxide.—D. E. J.

On the Solution of Bismuth Chloride in Saturated Solutions of Common Salt and on Basic Salicylate of Bismuth. H. Gansse. *Compt. Rend.* 1891, **113**, 547—549.

The author has previously shown that ammonium chloride hinders the dissociating action of water upon salts of bismuth, and has now found that sodium chloride acts in the same way. Thus if dilute hydrochloric acid (about 1 to 4) is allowed to act upon bismuth oxide until no further solution takes place, it is always found that the amount of oxide dissolved is much smaller than (about one-half) that required to saturate the acid; in other words, a considerable portion of the acid is required to maintain the solution in equilibrium. If the solution is now saturated with common salt and again placed in contact with bismuth oxide it will dissolve a further quantity. The author finds that the total amount held in solution in the latter case is almost exactly that required for complete neutralisation of the acid present. He has applied this method to the production of basic salicylate of bismuth, which is prepared as follows:—35 grms. of bismuth oxide are dissolved in 40 cc. of concentrated hydrochloric acid; this solution is mixed with 500 cc. of a saturated solution of common salt; the free acid is then neutralised either by adding oxide or carbonate of bismuth, or by pouring in a saturated solution of sodium carbonate and chloride until the precipitate produced refuses to dissolve. 9 grms. of caustic soda and 22 grms. of salicylate of soda are introduced into another

500 cc. of solution of common salt: this solution is filtered and allowed to run into the first. The solution becomes violet in colour and a precipitate of salicylate of bismuth is formed according to the equation—



The mother-liquor is decanted off and the salt is washed with water slightly acidulated with nitric acid until the washings are colourless. The salt thus obtained is in the form of microscopic prisms. When heated it decomposes with loss of salicylic acid.—D. E. J.

The Action of Benzoic Acid on Turpentine. G. Bouchardat and J. Lafont. *Compt. Rend.* 1891, **113**, 551—553.

Benzoic acid appears to combine slowly in the cold with French turpentine; at 150°, taking equal weights of acid and turpentine, the action is rapid; after heating for 50 hours the change is complete. The treatment is best carried out in a copper vessel with a reversed condenser. Several products are obtained. Before proceeding to isolate them it is necessary to remove the uncombined acid by means of an alkaline solution. The product is distilled up to 200°—220°, the thermometer dipping into the liquid.

The portions which volatilise above 200° consist of *camphene*, which is solid, boiling at 157°, and *terpene* its liquid isomer, which boils at 175°—180°. Both have only a slight action on polarised light. About half the product distils above 220°. It partially decomposes on distillation, but if the pressure is reduced to 3 cm. it can be distilled at 190°—195°. The residue consists of polyterpenes (principally colophonium) volatilising at about 315°. This product, distilling in vacuo at about 190°, consists of an oily mixture of benzoic ethers of *camphenol* and *isocamphenol*. These benzoates are scarcely attacked by boiling aqueous solutions of the alkalis; on the other hand they can be saponified in the cold by an alcoholic solution of potash. The product after saponification should be washed and fractionated, the fractions being collected for intervals of 2·5°. The fractions distilling above 205° deposit, on standing at 15°, abundant crystals of levorotatory camphenol, mixed with a little dextro-rotatory isocamphenol. The portions distilling between 185° and 205° are dextro-rotatory, those above and below are levorotatory.—D. E. J.

The Preparation of Crystallised Hydroxylamine.

L. Crismer. *Bull. Soc. Chim.* 1891, **6**, 793—795.

Two methods are given for the preparation of this substance from zinc dihydroxylamine chloride $\text{ZnCl}_2(\text{NH}_2\text{OH})_2$.

1. The dry zinc salt (10 grms.) is distilled in vacuo with some organic base, preferably aniline (20 cc. of pure, recently distilled aniline), capable of displacing the hydroxylamine from the double salt. A strongly refracting liquid passes over at first; but towards the end of the distillation the drops crystallise as they enter the receiver, and soon the whole of the distillate sets to a mass of large, colourless plates. The solidification may be hastened by placing the receiver in ice. Finally, the crystals are transferred to a filtering tube, plugged with glass-wool, and washed free from adhering aniline with a small quantity of absolute ether. Moisture must be carefully excluded during the whole of the operation by means of calcium chloride tubes, &c. The hydroxylamine thus obtained possesses all the properties ascribed to that substance. It is soluble in water in all proportions; and the crystals on exposure to air attract moisture so rapidly that they liquefy and volatilise.

2. A current of dry ammonia gas (dried by KOH) is passed into a mixture of a few grms. of the zinc salt with 100 cc. of anhydrous ether, contained in a flask, moist air being carefully excluded. The zinc salt is decomposed, and swells up. The reaction being completed, the ether is decanted and distilled in vacuo. The crystalline residue left in the retort consists of pure hydroxylamine.—H. T. P.

Action of Hydriodic Acid on Cinchonine. G. Pami Monatsh. 1891, **12**, 582—588. (Compare Skraup, this Journal, 1891, 946, and Lippmann and Fleissner, *ibid*, 915).

CINCHONINE combines with 3 mols. of hydrogen iodide, forming a compound of the composition $C_{19}H_{23}N_3O(HI)_3$, which begins to decompose at 223°, and melts at 230°; when this salt is carefully treated with alcoholic ammonia at the ordinary temperature it is converted into an unstable base of the composition $C_{19}H_{23}N_3OI_2$, which melts at 187°—190°, but begins to decompose at about 175°. This base, which is named *dihydriodocinchonine*, forms a crystalline *nitrate*, $C_{19}H_{23}N_3OI_2, HNO_3$, and a crystalline *sulphate* ($C_{19}H_{23}N_3OI_2, H_2SO_4$); when it is boiled with an alcoholic solution of sodium ethoxide it yields cinchonine and a smaller quantity of a substance, the composition of which was not determined; when warmed with silver nitrate in dilute alcoholic solution, it is converted into cinchonine.—F. S. K.

Action of Hydriodic Acid on Cinchonine. E. Lippmann and F. Fleissner. Monatsh. 1891, **12**, 661—666. (Compare Pami, preceding abstract).

THE authors have repeated some of their experiments on the formation of dihydriodocinchonine, $C_{19}H_{23}N_3OI$, and have confirmed the results previously obtained. They have also prepared the dihydriodocinchonine described by Pami (*loc. cit.*) by a method similar to that employed by the latter; this compound is decomposed by ammonia in the cold, yielding hydriodocinchonine. When a mixture of molecular proportions of cinchonine trihydriodide (compare Pami, *loc. cit.*) and hydriodocinchonine is dissolved in hot alcohol, a substance, melting at 187°—190°, which seems to be identical with Pami's dihydriodocinchonine, is deposited on cooling.—F. S. K.

Dissociation in Dilute Solutions of Tartrates.
S. Sonnenthal. Monatsh. 1891, **12**, 603—619.

THE author has examined very dilute solutions of various acid and neutral salts of tartaric acid, in order to ascertain the influence of concentration on the rotatory power; the results of his investigations may be summed up as follows:—

(1.) Aqueous solutions of neutral, and of acid tartrates, undergo a change of condition when a certain degree of dilution is attained.

(2.) This change begins to take place in the case of solutions of the neutral tartrates at between 0.4 and 0.3 per cent., but in the case of solutions of the acid salts not until between 0.3 and 0.2 per cent.

(3.) The commencement, and the amount, of this change is dependent on the nature of the salt-forming metal or radicle; the greater the atomic weight of the metal, or the molecular weight of the radicle, the greater the concentration at which the change begins, and the greater also the departure from the normal condition.

(4.) The rapidity with which the change in condition takes place seems to be dependent solely upon the greater or less solubility of the salt in question.

It would seem from these results that this change in condition is a dissociation phenomenon, more especially because relatively large masses of water must be present in order to produce the change, and, further, because the larger the atomic weight of the metal the sooner the change commences.—F. S. K.

Behaviour of Quinidine and of Quinine towards Hydriodic Acid. A. Schubert and Z. H. Skraup. Monatsh. 1891, **12**, 667—690. (Compare this Journal, 1891, 946.)

Dihydriodoquinidinehydriodide, $C_{20}H_{26}N_2O_2I_2.HI$ is formed, together with dihydriodo-apoquinidine hydriodide (see below) when anhydrous quinine is warmed with hydriodic acid of sp. gr. 1.7; if quinidine is heated with concen-

trated hydriodic acid (sp. gr. 1.96) at 100° for three hours, dihydriodo-apoquinidine hydriodide is the sole product, whereas when the reaction is carried out at the ordinary temperature and in the dark only dihydriodoquinidine hydriodide is formed. The last-named salt crystallises in large yellow plates, melts at 230°, and is insoluble in potash; when treated with alcoholic ammonia at the ordinary temperature it is converted into dihydriodoquinidine $C_{20}H_{26}N_2O_2I_2$. This base melts at 218°—220°, decomposes at about 228°, and is only very sparingly soluble in alcohol, and almost insoluble in water; it forms a crystalline *ovalate* ($C_{20}H_{26}N_2O_2I_2, C_2H_5O$), and a crystalline *hydrochloride* $C_{20}H_{26}N_2O_2I_2, HCl$.

Dihydriodoapoquinidine hydriodide, $C_{19}H_{23}N_2O_2I_2.HI$, melts at about 252°, and is soluble in potash. *Dihydriodoapoquinidine*, $C_{19}H_{23}N_2O_2I_2$, melts at about the same temperature as dihydriodoquinidine, and forms a crystalline *hydrochloride*, $C_{19}H_{23}N_2O_2I_2, HCl$, and a crystalline *nitrate*, $C_{19}H_{23}N_2O_2I_2, HNO_3$.

A base of the composition $C_{20}H_{26}N_2O_2$, isomeric with quinidine, is obtained when dihydriodoquinidine hydriodide is warmed with silver nitrate in dilute alcoholic solution; it melts at 78°—79°, and dissolves in acids yielding solutions which show a blue fluorescence and which give a green colouration with chlorine and ammonia. When dihydriodoapoquinidine is treated in a similar manner, it yields a base of the composition $C_{19}H_{23}N_2O_2$. This substance melts at 157°, and its acid solutions, which show a very slight greenish fluorescence, give with chlorine and ammonia a green colouration; this base seems also to be produced when dihydriodo-apoquinidine hydriodide is heated with aniline at 100° for a long time.

By heating anhydrous quinine with hydriodic acid of sp. gr. 1.17 at 100°, the authors obtained a salt melting at 228°—230° with decomposition, and identical with the hydriodoquinine hydriodide, $C_{20}H_{26}N_2O_2, 3HI$, described by Lippmann and Fleissner (this Journal, 1891, 915). This substance seems to be a mixture of two salts, because it is decomposed by alcoholic ammonia at the ordinary temperature, yielding a mixture of two bases having the composition $C_{20}H_{26}N_2O_2I$ and $C_{20}H_{26}N_2O_2I_2$ respectively, the former being present in the larger quantity.

The base of the composition $C_{20}H_{26}N_2O_2I$ (*hydriodoquinine*) is readily soluble in alcohol, but only sparingly in ether, and melts at 155°—160° with decomposition; its solution in dilute sulphuric acid shows a blue fluorescence, and gives a brownish-yellow precipitate with chlorine and ammonia.

When quinine is heated with hydriodic acid of sp. gr. 1.96 methyl iodide is evolved, and a salt of the composition $C_{19}H_{23}N_2O_2, 3HI$ is produced; this compound melts at 236°—238°, is soluble in potash, and is decomposed by alcoholic ammonia at the ordinary temperature, yielding a mixture of two bases having the composition $C_{19}H_{23}N_2O_2I_2$ and $C_{19}H_{23}N_2O_2I$ respectively, of which the former is produced in by far the larger quantity. It would seem, therefore, that the original salt is a mixture of the hydriodides of these two bases.—F. S. K.

The Alkaloids of the Solanaceae. W. Schütte. Arch. Pharm. 1891, **229**, 492.

THE investigations have been undertaken in view of the opinion expressed by Scheerer that the root of *Atropa Belladonna* does not contain any atropine but only hyoscyamine (Chem. Zeit. Rep. 1891, **15**, 117). The author finds that the young and wild belladonna roots contain only hyoscyamine, whilst the older roots, both wild and cultivated, contain atropine in small quantity side by side with the hyoscyamine. The ripe berries of cultivated *Atropa belladonna nigra* contain both atropine and hyoscyamine, whilst the fruit of the wild plant contains atropine only. The ripe fruit of *Atropa belladonna lutea* contains no hyoscyamine, the atropine being associated with a base perhaps identical with atropamine (this Journal, 1891, 158). The unripe fruit of the wild deadly nightshade contains essentially hyoscyamine, together with a little

atropine. The leaves of both deadly nightshades contain both alkaloids, the atropine again being present in small quantity only. Both fresh and old seeds of *Datura stramonium* consist essentially of hyoscyamine, but also contain a little atropine and scopolamine. *Solanum tuberosum* contains betain, together with an alkaloid possessing a mydriatic action which has not been identified. A similar alkaloid also occurs in very small quantities in *Lycium barbarum*, *Solanum nigrum*, and in *Nicotiana tabacum*. In the seeds, leaves, and root of *Anisodus luridus* hyoscyamine alone occurs.—C. A. K.

β-Naphthol Benzoate, or "*Benzonaphthol*," a New Intestinal Antiseptic. Yvon and Berlioz. J. Pharm. Chim. 1891, 24, 479.

β-Naphthol salicylate or "*betol*" produces objectionable secondary reactions in the system when the kidneys are disordered, owing to the separation of salicylic acid that takes place. To remedy this defect in the drug the authors have replaced the salicylic acid in betol by benzoic acid. The resulting benzonaphthol is decomposed in the body into *β-naphthol*, which remains in the bowels, and benzoic acid, which is eliminated in the urine either as such or as hippuric acid. To prepare the benzoate, *β-naphthol* and benzoyl chloride are heated gently to 125° C., and afterwards to 170° C., the mixture being kept at the latter temperature for half an hour. The product of the reaction is purified by recrystallisation from 90 per cent. alcohol, or any excess of *β-naphthol* may be removed by washing with very dilute caustic soda at 50–60° C. Benzonaphthol ($C_{17}H_{13}(C_{10}H_7O_2)$) is almost insoluble in water, fairly soluble in alcohol, and readily so in chloroform; it melts at 110° C. The pure product should not be coloured blue by the addition of solid caustic potash to its solution in pure chloroform and then warming, nor should the alcoholic solution be reddened on the addition of nitric acid, and a few drops of acid mercuric nitrate.

Benzonaphthol can be taken in considerable doses without producing any toxic effect. For adults the dose recommended is 5 grms. per day, for children 2 grms.—C. A. K.

Corydaline. J. J. Dobbie and A. Lauder. Proc. Chem. Soc. 1892, 105, 13–14.

ANALYSIS of the alkaloid, as well as of its salts and derivatives, led Herm. Wicke (Annalen, 1886, 137, 274) to assign to corydaline the formula $C_{17}H_{19}NO_4$. The authors have purified samples by recrystallisation from a mixture of alcohol and ether, and have obtained the alkaloid in the form of flat, prismatic, colourless crystals, melting at 134.5°. In analysing it they obtained results irreconcilable with Wicke's formula, $C_{17}H_{19}NO_4$, and propose instead the formula $C_{22}H_{25}NO_4$.

On oxidation with potassium permanganate, corydaline yields a number of products which the authors are now engaged in investigating.

Limettin. W. A. Tilden. Proc. Chem. Soc. 1892, 107, 33–34.

LIMETTIN is the name given by the author to a crystalline substance deposited from the essential oil of the lime, originally described by him in conjunction with C. R. Beck (C.S. Trans., 1890, 323).

Further investigation of its properties shows that, instead of the formula $C_{16}H_{11}O_6$ first attributed to it, limettin has the composition expressed by the molecular formula $C_{11}H_{10}O_4$, which requires nearly the same percentages of carbon and hydrogen.

By the action of nitric acid it is converted into a nitro-derivative $C_{11}H_9(NO_2)O_4$, and by the action of bromine into a dibromo-derivative $C_{11}H_8Br_2O_4$, while chlorine converts it into a trichloro-compound $C_{11}H_7Cl_3O_4$. The dibromo-compound also exchanges the third atom of hydrogen for chlorine, giving $C_{11}H_6Br_2ClO_4$. Oxidising agents convert

limettin into acetic or oxalic acid without definite intermediate products. Potash fusion produces from it phloroglucol and acetic, but no other acid. Treatment with concentrated solution of hydrogen iodide causes the elimination of two methyl groups.

Sulphuric acid slightly diluted causes limettin to assimilate a molecule of water forming a phenolic compound of which the diacetate was prepared and analysed.

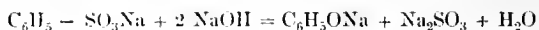
Limettin is not attacked by acetyl chloride, by phenylhydrazine or by sodium amalgam, and it gives no colouration with ferric chloride. It forms very pale yellow, thin prisms, which melt at 147.5°; it dissolves in alcohol, benzene, toluene, and acetic acid pretty freely, but scarcely in water or in light petroleum. Dilute solutions exhibit a beautiful violet fluorescence. It seems to have the constitution $C_6H_5(OCH_3)_2.C_5H_7O_2$.

Synthetical Carbolie Acid. H. W. Jayne. American J. of Pharm. December 1891.

It has been known for some years that carbolie acid (phenol) could be produced by numerous synthetical methods, but interest in the subject has been especially manifested recently on account of several firms, in response to the constant demand for purer preparations, having undertaken its manufacture on a commercial scale. Of the many reactions by which phenol can be produced, only two are, at present, commercially practical, both using pure benzene as the starting point.

The first or sulphate method is applicable to the preparation of all phenols, and has been used for some years, producing on an immense scale naphthol. In this method pure benzene, free from thiophene, is placed with about five times its weight of strongest commercial sulphuric acid (67° B.) in closed cast-iron pots provided with stirrers and lead coolers, and capable of being heated by a steam jacket. While the mixture is slowly stirred, the vessel is gently heated with steam in such a manner that the vapours of benzene which pass into the cooler are continually returned to the kettle. After a number of hours the reaction is finished, and the benzene not acted on is collected as it flows from the cooler. The crude benzenesulphonic acid, mixed with the excess of sulphuric acid used, is allowed to cool, and then diluted with water in a lead-lined tank. Slaked lime is added to the hot solution in sufficient quantity until it is faintly alkaline. This removes the excess of acid by forming calcium sulphate, which is then filtered off by means of a filter-press. The clear liquor containing calcium benzenesulphonate is treated with sufficient sodium carbonate to precipitate all the calcium as carbonate, which is removed by filtration, and the liquor is now evaporated to dryness, leaving the sodium benzenesulphonate as a white powder.

In a large cast-iron kettle heated by a coal fire, caustic soda is melted, and small portions of the dry sodium salt, prepared as above, are gradually added, and finally the whole is kept in quiet fusion for some time. The melt now contains sodium carbolate and sulphite, together with the large excess of caustic soda used—



It is ladled from the kettle into pans and allowed to cool, broken up, dissolved in water, and acidified with sulphuric or hydrochloric acid. The phenol thus liberated separates from the concentrated salt solution, and can be collected and distilled.

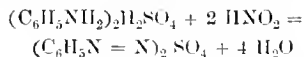
In melting the sodium benzenesulphonate with caustic soda, it is necessary in order to obtain a good yield to use a very large excess of the latter. A greater yield is obtained with caustic potash, and if as large a quantity as six parts are used to one of the soda or potash salt a nearly theoretical yield can be obtained, but as this would greatly increase the cost, caustic soda is used instead.

It has been proposed to treat the melt after dissolving in water with carbonic acid gas, which would liberate the phenol equally well as a stronger acid, and in addition would form carbonate of soda or potash, which together with the

sulphite already present could be converted into the hydrate by treating with lime, concentrated, and used for a second operation.

The second method is much simpler. A pure aniline oil, preferably that grade called aniline for blue, is dissolved in water in a lead-lined tank covered with a hood, and provided with stirrers and leaden steam coils. The solution is acidulated very strongly with sulphuric acid, and to the hot liquid a solution of commercial nitrite of soda is gradually added, phenol being at once formed.

In this reaction the sodium nitrite, in contact with the acid solution, liberates nitrous acid, which forms diazobenzene-sulphate with the aniline sulphate—



but as the solution is hot it at once decomposes into phenol with evolution of nitrogen—



Neither of these synthetical methods can at the present time compete in price with the extraction of carbolic acid directly from the coal-tar oils.

A good grade of crystal acid can be purchased abroad in large quantities at this time at about 11 cents per pound, while the pure benzene used in the first method is worth at the English refineries about 14 cents per pound, and aniline oil about 20 cents, without taking into consideration the other expensive chemicals necessary to carry out the reaction.

When the synthetical acid was first placed upon the market it excited much interest, and purchasers were willing to pay the high price it commanded, believing that they were getting a much purer article than could be produced by the ordinary methods. This interest has, however, considerably abated since the acid has been found to redden just as easily as the best commercial grades.

It could scarcely be expected that an acid obtained by either of the complex reactions just described would not be contaminated by products formed by side reactions in the process. In its preparation by the sulphonate method, sulphur compounds (thiophenols, &c.) are likely to be formed; and its manufacture from a substance like aniline, which so readily produces colouring matters, could scarcely be carried out without at the same time forming bodies which at once or later under the influence of light and air would discolour it.

In addition, commercially pure benzene or aniline oil always contain small quantities of, respectively, toluene or toluidine. These bodies being submitted to the same treatment as their homologues give cresol. It is true that this body would be present only in minute quantities, but sufficient to reduce the melting point of the resulting phenol.

Lunge has shown that the addition of 1.3 per cent. of cresol to pure phenol reduces the melting point 8° to $31\frac{1}{2}^\circ$, and in the preparation of a high grade carbolic acid a difference of a part of a degree is of great importance.

"Forty degrees acid" is at present a commercial article sold at excessively low prices, and if a small part of the attention and labour which is used in producing a synthetical acid was expended in the further purification of this 40° acid, without doubt just as pure if not a purer article could be produced direct from tar oils and at a very much lower cost.

Chemical Study of the German and Turkish Otto of Roses. U. Eckart. Archiv. des Pharm. **229**, 355; Monit. Scient. November 1891, 1145—1153.

THE centre of production for this essential oil is Roumelia, 120 villages on the confines of Kesanlik possessing 2,500 stills, and furnishing from 1,900 to 2,500 kilos. per annum. No one knows precisely the date at which this industry was commenced, but it is believed to have been somewhere about the 17th century. For the preparation of the essential oil, the *Rosa Damascena f. trigintipalata* is principally cultivated, a cultured red variety of *Rosa gallica* and of *Rosa centifolia* richer in essence than the white variety.

The fresh petals are introduced into alembics of tinned copper with an addition of twice their weight of water. The contents of the vessel are then submitted to distillation, which is stopped when half the water has passed over. The product is then submitted to renewed distillation, receiving the sixth part of the liquid, which is let stand for two days. The supernatant essential oil is separated by means of small funnels of tin, and preserved in jars of tinned copper containing from 500 to 5,000 grms. each.

1,000 kilos. of fresh flowers yield about 160 to 400 grms. of essential oil. In recent years the firm of Schimmel and Co., of Leipsic, have cultivated the *R. centifolia major*, and have obtained by the distillation of 23,000 kilos. of fresh roses, 4 kilos. 500 grms. of essential oil. This product has in part served for the investigation to be described, along with another quantity of essential oil from Kesanlik which had had separated from it its stearoptene.

The Crude Essence.—The German essential oil obtained in the harvest of 1890, possesses at the ordinary temperature the consistence of butter, has a light green colour from chlorophyll, and melts at 27° . The odour is powerful, and recalls to some extent that of mint. This essence is finer than the Turkish product, and is composed of stearoptene and a liquid oil. It has no action on litmus paper moistened with alcohol, is easily soluble in ether and chloroform, but with difficulty in alcohol and glacial acetic acid. The Turkish essential oil solidifies at the ordinary temperatures, and melts at 17° to 22° . The melting point varies more or less with the extent of stearoptene, and this content is independent of the climate. The specific gravity of this oil oscillates between 0.87 and 0.89. The other properties approach very closely those of the German oil.

Separation of the Stearoptene.—The German essential oil is distilled and about 5 per cent. of the product is collected from 79° to 100° . The residue distilled in vacuo gives a fresh portion of liquid, whilst the stearoptene does not pass over. This process was replaced by the following, which, however, does not yield the products distilling below 100° . The oil is dissolved in five times its weight of alcohol at from 70° to 80° , the solution is cooled to 0° , agitating meanwhile. The stearoptene is separated by filtration, and washed with cold alcohol. The alcoholic solution is evaporated in vacuo, and an oil is thus obtained almost completely free from stearoptene. By this treatment it is possible to obtain:—

(1.) A product distilling below 100° , obtained by the method first specified.

(2.) Elaeoptene, remaining portion of the liquid product.

(4.) Stearoptene.

The principal part of the essence, that also which is aromatic, is the elaeoptene.

Product passing over below 100° .—This product, 5 per cent. of the essential oil, consists of ethylic alcohol.

Properties of the Oil separated from the Stearoptene.—*Physical Properties.*—This portion of the German essential oil is coloured a light green and has an odour like that of mint, a specific gravity of 0.891 at 11.5° , and the power of rotating the plane of polarised light to the left. It easily dissolves in ether, alcohol, chloroform, bisulphide of carbon, benzene, petroleum spirit, and glacial acetic acid. The Turkish oil freed from stearoptene possesses an odour strongly resembling that of mint, is yellowish in colour and has a specific gravity of 0.8804 to 0.8813 at 15° . According to the polariscope of Wild, it turns the plane of polarised light to the left 5.4° for a length of 200 mm. As regards solubility it behaves like the elaeoptene of the German oil.

Chemical Properties.—This oil only contains carbon, oxygen, and hydrogen. It is neutral and without action on ferric chloride. Potash and an ammoniacal solution of nitrate of silver are equally without action on the substance. It does not combine with hydroxylamine. Consequently it neither possesses the phenolic, aldehydic, or cetic functions.

Submitted to distillation in portions of 20 to 30 grms., this oil passes over from 110° to 120° under a pressure of 12 mm. (It is necessary to avoid the use of more of the product for distillation than that mentioned, for a portion becomes transformed into a non-volatile substance.) Analysis gave numbers corresponding to the formula $C_{10}H_{15}O$.

The compound $C_{10}H_{16}O$, which Markownikoff found in the oil of Bulgarian roses, contains 76.92 per cent. C, 12.82 per cent. H, whereas the author found 11.40 to 11.70 per cent. H (this Journal, 1891, 63).

The eleoptene does not contain terpenes, and this extract of the Turkish essential oil behaves like that found in the German oil. Thus they show the following physical constants:—

Specific Gravity.	Temperature.	Boiling Point.	Index of Refraction.	Molecular Refraction.	Dispersion.	Rotatory Power.
THE ELEOPTENE OF THE GERMAN ESSENCE.						
.. .. 0.8837	15	216	1.4775	49.28	12.5	2.8
	18	..	1.4719	49.28	12.5	2.8

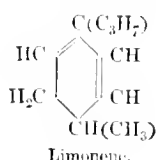
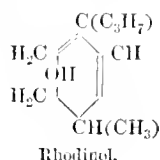
THE ELEOPTENE OF TURKISH ESSENCE.						
2nd fraction. 0.8789	18	216	1.4719	48.97	12.0	2.7
3rd fraction. 0.8782	18	217	1.4718	48.98	11.7	2.7
4th fraction	18	217	1.4725	48.98	11.1	2.7

The author gives the substance the name of *Rhodinol*, and various compounds of this body are now described. By heating rhodinol for three hours from 180° to 120° in a sealed tube, with lime or an alkali, it is decomposed so as to yield small quantities of valerianic acid, acetic acid, and formic acid.

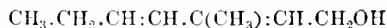
Stearoptene.—Rose oil contains from 20 to 68 per cent. of this substance, which, according to Flückiger, crystallises in the hexagonal system, boils at 32.5° and distils at about 350° , though not without decomposition. Its formula expresses a carbide $C_{16}H_{34}$, and on oxidation by nitric acid, succinic and oxalic acids are produced along with other acids. The carbide thus appears to belong to the fatty series. From the stearoptene of the Turkish oil two carbides were isolated, one of which melted at 23° and the other at 40° , the German oil yielding under the same conditions a carbide melting at 22° and another the melting point of which lies between 40° and 41° .

Thus, the conclusion is arrived at that stearoptene from rose oils is a mixture of different homologous hydrocarbons.

The author confirms the fact of the existence of two kinds of stearoptene in the rose oils. The oils obtained in cold countries are richer in stearoptene than those of hot countries, but it must be added that the amount of stearoptene varies in the same region with the time of the year. The melting point of the rose oil is shown to depend upon the amount of stearoptene present, that the melting point of this body is not always the same, and that it is generally lower as the percentage of the stearoptene increases. The research shows that the Turkish and German oils are composed of three substances: Ethylic alcohol, eleoptene, and stearoptene. The most important constituent is eleoptene, or *rhodinol* $C_{10}H_{16}O$, which belongs to the series of alcohols, $C_nH_{2n-2}O$. It is further shown that rhodinol belongs to the methane series. Thus rose oil can be classed amongst the rare essential oils which contain bodies rich in carbon, and in which the chain is a closed one. Rhodinol is a primary alcohol. Its molecular refraction and absorption for bromine point to two ethylene links in its chain. Its optical properties indicate that it contains an atom of asymmetric carbon. The production of terpenes points to the position in the ring of the methyl and propyl groups. The formula thus derived explains easily the transformation of rhodinol first into limonene and then into dipentene—



The constitution of *Geraniol*, an isomeride which behaves like rhodinol, is, according to Semmler—



(this Journal, 1890, 889 and 1145). According to the author, the difference between the two isomerides lies in the positions of the groups of methyl and propyl, in those of the double links, and in the nature of the asymmetric carbon.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Photography in Colours. Labatut. Compt. Rend. 1891 113, 126—129.

THE author has employed Lippmann's method for photographing in natural colours (this Journal, 1891, 483), to show that when colour sensitizers are employed the maximum effect of the acting light corresponds exactly to absorption spectra of the dyes used. The colours experimented with were Cyanine and Victoria green. In both cases the maximum effect was coincident with the light absorbed by the transparent and sensitised emulsion used, whilst as in the previous experiments the resulting plates after development showed complementary colours when viewed by direct and by reflected light respectively. The due interpretation of this result in relation to the wave theory of light is discussed in the paper. Since the colours on the sensitive plate, obtained when any colour sensitizer is used indicate the portion of the light rays absorbed by the plate, it is unnecessary to examine such sensitizers spectroscopically in order to ascertain the limits of their action.—C. A. K.

The Action of Light on Silver Chloride. A. Béchamp. Bull. Soc. Chim. 1891, 6, 836—840.

THE recent work of Guntz in this direction (this Journal, 1892, 179) has induced the author to recapitulate some experiments made by himself in 1833.

Pure silver chloride was exposed under water to the action of light for four days, the water being frequently changed. The supernatant liquid soon after the commencement of the experiment gave a precipitate with silver nitrate, and readily decolourised a solution of indigo. At the same time no gas was apparently disengaged from the

chloride, and the odour of the water was somewhat different from that of chlorine. Evidently an oxygen compound of chlorine had been formed. The blackened chloride was afterwards collected and dried. When fused it did not diminish appreciably in weight, proving the absence of an oxychloride, and on cooling separated into two layers, the one being yellow, transparent, and horny, the other black and porous. From the loss of weight undergone by the silver chloride during exposure to light, the amount of silver-subchloride, Ag_2Cl , present (assuming it to have been formed) was deduced and found to be equal to rather more than one-sixth of the total chloride taken; and the author remarks that so far as he can remember the relative bulks of the horny and porous layers above mentioned were in the same ratio. Referring to Guntz's discovery, that silver chloride which has been heated in absence of light becomes reducible by the oxalate developer, the author remarks that by an investigation of the action of solar light deprived of its heat rays, on silver chloride, an explanation might possibly be found for the varying influence of light, transmitted by coloured and uncoloured screens, on silver chloride.—H. T. P.

Quantitative Estimation of Silver and Gold by Means of Hydroxylamine Hydrochloride. A. Leiner. *Monatsh.* 1891, 12, 639—641.

See under XXIII., page 271.

PATENT.

Improvements in or Relating to Magnesium Flash Lights. R. Hadden, London. From F. H. F. Engel, Hamburg, Germany. Eng. Pat. 7487, April 30, 1891.

IN this improved apparatus the magnesium reservoir is mounted in such a manner that it can be turned on the blowing tube and so be brought into an inverted position over cavities, provided for receiving the magnesium powder, along the upper part of the blowing tube; these then become charged and the reservoir is turned back again; any superfluous powder being wiped from off the blowing tube back into the reservoir by lateral strips of packing. A puff of air into the blowing tube projects the powder into burning gas jets placed above, but with this apparatus the cavities can be quickly refilled by repeating the above operations.

—D. A. L.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENTS.

Improvements in the Manufacture of Explosive Substances. H. E. Newton, London. From A. Nobel, Paris, France. Eng. Pat. 5331, April 16, 1886. (Second Edition.)

This invention describes "explosives composed of a nitrate, chlorate, or perchlorate of the metallic bases intimately mixed with nitroglycerol or equivalent explosive matter, but without the addition of combustible matter."—W. M.

Improvements in the Manufacture or Production of Gunpowder or like Explosives. J. Y. Johnson, London. From the "Dynamite Actiengesellschaft Nobel," Vienna, Austria. Eng. Pat. 6128, April 9, 1891.

A SMOKELESS powder is made by mixing 70–99 parts of nitro-starch with 1–30 parts of di- or tri-nitrobenzene and compressing the powder to a suitable degree. The pressure employed imparts a density to the grains which "gives the lowest possible pressure of gas on combustion."—W. M.

Improvements in and Relating to High Explosives for Use in Mining and for Military and other Purposes. J. M. Pollard, Washington, U.S.A. Eng. Pat. 20,418, November 24, 1891.

THIS invention consists essentially in the manner of mixing chlorates or nitrates and sulphur together. Sulphur is first added to melted paraffin so that each particle becomes coated with the hydrocarbon, then the chlorate or nitrate is added and the incorporation continued. The mass may now be pressed into cartridges, or if the explosive be desired in the form of grains it is granulated while hot and allowed to cool gradually, so that each particle may retain its coating of paraffin and thus become waterproofed.—W. M.

Improvements in Railway Fog Signal Detonators. A. Ruston and E. Beadle, London. Eng. Pat. 21,879, December 15, 1891.

IN this signal the base is formed with a recess in which the clip for attaching it to the rail is secured so that the surfaces of the base and clip lie flush on the rail. The top is also formed with a circular recess for holding the percussion caps in position.—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

Composition of Glass suitable for Chemical Apparatus. R. Weber. *Zeits. f. angew. Chem.* 1891, 662—665.

THE author, continuing the investigation he has been engaged in for years, has examined some more specimens of glass with the following results:—

Glass.	Percentage of					Ratio.		
	SiO_2	Al_2O_3	Fe_2O_3	$\text{CaO}(\text{MgO})$	K_2O	Na_2O	$\text{SiO}_2:\text{CaO}:$	$\left(\frac{\text{K}_2\text{O}}{\text{Na}_2\text{O}}\right)$
A	69.86	1.05	3.23	8.86	17.00	17.5	1	4.9
B	74.19	0.49	5.85	7.32	12.24	11.8	1	2.64
C	74.88	1.36	5.85	..	17.70	12.0	1	2.0
D	74.48	0.50	7.15	6.61	11.23	9.5	1	2.0
E	74.68	0.50	6.82	7.62	10.20			
F	73.63	2.01	7.10	..	16.64	9.5	1	2.0
G	71.23	1.70	16.59	..	10.79	4.0	1	0.6
H	73.49	0.51	11.50	2.50	9.50	4.7	1	0.8
I	73.20	1.98	9.12	1.75	13.95	7.6	1	1.4
J	73.13	1.41	11.51	5.65	10.06	5.8	1	1.0
K	71.10	1.90	9.75	6.70	10.55	7.2	1	1.34

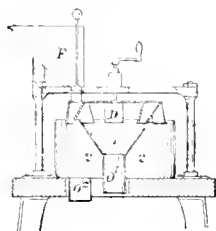
Glass A was a fragment of a finely graduated burette, it had become rough both in and outside, glittering flakes dropped from it when it was gently heated, and on boiling for a short time with water it yielded a solution strongly alkaline to ordinary indicators. Glass B was from a boiling flask; this flask when left filled with water for about four weeks became coated inside with a gelatinous deposit, which was developed again by a second treatment. In the two treatments the flask, 0.8 litre capacity, lost 0.162 gm. in weight. From the analytical data it is presumed that this glass must have been prepared from a mixture of 100 parts of sand, 14 parts of calc spar, 14.5 parts of potash, and 28 parts of soda, a mixture which cannot yield a proper glass. Both this and the first glass are absolutely unfit for

chemical apparatus. Glass C is a sample of similar inferior glass examined 10 years or so ago. Glasses D and E are from flasks about 100 cc. capacity, of Bohemian manufacture. These were only slightly affected by prolonged exposure to the air or to the fumes of hydrochloric acid, and when water was boiled in them continuously for six hours they lost 0.012 gm. in weight. Glass F is a similar glass examined 10 years or so ago. Glass G is an example of excellent window glass, glass H of French glass used in the manufacture of Fresnel's lighthouse lenses, both characterised by their high resistance towards ordinary deteriorating agents. Glass I is a sample of "Hohl" glass, from which articles of great durability have been manufactured. Glass J is a similar good glass examined in 1879. It seems that what is required is more lime and less alkali in glasses for chemical purposes, and the author is of opinion that much might be done in improving matters in this direction without fear of increasing the cost of production on account of decreased fusibility. Glass K is an example of a glass which the author has obtained for some years; it resists the action of air and acid fumes well, and loses only very slightly in weight on boiling with water or dilute acid; thus a 100 cc. flask of this glass only lost 0.008 after boiling water in it six hours continuously. This glass is decidedly less readily fusible, but nevertheless does not present any special difficulty to be overcome in its manufacture.—D. A. L.

A Mixer and Divider for Ore Samples, and small Sampling Machine. H. L. Bridgman. Eng. and Mining J. 1892, 275.

This apparatus (Fig. 1) entirely obviates the tedious and

Fig. 1.



frequently inaccurate methods—usually with oil cloth and spatula—now in general use, for mixing and dividing the ground samples of ore, matte, slag, and other similar material. An experience of several months has shown a very decided improvement in accuracy, speed, and general convenience over the old way.

The operation is as follows:—The ground material is introduced into the large covered funnel (mixer), the outlet being first closed by thumb or finger, as may be most convenient. Funnel and contents are then well shaken for a few minutes, and then, with open outlet, passed to and fro over the set of distributing funnels (divider) and bottles, as shown. With very finely ground or very light material the flow may be assisted by a slight shaking or tapping with the hand. The little skill necessary is readily acquired.

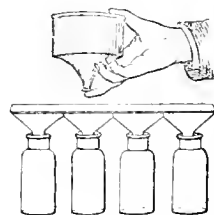
The mixer will also be found very useful for the prompt and thorough mixing of crucible assay charges and all other work of similar character.

To test the efficiency of the mixer, a lot of 6 assay tons of litharge, 3 assay tons of soda and $\frac{3}{4}$ assay ton of argols was taken, well shaken, divided by weight into three lots of $3\frac{1}{4}$ assay tons each, and these charges fused separately in crucibles. The resulting lead buttons weighed 53.436 grms., 53.416 grms., and 53.398 grms. respectively.

The ore sampling machine is shown in Fig. 2. Its particular field of usefulness is the quick and certain cutting down of the miscellaneous small samples (from 5 lb. to 500 lb. in weight) that are constantly being received by all assay offices. It is applicable for anything from the fines

assay pulp to crushed material of one-half inch or more in size. It is a very decided improvement over any of the

Fig. 2.



present methods of quartering, or cutting down with sample shovel or tin sampler.

In operation, the material is fed either by hand or (with large lots) from a suitably supported bucket into the funnel F, the divider D being first set in rotation by hand, clockwork, or any convenient power. The divider gives eight cuts to the revolution, four being delivered to the funnel 1, and four to the receptacle 2; that is, with uniform flow and speed, cutting the material in half. The divider may easily run 100 revolutions per minute, giving in that time 800 cuts, a very much greater distribution and division than can be secured in any other way. The rejected sample passes down the outlet to O₂, both into suitable vessels. The retained portion, should it be too large, may be cut again and again until of suitable size. The operation is very accurate and very rapid, being about as fast as the material will flow through a 1-in. spout.

INORGANIC CHEMISTRY.— QUALITATIVE.

Volatility of Nickel in Presence of Hydrochloric Acid. P. Schützenberger. Compt. Rend. 1891, **113**, 177—179.

See under X., page 243.

Behaviour of Tricalcium Phosphate towards Carbonic Acid and Ferric Hydroxide. G. v. Georgievics. Monatsh. 1891, **12**, 566—581.

See under XV., page 254.

INORGANIC CHEMISTRY.— QUANTITATIVE.

The Direct Determination of Aluminium in Iron and Steel. T. M. Drown and A. G. McKenna. Technology Quarterly, 1891, **4**, 220—227.

The unsatisfactory nature of most methods for the direct determination of aluminium in presence of iron and phosphoric acid, and the sharpness with which the two latter can be estimated, have led chemists to rely mainly upon processes in which the aluminium is obtained by difference. But in examining modern alloys which may contain only a fraction per cent. of aluminium, nothing short of its direct determination can be satisfactory.

The authors have found that it is possible to remove iron by electrolysis from its acid solution using a current that in no way affects the aluminium present. The essential condition of success is the use (as proposed for other purposes by Dr. Wolcott Gibbs) of mercury as a cathode, the iron forming an amalgam with the mercury as fast as it is deposited from solution. Preliminary experiments made to test the completeness of the deposition of iron showed an apparent loss notwithstanding that the iron was completely removed from solution. This was found to be due

to the volatilisation of mercury on drying before weighing. To free the mercury completely from moisture it is only necessary to heat it for about two minutes at a temperature of 100°C ., and in this time the loss is very small. It is, however, advisable, in cases where the process is used to determine iron, to have a blank beaker in the circuit containing only mercury and dilute sulphuric acid, and to add any loss which may be found in this beaker to the amount found in others in the series. The best conditions for the rapid precipitation of the iron are a strong current (about 2 amperes or 20 cc. of electrolytic gas a minute), a nearly neutral solution of small bulk, a large amount of mercury (not less than 50 times the weight of the iron to be precipitated), and a large anode of platinum. The mercury cathode is brought into the circuit by means of a platinum wire enclosed and fused into one end of a glass tube, which passes through the liquid. It is of advantage to pour mercury into this tube to the depth of an inch, in order to weight it and make the connexion with the mercury cathode more stable. 10 grms. of iron can be precipitated in 10 to 15 hours. The iron amalgam may contain as much as 10 per cent. of iron. After long exposure to air, the iron separates out as a black powder, which may be removed by agitation with water. The mercury may be purified by filtration through chamois leather, and then passing air through it.

Secondly, the authors find that under the foregoing conditions manganese in solution is partly reduced to the metallic state (forming an alloy with the mercury) and partly oxidised to the dioxide which coats the platinum anode.

Thirdly, as to the influence of phosphoric acid on the deposition of iron. Duplicate experiments made with and without addition of phosphoric acid (hydrogen di-sodium phosphate) showed that its presence did not affect the deposition of the iron, and further, that the phosphoric acid in solution could afterwards be accurately determined by precipitation with magnesium mixture.

Fourthly, as to the separation of iron and aluminium solutions containing known amounts of both (as sulphates) were electrolysed, and, after the iron had been deposited and estimated, the aluminium was precipitated by ammonia. The results were entirely satisfactory.

Finally, the following process is recommended in the examination of iron or steel. Dissolve 5 to 10 grms. of the sample in sulphuric acid, evaporate until white fumes of sulphuric anhydride begin to come off, add water and heat until all the iron is in solution, filter off silica and carbon, and wash with water acidulated with sulphuric acid. Make the filtrate nearly neutral with ammonia, and add to the beaker in which the electrolysis is to be made about 100 times as much mercury as the weight of iron or steel taken. The bulk of the solution should be from 300 to 500 cc. Pass a current of about two amperes over night. In the morning test for iron, and, if necessary, continue the electrolysis after adding nearly enough ammonia to neutralise the acid set free. Finally, remove the solution from the beaker with a pipette while the current is still passing. When as much has been removed as possible without breaking the current, add water, and continue the operation until the acid has been so far diluted that there is no danger of dissolving iron from the mercury. Take the anode out and wash the mercury. After filtering (to remove any flakes of MnO_2) add sodium phosphate in excess, and 10 grms. of sodium acetate. Make nearly neutral with ammonia and boil for 40 minutes. The precipitate of aluminium phosphate is then filtered off, ignited, and weighed.—D. E. J.

On a New Hydrate of Copper, and on the Preparation of Pure Nitrogen. A. Le Due. *Compt. Rend.* 1891, **113**, 71–72.

By carefully watching what happens in the preparation of pure nitrogen by means of copper, the author has been led to discover a new compound of copper with hydrogen. This new compound has nothing in common with the compound discovered by Wurtz, which is formed in the cold and disappears entirely at about 60° . This, on the other hand,

is formed at a dull red heat by direct union of its elements, and shows only traces of dissociation at a bright red heat. It is, therefore, analogous to the alkaline hydrides discovered by Troost and Hauteville.

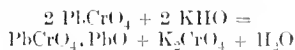
In preparing pure nitrogen (in order to determine its density), the author as usual passed pure dry air through a tube of Bohemian glass containing copper turnings heated to a red heat. He found it was important to carry out this operation at a somewhat dull red heat; also to have near the further end of the tube about 10 cm. of oxidised turnings. Several experiments in which the tube was raised to incandescence, showed that these oxidised turnings at the end were completely reduced, and the nitrogen formed in these experiments had (like Regnault's) too low a density. The explanation lay in the fact that the copper used had first been oxidised, and then reduced in a current of hydrogen in order to give it a clean surface. This was shown to be the case by the following experiment.

The tube containing the copper filings was heated to a bright red heat in the middle and to 300° towards the ends; a current of hydrogen was passed for two hours, and the copper was then allowed to cool in the gas. In the parts of the tube which had been heated to a dull red heat there was formed a large quantity of a substance of a beautiful hyacinth-red colour, partly on the metal itself and partly on the top of the tube. A current of carbonic acid was afterwards passed through the cold tube, and the gas on leaving was completely absorbed by potash; the tube was then gradually raised to incandescence. The gas now ceased to be completely absorbed, and in a quarter of an hour over 20 cc. of gas was collected, which proved to be hydrogen mixed with a small quantity of carbonic oxide, formed by the reducing action of hydrogen upon carbonic acid.

The author is convinced that the hydrogen in the above substance is really combined with the copper, and not merely absorbed by it.—D. E. J.

New Method of Examining Chrome Yellows. M. Lachaud and C. Lepierre. *Bull. Soc. Chim.* 1891, **6**, 235–237.

The authors have shown that chromate of lead on treatment with dilute solutions of potash become decomposed, according to the equation—



On this reaction the following analytical process is based. Two grms. of the lead chromate are well shaken in a flask with 20 cc. of binormal potash solution (112 grms. of KHO per litre). The mixture is diluted with distilled water, and the solution is decanted or filtered from the residual basic chromate. The excess of potash in the solution is determined by titration with sulphuric acid in presence of phenolphthalein, the latter part of the titration being performed with very dilute acid in order to observe the transition point more exactly. From the amount of potash neutralised by the chromic acid extracted from the original pigment, the total amount of normal lead chromate can be calculated. The process is recommended for simplicity and rapidity.—G. H. B.

The Action of Light on Silver Chloride. A. Béchamp. *Bull. Soc. Chim.* 1891, **6**, 836–840.

See under XXI., page 266.

On the Colorimetric Determination of Iron by Means of the Sulphocyanate and other Coloured Compounds of the Metal. J. Ribau. *Bull. Soc. Chim.* 1821, **6**, 916–920.

A METHOD of estimating small quantities of iron (especially in blood) has been proposed, which is based on transforming it into the sulphocyanate and comparing in a colorimeter the solution thus obtained with a standard solution containing a known quantity of the sulphocyanate. The author has examined the accuracy of the method by means of a Duboseq colorimeter. In using this instrument (and all

others of the same type) a certain assumption is made. Calling the amounts of the colouring matter contained in the two solutions to be compared p and p_1 , and the depths of two columns of the respective solutions which appear of the same colour e and e_1 , then it is usually assumed that—

$$\frac{p}{p_1} = \frac{e_1}{e}$$

In order to test the reliability of the method it is sufficient to see whether experiment shows that this relation is true.

A series of solutions of ferric chloride was prepared containing regularly decreasing amounts, p_0, p_1, p_2, p_3 , &c. of iron, so that—

$$p_1 = \frac{p_0}{2}, p_2 = \frac{p_1}{2}, \text{ \&c.}$$

To the original solution (from which the others were prepared by successive dilutions with water) a large excess of ammonium sulphocyanate was added in order to diminish the dissociation which the dilution with water might be expected to produce. The first solution (p_0) contained 0.0001 grm. of iron per cc.; the fifth (p_4) contained 0.0000063 grm. per cc. The solutions were compared in pairs and the depths (e_0, e_1, e_2 , &c.) required to produce equality of tint were noted. The results show a wide divergence from the values required by the relation—

$$\frac{p}{p_1} = \frac{e_1}{e}$$

(Thus, e.g., in comparing p_1 and p_4 , the ratio between e_1 and e_4 was found to be 14.8, whereas according to the theory it should be = 8.) This divergence is most marked when the solutions compared are of very unequal concentration. The discrepancy is due to progressive dissociation of the sulphocyanate by water. The method is therefore unreliable excepting when the two solutions to be compared are of the same composition and strength; and in practical colorimetry it is difficult, if not impossible, to fulfil these conditions.

The author has endeavoured to obtain better results by transforming the iron salt into acetate (both neutral and acid), and also into alkaline tartrate of iron, but without success. The neutral acetate decomposes in the cold in about 24 hours, depositing a basic acetate; and the addition of acetic acid scarcely mends matters. Dilute solutions of the alkaline tartrate lose their colour spontaneously in the light.—D. E. J.

The Composition of the Atmosphere: a New Gravimetric Method for ascertaining the Same. A. Ledue. Compt. Rend. 1891, 113, 129—132.

THE method adopted for ascertaining the gravimetric composition of the air is a modification of that proposed by Brunner, and consists in absorbing the oxygen contained in a known weight of air by means of phosphorus and weighing the residual nitrogen. Full details are given of the precautions taken to avoid all possible sources of error. The method is considered more exact than that of Dumas and Boussingault inasmuch as any error arising from the occlusion of hydrogen by the copper used in their method is avoided. Two analyses made at intervals of six days gave 23.244 and 23.208 per cent. of oxygen by weight, whilst Dumas and Boussingault found 23 per cent. of oxygen. This corresponds to 21.02 per cent. of oxygen by volume, a result agreeing with that obtained by the author from a comparison of the specific gravities of oxygen and nitrogen.—C. A. K.

α -Orthostannic Acid. G. Neumann. Monatsh. 1891, 12, 515—523.

THE author attempted to isolate germanium from the mother-liquors of commercial tin-salt, but without success; in the course of these experiments a considerable quantity of stannic chloride was prepared, and the boiling point of

this compound was found to be 114°, under a pressure of 760 mm. When a solution of stannic chloride containing a large quantity of ammonium sulphate is treated with a small quantity of an aqueous solution of hydrogen sulphide, a white precipitate is produced; this precipitate has, when air-dried, the composition $\text{SnO}_2 \cdot 2\text{H}_2\text{O}$, or $\text{Sn}(\text{OH})_4$, and is readily soluble in hydrochloric acid, so that it must be regarded as the hydrate of α -stannic acid. The same compound is obtained when a solution of stannic chloride is treated with an alkaline sulphate alone.—F. S. K.

Estimations in Alkaline Solution by aid of Hydrogen Peroxide. P. Jannasch and R. Niederhöflich. Ber. 1891, 24, 3945—3947. (See also this Journal, 1891, 659 and 1037.)

Separation of Zinc and Manganese.—The mixture of sulphates dissolved in 50 cc. of water in a platinum dish had added to it 10 cc. of a 10 per cent. solution of cyanide of potassium, and then 10 cc. of a 25 per cent. caustic potash solution; the whole was stirred until the precipitate was almost completely dissolved. The manganese was now precipitated with 50—60 cc. of hydrogen peroxide solution. The whole was heated for a quarter of an hour on the water-bath, and then filtered. The filtrate was saturated with hydrochloric acid on account of the nitrate of soda contained in the hydrogen peroxide, taken to dryness in a porcelain dish and heated to 110°—115°; the zinc was then precipitated in hydrochloric acid solution of the residue so obtained (silica being filtered off) with sodium carbonate and determined as oxide.

Since it is extremely difficult to remove all the potash from the manganese precipitate, it is advisable to re-dissolve in dilute nitric acid in presence of a small quantity of oxalic acid, and re-precipitate with hydrogen peroxide in ammoniacal solution.

It is mentioned that copper, in slightly ammoniacal solution, containing only small quantities of ammonia salts, is precipitated quantitatively by excess of hydrogen peroxide, and methods for the separation of copper and zinc, and also of copper and nickel, are in progress.—T. L. B.

The Estimation of the Inorganic Constituents of Raw Sugars. Alberti and Hempel. Zeits. Rübenzucker Ind. 1891, 27, 85—91.

See page 273.

Calculation of Slag Components. G. Murray. Eng. and Mining J. 1892, 281.

FROM a given set of ores which may be made into combinations such that there may be a division into three or more classes, in No. 1 metallic basic, No. 2 earthy basic, No. 3 acid, it is required to take of each such quantities as combined will give a mixture containing its components in desired proportion.

Let the proposed mixture be such that there shall be a , FeO metallic bases, b , CaO earthy bases, and c , SiO_2 acid components, the whole = 100 lb., so that the letters may express percentages: from this we have—

$$\text{Total FeO} = \frac{a}{c} \text{ SiO}_2 \text{ and } \frac{a}{b} \text{ CaO}$$

Take an ordinary example: Let the composition of required slag be 40 per cent. FeO, 20 per cent. CaO, 40 per cent. SiO_2 , in the sense above taken, No. (1) as above, 30 per cent. FeO, 5 per cent. CaO, 20 per cent. SiO_2 ; No. 2, 3 per cent. FeO, 50 per cent. CaO, 4 per cent. SiO_2 ; No. 3, 6 per cent. FeO, 2 per cent. CaO, 60 per cent. SiO_2 , weight of charge to be 1,000 lb.

Denote quantity of No. 1 by x , of No. 2 by y , take 100 lb. of No. 3.

Making the first term of an equation regarding FeO components, the second siliceous, we have—

$$0.30x + 6 + 0.03y = (0.50y + 0.05x + 2) \frac{a}{b} \cdot \frac{a}{b} = 2.$$

$$x = 4.85y - 10$$

$$0.30x + 6 + 0.03y = (0.20x + 0.04y + 60) \frac{a}{c} \cdot \frac{a}{c} = 1.$$

$$x = 540 + 0.1y = 4.85y - 10$$

$$4.75y = 550, \quad y = 118$$

$$x + y + \text{No. 3 ore} = 770$$

$$1,000 \div 770 = 1.3$$

$$118 \times 1.3 = 152; 552 \times 1.3 = 717; 100 \times 1.3 = 130; \text{total, } 1,000.$$

Amounts of FeO, CaO, SiO₂ contained in the above are respectively 227, 227, and 114, which relate to each other as required. The total is partly equal to the weight of slag in charge = 568 lb.

Were the quantities of FeO, CaO, SiO₂ in the generally constant quantity of coke used in place of those in No. 3 ore, the amounts of x, y deducted from 1,000, we should have the difference only to obtain in x, y , and No. 3 ore. On finding these and adding likes to likes, we have the amounts of the components in proportion required.

In practice, the above is not used in its entirety, small percentages of some elements being discarded, and in cases of very constant ore simple factors taking its place altogether.

The Estimation of Oxygen Dissolved in Water.

M. A. Adams. Proc. Chem. Soc. 105, 1—2.

THE author describes an apparatus in which the estimation of oxygen in water by Schützenberger's method may be carried out so as entirely to avoid the loss of oxygen, or diffusion or its entry. The essential feature is a cylindrical laboratory vessel about 350 cc. in capacity, 20 cm. long, and 5 cm. in diameter, provided with four small lateral tubulures midway from the closed ends. By means of these it is attached to two burettes, one containing the indigo carmine, the other hyposulphite solution, and also to a mercury reservoir and to a Y-tube, one branch of which is connected with a supply of the water to be examined, the other serving as an outlet for the water. The tubes are all controlled by pinchcocks. The water and the liquids for titration are sucked into the vessel by lowering the mercury reservoir, and are subsequently discharged by raising it again; the tubes passing into the vessel from the burettes are provided with india-rubber valves which prevent either reflux or diffusion taking place into the burettes.

The author then refers to the peculiar irregular manner in which the action is known to take place, and describes his own observations, giving the results both of experiments made in the manner directed by Schützenberger and in the indirect manner recommended by Roseoe and Lunt (this Journal, 1889, 729—732). From the results he concludes that in estimating oxygen by the Schützenberger process, the result obtained is liable to differ according to the rate at which the determination is effected, it being always higher when the titration is quickly performed.

Quantitative Estimation of Silver and Gold by Means of Hydroxylamine Hydrochloride. A. Lainer. Monatsh. 1891, 12, 639—641.

HYDROXYLAMINE hydrochloride, in presence of potash, is eminently suitable as a reagent for the quantitative determination of silver in silver nitrate, silver sodium thiosulphate, and silver potassium cyanide, and also for the complete reduction of chloride, bromide, and iodide of silver. Special experiments showed that the presence of organic acids, such as citric acid, does not prevent the precipitation of silver by hydroxylamine hydrochloride and potash. For separating silver from other metals, such as copper, for

example, it is first precipitated as chloride, and the washed precipitate reduced to metal by boiling it with an aqueous solution of hydroxylamine hydrochloride and potash.

Hydroxylamine hydrochloride alone precipitates gold from a solution of auric chloride in the cold, but on warming reduction takes place much more readily; this reaction may be very conveniently employed for the separation of gold from solutions of the chlorides of the alkalis and alkaline earths. In presence of potassium cyanide, gold is not precipitated from a solution of auric chloride on addition of hydroxylamine hydrochloride and potash, but it is completely precipitated from a solution of auric chloride containing sodium thiosulphate.

The above methods may be suitably employed for the recovery of silver and gold from photographic residues, commercial "reducing salt" being used instead of pure hydroxylamine hydrochloride. —F. S. K.

ORGANIC CHEMISTRY.—QUALITATIVE.

The Qualitative Reactions of Vegetable Lubricating Oils.

Holde. Mitt. könig. techn. Versuchs. 1891, 294—302.

THE author has investigated various reactions for the identification of various lubricating oils and the detection of their commonest impurities.

(a.) *Rape Oil*.—The detection of rape oil in such lubricating oils as olive oil, has been alleged to be possible by means of the sulphur which it, in common with other oils of the *cruciferae*, is said to contain. The usual method for this purpose consists in saponifying the oil and testing the product with a lead or silver salt. According to Schädler, however, cold pressed rape oil is free from sulphur, while Benedikt states that other oils that have been extracted by carbon disulphide, contain sulphur. Schweissinger failed to find sulphur in a large number of samples of genuine rape oil, a result in accordance with the author's experience. Schneider's method for detecting as little as 2 per cent. of rape oil in olive oil, which consists in dissolving one volume of the oil in two volumes of ether, and shaking the solution with 20 to 30 drops of a saturated alcoholic solution of silver nitrate, was found quite unreliable. The method proposed by Villavechia and Fabris, consisting in treating 10 cc. of the oil, previously saponified, with 2 cc. with a solution of silver nitrate and 10 cc. of dilute nitric acid, also proved unreliable, as the dark ring which is supposed to form between the two layers into which the liquid divides, appeared as readily with olive oil as with rape oil.

(b.) *Cotton-Seed Oil*.—Of the various forms of the Bechi test, which is too well known to need description, that devised by Milliau alone proved of value. Five per cent. of cotton-seed oil gave a chocolate-brown coloration, while pure rape oil and olive oil yielded only a yellow solution. The author confirms the statement of Dieterich (Hefenberger Annalen, 1890, 2) that cotton-seed oil, after being heated, may fail to give the reaction. One of the two samples examined gave a comparatively feeble coloration after it had been heated to 240° C., while the other yielded no perceptible result. The process proposed by Hirschsohn, which depends on the production of a red coloration with gold chloride in chloroformic solution, was also tried and condemned. The same remark applies to the use of nitric acid of sp. gr. 1.37, which is supposed to give a coffee-brown coloration. By shaking 1—2 cc. of the oil with an equal volume of nitric acid of sp. gr. 1.41 somewhat better results were obtained. The coloration was red-brown in the case of pure cotton-seed oil, and dirty yellow with pure olive oil, becoming brownish on standing. Refined rape oil gave a brown coloration. 20 per cent. of cotton-seed oil could be detected in olive oil, but 10 per cent. was not recognisable with certainty. The method has therefore a certain utility as a preliminary test. The tests proposed by Peters of warming equal volumes of the oil and acid together, and observing the colour of the solidified product, proved valueless.

(c.) *Sesame Oil*.—The well-known sugar test was found to be of value. The author carries it out by shaking about 2 cc. of hydrochloric acid of sp. gr. 1.19 with a pinch of powdered sugar, adding about double the volume of oil and again shaking. 0.5 per cent. to 1 per cent. can be thus detected. Pure olive oil, rape oil, and hemp oil gave only a yellowish colouration. The colouration should be observed immediately after the separation of the acid, as a solution of sugar in hydrochloric acid itself becomes reddish-brown on standing. Grace Calvert's method depending on the use of a mixture of nitric and sulphuric acid gave unsatisfactory results.

(d.) *Drying Oils*.—The method proposed by Benedikt, which consists in immersing a clean copper wire in a mixture of 2 cc. of nitric acid and 5 cc. of the oil to be tested, and stirring with a glass rod, proved ineffective when tried with linseed oil, no pink colouration of the wire being observed. With regard to hemp oil, Benedikt's method of treatment with hydrochloric acid of sp. gr. 1.19 or with nitric acid sp. gr. 1.18, which are said to give a green colour, and the test with a mixture of sulphuric acid and nitric acid mentioned by the same chemist, proved too uncertain for useful application.

(e.) *Brull's Reaction for Seed Oils*.—This reaction, which consists in warming 10 cc. of the oil to be tested with 0.1 of the grm. of powdered albumen and 2 cc. of nitric acid, which was stated to be of general applicability, was also found to be useless for the detection of seed oil in olive oil.

(f.) *Fish Oils*.—The reaction for the detection of fish oils by means of syrupy phosphoric acid has been already found valueless by Schädler and Grittner.

(g.) *Mineral Oils*.—The method already described by the author (Mittheilungen, 1890, 22) was further tested. It was found that in the presence of only small proportions of mineral oil (0.5 to 2 per cent.) the turbidity which first appears on the addition of water sometimes disappears on dilution, the mineral oil being dissolved in the soapy liquid.

(h.) *Rosin Oil*.—The method given in the Mittheilungen 1890, 19 (this Journal, 1890, 419), for the detection of rosin oil by means of sulphuric acid of sp. gr. 1.624, suffices for the examination of olive and rape oil. Morawsky's reaction (this Journal, 1889, 372) is also available in the absence of rosin. (Compare this Journal, 1891, 661.)

It appears from these results that qualitative reactions for the detection of adulterants in oils are of very limited utility, seeing that those tried the sugar test for sesame oil was the only one of undoubted reliability. This is not surprising when the fact that the reactions probably depend on unessential constituents of the oils is considered.—B. B.

On some Colour Reactions of the Carbohydrates. G. Bertrand. Bull. Soc. Chim. 1891, 6, 259–261.

WHEN a glucose is gently heated with concentrated hydrochloric acid containing a small quantity of phloroglucol a yellow colour is developed which passes rapidly to orange red. Ultimately a dirty red precipitate forms and the solution becomes partially decolourised. The reaction proceeds in the cold, but requires several hours for completion. Analogous reactions have been described by various authors, who have also employed orcinol and α -naphthol instead of phloroglucol; but the author considers that erroneous interpretations were given to the reactions, and instances the fact that Wiesner considered a violet colouration given by gum arabic with hydrochloric acid and orcinol to be due to the presence of a diastase. The author finds that the red colouration is given by this reaction with all the glucoses and substances furnishing glucose by hydration, but it is always necessary to use the concentrated acid, as dilution diminishes the number of substances susceptible of the reaction. Many of the phenols can be substituted for phloroglucol, and the employment of orcinol is the more instructive, as the colouration varies with the molecular condensation of the sugar to be examined; thus the colour is violet-blue with arabinose and xylose of the

five carbon atom class and orange-red with glucoses containing six carbon atoms. The author believes these reactions are attributable to certain furfural derivatives which are produced under the conditions of the experiment. The following colour reactions were obtained with orcinol and hydrochloric acid:—

1. Orange-red solution: glucose (by Soxhlet's method), glucose (from cellulose), galactose, mannose, levulose, sorbin, saccharose, lactose, maltose, melizitose, strechyoze, trehalose, isodulcite, glycogen, inulin, levulin, potato starch, rice starch, dextrin, achroo-dextrin, amygdaline, salicin, hesperidin.

2. Violet-blue solution: arabinose, xylose, cherry-tree gum, and other natural gums. Gum arabic and gum senegal give a violet-red colour.

3. No colouration: xylite, sorbite, duleite, mannite, perseite, inosite, pinito, bergénite, saccharin (of Peligot).
—G. H. B.

ORGANIC CHEMISTRY.—QUANTITATIVE.

The Detection of Saccharine. D. Vitali. L'Orosi 14, 109.

THREE different methods are given. In each case the saccharine is first isolated in the usual way and then tested for by one of the methods.

1. The substance is heated in a tube with three to four times its volume of slaked lime. Ammonia, calcium carbonate, calcium sulphate, and phenol are thereby formed. The latter, condensing in the colder parts of the tube, may be detected by a new colour test devised by the author. A few crystals of potassium chlorate are carefully added to a few cc. of concentrated sulphuric acid. A drop of this placed on a porcelain tile, and touched with a glass rod which has been moistened with the distilled product, produces when phenol is present a green colour, which changes to an intense blue.

2. When the substance is treated with concentrated sulphuric acid, benzoic acid is produced.

3. By heating with caustic soda, ammonia, salicylic acid, and sulphuric acid are produced.—J. C. C.

On Graphites. W. Luzi. Ber. 1891, 24, 4085–4095.

IT has been known for a considerable time that graphite puffs up when boiled for a lengthened period with concentrated sulphuric acid, then washed, dried, and ignited. The following reagents and mixtures of reagents have been used by various authors to produce the result, viz., concentrated sulphuric acid, a mixture of the same with concentrated nitric acid, a mixture of sulphuric acid with potassium bichromate, and a mixture of sulphuric acid with potassium chlorate. The present author finds concentrated nitric acid to act perfectly well alone; a mixture of sulphuric acid and potassium permanganate is also recommended. A quicker method, however, is to moisten the graphite on platinum foil with fuming nitric acid and then to heat to redness in the Bunsen flame. In this manner, by taking pieces of graphite of the size of peas, products may be obtained on which the structure of the formation is easily examined. These transformed pieces of graphite float on water, alcohol, and ether for weeks, and evacuation of the flask in which pieces were floating on water did not produce a sinking of the particles. A low-power microscope reveals the crystalline nature of the inner surfaces. This shortened method of treating graphite has resulted in a revelation of the fact that two classes of natural graphites exist, the members of the one class showing the puffing up with the treatment mentioned, the members of the other class showing no puffing up whatever.

Belonging to the first class are:—

Graphite from Ticonderoga, New York.

Ceylon graphite.

Norwegian graphite.

Graphite from Quebec.

Belonging to the second group are:—

Graphites from Passau, Siberia, New Mexico, Saxony, The Fichtelgebirge, and also "electric" graphite.

The author, conceiving the idea that there might be a difference in constitution between the two classes, made analyses of members of each class, but no essential difference in composition could be detected, and it would seem that two different modifications of carbon are here in question.—T. L. B.

A Method for the Alkalimetric Estimation of Phenol. R. Bader. *Zeits. Anal. Chem.* 1892, **31**, 58—60.

THE author has found that phenol in solution in water may be titrated with normal caustic soda, using as an indicator an alcoholic solution of symmetrical trinitrobenzene. This solution is made by dissolving as much trinitrobenzene (melting point 122°) as will lie on the point of a knife in 50 cc. of absolute alcohol and filtering; this solution has a slight yellow tinge and is acted upon by light, so it is best to prepare fresh solution from time to time. Not more than 2—3 drops must be used for each titration, and excess of alkali gives a reddish-yellow colouration. The results from this method are from $\frac{1}{4}$ to $\frac{1}{2}$ per cent. too high. The author gives several examples. As regards the application of the method to the titration of the homologues of phenol with ortho- and meta-cresol, the results are somewhat unsafe, whilst para-cresol gives at once a troublesome yellow colour with caustic soda. The author thinks the method would give good results with catechol and its isomerides.—J. C. C.

New Method for the Determination of Phenol. L. Carre. *Compt. Rend.* 1891, **113**, 139—141.

THE method consists in converting the phenol into picric acid, and then determining the quantity of the acid formed colorimetrically. The solution to be tested should be dilute; if strong it must be diluted to 10 times its original strength. 25 cc. of the liquid are placed in a small flask containing 5 cc. of nitric acid, and the mixture heated on the water-bath for 1—2 hours. The colouration at the end of the heating is compared with that given by solutions of phenol of known strength heated with the same quantity of nitric acid for exactly the same length of time. The method is rendered more accurate by adding 20 cc. of caustic soda solution after the heating and making up the solutions, both tests and standards, to 50 cc. In this case the solution must be filtered if necessary. In presence of small quantities of alcohol the heating on the water-bath must be continued for a sufficient length of time to volatilise the alcohol; if larger quantities are present the solution must be diluted first so as to prevent the formation of nitrous ether. If the phenol is impure it must be heated with the nitric acid until all tarry matters are destroyed. Two results given show the accuracy of the method.

—C. A. K.

The Testing of Inks. *Zeits. Anal. Chem.* 1892, **31**, 116—120.

A NORMAL ink is first prepared by dissolving 23.4 grms. of tannin and 7.7 grms. of crystallised gallic acid in water at 50°C ., and adding to it a solution of .6 grms. of gum arabic, 10 grms. of hydrochloric acid containing 2.5 grms. of HCl, a solution of 30 grms. of sulphate of iron, and 1 gm. of carbolic acid; the whole is diluted to 1 litre and allowed to stand for four days and the clear solution poured off. To this normal ink colouring matter is added to get the required tint. The ink to be tested having stood for three days is uncorked and 50 cc. is taken out from the centre of the liquid and filtered through a small fine filter-paper; 25 cc. of the filtrate are placed in a cylindrical vessel, the neck is closed loosely with filter-paper, and the liquid is allowed to stand for some time in diffused light and in contact with air free from ammonia and acid; if after 14 days there is a deposit on the walls of the vessel the ink is unsatisfactory.

In order to test the darkening qualities of the ink a sheet of the best white writing paper is stretched on a frame and placed at an angle of 45° , then a little of the unfiltered ink is allowed to run down the surface from a glass tube and

form a streak on the paper. Another streak of the first ink is formed in the same way by the side of the second and both are allowed to dry; then if they compare favourably both inks are diluted with an equal volume of water and fresh streaks are made, allowed to dry, and compared. Further, the paper may be cut into strips across the streaks and treated with water, 85 per cent. alcohol and 50 per cent. alcohol for two days, after drying they are again compared.

To test the fluidity the ink is allowed to flow from an oval spreader and the width of the streak measured. The tendency to blot may be observed in the first test. The stickiness is tested by putting bits of paper on the dried ink or by the hand.—J. C. C.

The Estimation of the Inorganic Constituents of Raw Sugars. Alberti and Hempel. *Zeits. Rubenzucker Ind.* 1891, **27**, 85—91.

IN practice, the ash of sugars is usually determined by the "sulphate" process, one-tenth being deducted from the weight of the sulphated ash, to allow for the increase due to the conversion of carbonates, &c., into sulphates. The authors point out that the results thus obtained are liable to serious errors, and are not even comparable amongst themselves, owing to the variable composition of sugar ash, and to the fact that mechanically introduced impurities, such as sand, are often present. Apart from this consideration, however, it is now becoming generally recognised that the organic non-sugars influence to a far greater extent than the mineral constituents of any given raw sugar, the production of uncrystallisable molasses during refining. The non-sugars are usually estimated by difference (100—ash, —water, —cane sugar); and the authors contend that the numbers thus obtained are always too low, because the ash, even when directly determined (without previous sulphation) contains something (CO_2) not present as such in the original sugar. The following process is recommended in order to overcome this difficulty. 6—7 grms. of coarsely powdered quartz-sand are ignited in a platinum dish, and after cooling, the whole is weighed. 5 grms. of sugar (in the case of molasses, 3 grms.) are then added and well mixed with the sand by stirring with a platinum wire. The dish and contents are subsequently ignited in a platinum muffle in the usual way. By this means the carbon dioxide is completely expelled from the ash, whilst the sulphates and chlorides originally present are not appreciably decomposed. The weight of ash found, therefore, accurately represents the total mineral matter present in the sugar. A large number of duplicate ash determinations made by the "sulphate" and "sand" processes, as well as a series of complete analyses of sugars are given, showing the variations in the percentages of organic non-sugars caused by adopting either the one or the other ash result.—H. T. P.

On the Estimation of Sugars by Ost's Copper Solution. M. Schmoeger. *Zeits. Rubenzucker Ind.* 1892, **28**, 23—27.

THE author, in general, confirms the advantages over Fehling's solution claimed by Ost for his cupric potassium carbonate solution (this Journal, 1890, 825 and 1160; 1891, 858). In the case of dextrose and invert sugar the agreement between duplicate determinations is very good, and the results are practically identical with those of Ost. With milk-sugar the results are not quite so satisfactory, and in this case the use of Fehling's solution is to be preferred. Ost's solution is, however, particularly to be recommended for the estimation of small quantities of invert sugar in presence of much cane sugar, since the latter has only a very slight reducing action on the reagent. The weaker solution (3.6 grms. of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ per litre) is most suitable for the purpose. There are, however, several drawbacks to the use of Ost's solution. In presence of calcium salts the precipitated cuprous oxide will contain calcium carbonate. According to the author this difficulty may be got over by precipitating the lime with potassium oxalate, and after filtration using the clear

filtrate for analysis. Another disadvantage is that Ost's stronger solution when boiled with water or a sugar solution, deposits a brown film of cupric oxide on the side of the beaker. This film ordinarily weighs from 1—2 mgrms. The weaker solution gives no such deposit even on prolonged boiling. As regards the keeping qualities of the reagent, the author finds that the stronger solution after several months (sometimes weeks) storage in closed bottles deposits a distinct blue sediment consisting chiefly of a copper silicate, the silicic acid being derived from the glass which was strongly attacked. Ost's weaker solution remains unaltered under similar conditions.—H. T. P.

The Melting Points of Mixtures of Hydrocarbons.

L. Vignon. Compt. Rend. 1891, **131**, 133—136.

See under III., page 235.

On the Solution of Bismuth Chloride in Saturated Solutions of Common Salt, and on Basic Salicylate of Bismuth.

H. Gause. Compt. Rend. 1891, **113**, 547—549.

See under XX., page 262.

ANALYTICAL AND SCIENTIFIC NOTES.

The Flow of Water, Petroleum, and Mineral Oil through Tubes.

H. Merczyng. Chem. Zeit. Rep. 1891, **15**, 223.

WHEN liquids flow through tubes two cases occur. If the liquid passes through capillary tubes, the fluidity of the body is calculated after Poiseuille's formula—

$$Q = \frac{\pi a}{8k} r^4$$

a being equal to the working pressure (the difference between the pressure at the beginning and end of tube), r = radius, k = constant of friction. This formula only holds good for tubes up to 1 mm. diameter, and where the length exceeds the diameter 40 times. In practice, to determine the fluidity of any liquid, being given the diameter of the tube and the pressure used, the formula—

$$Q = \gamma \sqrt{i d^3}$$

can be made use of where γ is an experimentally-obtained constant, which alters in a certain proportion to the rate of outflow of the liquid.

The temperature of the liquid on flowing out is of importance, as it alters the viscosity and friction constant, greatly decreasing the latter as the temperature rises. In practical work the rise of temperature due to movement of the liquid through tubes in the case of water, petroleum, and mineral oil may be neglected in the calculation. Krussel's experiments gave the following results, one kilo. of liquid flowing through the tube per second:—

Temp.	Water.				Petroleum.			
	Under a Pressure of Kilos.				Spec. Grav. 0.823. Under Pressure of Kilos.			
	0.70	1.40	2.11	2.81	0.70	1.40	2.11	2.81
10°	5.25	3.75	3.25	2.75	6.56	4.5	3.75	3.25
25°	5.1	3.75	3.0	2.60	6.0	4.25	3.5	3.1
40	5.0	3.5	3.0	2.66	5.9	4.25	3.5	3.0

Temp.	Solar Oil.				Mineral Oil.			
	Spec. Grav. 0.886. Under Pressure of Kilos.				Spec. Grav. 0.885. Under Pressure of Kilos.			
	0.70	1.40	2.11	2.81	0.70	1.40	2.11	2.81
10°	12.0	7.25	5.0	4.25	18.5	10.25	7.85	6.25
25°	8.25	5.0	3.9	3.36	11.0	6.25	4.50	3.75
40°	7.25	4.75	3.75	3.0	7.5	5.0	3.75	3.25

Temp.	Lubricating Oil.				Mineral Oil Residue.			
	Spec. Grav. 0.912. Under Pressure of Kilos.				Spec. Grav. 0.907. Under Pressure of Kilos.			
	0.70	1.40	2.11	2.81	0.70	1.40	2.11	2.81
10°	126.5	85.0	50.5	43.0	186.5	94.25	65.0	45.25
25°	61.0	44.5	21.0	17.75	72.5	36.5	20.75	17.25
40°	26.25	14.25	10.0	8.0	22.0	11.75	8.0	6.25

—E. F. H.

Magnesium Nitride.

V. Merz. Ber. **24**, 3940—3944.

MAGNESIUM nitride, Mg_3N_2 , may be prepared in the form of a light yellow mass, becoming darker on heating, by passing pure dry nitrogen over magnesium powder, previously carefully dried, and strongly heated by a compound Bunsen burner. It may, however, be obtained more readily and at a lower temperature by substituting ammonium for nitrogen. The gas must be dried with great thoroughness by passage through long absorption tubes of caustic potash and lime, and the powdered magnesium must be equally free from moisture. Hydrogen is evolved in almost the calculated amount, and the magnesium nitride obtained corresponds to the formula Mg_3N_2 , sundry samples prepared by the author containing nearly 27 per cent. of nitrogen as against 28 per cent. demanded by theory. A small proportion of the magnesium attacks the glass of the combustion tube, and therefore absorbs no nitrogen. Only traces of hydrogen were recognised in the author's preparation.—B. B.

A Mode of Formation of Sulphide Minerals.

E. Chuard. Compt. Rend. 1890, **113**, 194—196.

THE work of Daubrée (Compt. Rend. 1875, **80**, 461) illustrates the manner of formation of a number of sulphide minerals, such as galena, pyrites, tetrahedrite, by the aid of sulphuretted waters, but such a method of formation cannot well have been universal, and examination is here entered into of objects of the bronze period found in the Swiss lake districts. Bronze objects embedded actually in the mud have been found to be coated very thinly with a substance which proves to contain:—

	Per Cent.
Sulphur.....	27.09
Tin.....	5.07
Iron.....	31.05
Copper.....	33.97

—T. L. B.

Physiological Research on Carbon Monoxide.

N. Grehant. Compt. Rend. 1891, **113**, 289—290.

See under XVIII.—B., page 260.

On Certain Capillary Phenomena and the Spheroidal State.

E. Gossart. Compt. Rend. 1891, **113**, 537—540.

THE author has measured by means of Le Chatelier's pyrometer the minimum temperature at which a plate will support a liquid in the spheroidal state. In the case of

platinum, which cannot be satisfactorily polished, he has always found that Bontigny's values are correct. But on well-polished gold and silver he has found globules remain in the spheroidal state decidedly below their point of ebullition (e.g. water on a plate at 80°).

He also finds that durable spheroids (in all respects like those of Leidenfrost) can be obtained by introducing into a liquid, lying on a polished support, drops of another liquid of greater density and superficial tension. Such is the case with mercury in water, alcohol, saline solutions, &c., on polished gold. The gold remains unattracted for about half an hour, and there is no electrical contact between the plate and the drop. The mobility of the spheroid shows that it is in a condition different from that of a drop of mercury in free air.—D. E. J.

New Books.

REACTIONEN. Eine Auswahl in Pharmaceutischer Hinsicht-wichtiger Präparate der organischen Chemie, in ihrem Verhalten zu der gebräuchlichsten Reagentien. Von F. A. FLÜCKIGER. 1892. Berlin: R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder, Schönebergerstrasse, 26, S.W. London: H. Grevel & Co., 33, King Street, Covent Garden.

A SMALL compact work on the Qualitative Determination of the more important pharmaceutical preparations and compounds of Organic Chemistry. It contains, besides the author's Preface, a List and definition of the most commonly employed reagents, the temperature being 15° C. The text covers 163 pages, and at the close is an Alphabetical Index of substances treated of. The book is bound in cloth. Price 4s.

Besides the reactions for the vegeto-alkaloids, the newer coal-tar medicaments are fully treated, and we note amongst these the following:—Antifebrin, Antipyrine, Betol, Phenol, Quinoline, Cocaïn, Cumarin, Eegonine, Exalgin, Guaiacol (wood-tar), Isonaphthol, Iodol, Methacetin, Methylacetanilide, Naphthalene, Naphthol, Phenacetin, Phenyl-dihydroquinazoline, Phenyl-dimethylpyrazolone, Propyl-metacresol, Pyridine, Resorcinol, and Saccharine, &c.

HANDWÖRTERBUCH DER PHARMACIE. Praktisches Handbuch für Apotheker, Ärzte, Medicinalbeamte und Drogisten. HERAUSGEGEBEN VON A. BRESTOWSKI. Zwei Bände. Wien und Leipzig, Wilhelm Braumüller, K.U.K. Hof- und Universitäts-Buchhändler. 1892. Erscheint in circa 24 Lieferungen zu je 5 Bogen, Lex. 8. London: H. Grevel and Co., 33, King Street, Covent Garden.

THIS new Dictionary of Pharmacy, brought out under the best auspices, is being issued in parts of large 8vo. size, bound in paper covers. The price of each part is 2.40 M., or about 2s. 5d. It contains 80 pages of Subject-matter, commencing with *Aachen* and ending with *Amylalkohol*, and counts amongst contributors the names of such men as Arnold, von Buchka, Elsner, B. Fischer, Hellmann, Jolles, Virchow, and Waage. The methods of preparation of the various drugs and chemicals described are given with great clearness and precision, space being at the same time economised to the utmost.

The contributors whose names appear along with the Editor's on the cover of each part, are 41 in number, and consist of the best known pharmacists and pharmaceutical chemists in Germany and Austria.

CHEMICAL CALCULATIONS, with Explanatory Notes, Problems, and Answers. Specially adapted for use in Colleges and Science Schools. By R. LLOYD WHITELEY, F.I.C., Lecturer on Dyeing and Assistant Lecturer and Demonstrator in Chemistry in the University College, Nottingham. London: Longmans, Green and Co. New York: 15 East 16th Street. 1892.

PROFESSOR CLOWES writes a preface to this little work, in which he points out that laboratory students will find a most useful and convenient explanation of the methods of calculating the results of specific gravity determinations, analyses, and of atomic and molecular weight determinations. We are further told, and wisely so, that it is not written for candidates for any special examinations, but for the general equipment of students of chemical science. The little work is not confined to mere problems for calculation with answers appended, but each division of the subject is prefaced by definitions, explanations, and fundamental data, so that based on these and in view thereof the student can then attempt the solution of the problems.

The subject is divided as follows:—Atomic Weights. Miscellaneous Data. Metric System. Conversion of Thermometric Scales. Density and Specific Gravity. Calculation of the Percentage Composition of a Compound. Calculation of Empirical Formulae from percentage composition. Influence of Temperature and Pressure upon the Volume of Gases. Calculations depending upon Chemical Equations. Combination of Gases by Volume. Calculation of the Results of Quantitative Analysis. Atomic Weights Determinations. Simple Calculations in Gas Analysis. Absorption of Gases by Liquids. Determination of the Molecular Weights of Compounds. Calorific Power and Calorific Intensity. Answers and Appendix. The Alphabetical Index closes the little work, which comprises 160 pages of Subject-matter illustrated by nine woodcuts representing apparatus. Price 2s.

THE TANNINS. A Monograph on the History, Preparation, Properties, Methods of Estimation, and Uses of the Vegetable Astringents, with an Index to the Literature of the Subject. By HENRY TRIMBLE, Ph. M., Professor of Analytical Chemistry in the Philadelphia College of Pharmacy. Volume I. Philadelphia: J. B. Lippincott Company. 1892. London: H. Grevel & Co., 33, King Street, Covent Garden.

OCTAVO volume, bound in green cloth and containing Preface, Table of Contents, and Subject-matter, divided into two parts. Part I. General, and Part II. Gallotannic Acid. In the Preface the author states that the title of his monograph "might well have been *A Century of Tannin*, as just about one hundred years have elapsed since tannin first became recognised as a distinct substance, or class of substances, as we now express it." The text covers 165 pages, and is sub-divided as follows:—PART I. GENERAL DESCRIPTION OF THE TANNINS. Section I. The Discovery of the Tannins. II. General Character. III. The Detection and Estimation of the Tannins. PART II. GALLO-TANNIC ACID. Section I. Sources. II. History. III. The Preparation and Purification of Tannic Acid. IV. The Properties of Tannic Acid. V. The Composition and Constitution of Tannic Acid. Then follow an Index to the Literature of the Tannins, Index of Authors, Index of Titles with Authors and Sources, and List of Books containing notable chapters on the Tannins. In the former Index the Journal of this Society figures prominently from the year 1885, in connexion with the names of Bertram Hunt, R. L. Whiteley, and especially Henry R. Procter. Two or three well-executed woodcuts representing apparatus for the analytical determination of tannin adorn the text.

ANILINSCHWARZ. Und Seine Anwendung in Färberei und Zeugdruck. von Dr. E. NOELTING und Dr. A. LEHNE. Mit 11 Abbildungen im Text und 32 Zeugdruckmustern und Ausfärbungen auf 4 Tafeln. 1892. Berlin: Verlag von Julius Springer, Monbijouplatz 3. London: H. Grevel & Co., 33, King Street, Covent Garden.

LARGE 8vo. volume, appropriately bound in black cloth, and containing Preface, Table of Contents, text covering 106 pages, followed by an Alphabetical Index of Subject-matter, one of names of authors, and 4 sheets of dyed and printed specimens in illustration of matter in the text. The text is embellished with 11 well executed wood engravings, and comprises the following sub-divisions:—Historical Introduction. Theory of the Formation of Aniline

Black. The Greening of Aniline Black. Employment of Aniline Black in Printing. I. Aniline Black in Powder. II. Formation of Aniline Black on the Tissue. Employment of Aniline Black in Dyeing. Investigation of the most important Raw Materials as follow:—I. Aniline. II. Aniline Salts. III. Chlorate of Potash. IV. Chlorate of Soda. V. Potassium Bichromate. VI. The Testing and Investigation of Aniline Black Dyes.

It is shown in the Preface that this work, originally designed to demonstrate the invalidity of the Grawitz Patents, has now become, with certain additions, an important and useful treatise in itself, and hence whilst the useful in it is now as much as possible made prominent the polemical is allowed to die out. The price of the work is 8s.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

(From the Board of Trade Journal.)

NEW SPANISH CUSTOMS TARIFF.*

Statement showing the Rates of Import Duty to be levied in Spain under the New Spanish Tariff, compared with the Rates of Duty hitherto leviable on Imports into that Country.

Note.—Up to the 30th June next, when the Anglo-Spanish Convention of 1886 expires, the Conventional rates of the Spanish Tariff will still be levied on British produce, including those of the Franco-Spanish and German-Spanish Treaties which are enumerated in Parliamentary Paper, Commercial No. 15 (1886). (C.—478).

No.	CLASSIFICATION OF ARTICLES.	Rates leviable by New Tariff of 1st February 1892.		CLASSIFICATION OF ARTICLES.	Rates leviable hitherto on Imports from United Kingdom.
		General Tariff.	Special Tariff.		
	CLASS 1.	Per 100 kilogs. Pes. cts.	Per 100 kilogs. Pes. cts.		Per 100 kilogs. Pes. cts.
	STONES, EARTHY MATTERS, MINERALS, GLASS, EARTHENWARE, AND PRODUCTIONS OF POTTERY.				
	Group 1.—Stones and Earthen Productions employed in Building, Arts, and Manufacture.				
5	Other stones and earthenware substances employed in building, arts, and manufactures; cement, lime, and gypsum.	0 40	0 30	.. .. .	0 06
	Group 2.—Coals.	Per 1,000 kilogs.	Per 1,000 kilogs.		Per 1,000 kilogs.
6	Coal and coke (Note 1)	3 09	2 59	.. .. .	1 25
	Group 3.—Bituminous Shale, Bitumen, and Bituminous Products.	Per 100 kilogs.	Per 100 kilogs.		Per 100 kilogs.
7	Pitch, tar, creosote, unrefined, mineral oils and asphalt, bitumen, and shale (Note 2).	0 60	0 40	.. .. .	0 41
8	Naphtha, vaseline, crude petroleum, natural petroleum oil, and other crude oils of shale (Notes 2 and 3).	25 00	25 00	.. .. .	21 00
9	Benzine, gasoline, petroleum, and other refined oils (Notes 2 and 3).	40 00	40 00	.. .. .	32 00
	Group 4.—Minerals.	Per 1,000 kilogs.	Per 1,000 kilogs.		Per 1,000 kilogs.
10	Mineral ores	0 30	0 25	.. .. .	0 25
	Group 5.—Glass.	Per 100 kilogs.	Per 100 kilogs.		Per 100 kilogs.
11	Common or ordinary hollow glassware (Note 4)	13 00	10 00	.. .. .	6 50
12	Crystal, or its imitations in glass (Note 5)	65 60	50 00	{ Flint glass and glassware in imitation of it even if gilt or silvered inside. }	34 65
13	Flat glass and crystal	24 00	20 00		
14	Glass and crystal quicksilver	104 00	80 00	Window and plate glass...	16 00
	Group 6.—Pottery, Earthenware, and Porcelain.	Per 100 kilogs.	Per 100 kilogs.		Per 100 kilogs.
16	Ornamental clay flagstones, brick and tile for buildings, ovens, &c. (Note 6).	4 55	3 50	.. .. .	0 06
17	Clay flagstones, floor tiles, ornamental tiles, japanned tiles, and piping (Note 7).	6 50	5 00	.. .. .	1 50
18	Fine earthenware, fine clay, and figures of gypsum (Note 8).	48 75	37 50	.. .. .	26 58
19	Porcelain	68 25	52 50	.. .. .	37 50

* A translation of the notes which are appended to the Spanish Tariff will appear with the concluding portion of the tariff in the April issue of the Journal.

NEW SPANISH CUSTOMS TARIFF—continued.

No.	CLASSIFICATION OF ARTICLES.	Rates leviable by New Tariff of 1st February 1892.		CLASSIFICATION OF ARTICLES.	Rates leviable hitherto on Imports from United Kingdom.
		General Tariff.	Special Tariff.		
	CLASS II.	Per 100 kilogs. Pes. cts.	Per 100 kilogs. Pes. cts.		Per 100 kilogs. Pes. cts.
	METALS AND ALL MANUFACTURES INTO WHICH METAL ENTERS AS A PRINCIPAL ELEMENT.				
	<i>Group 1.—Gold, Silver, and Platinum.</i>				
	<i>Group 2.—Iron Castings (Note 12).</i>				
	<i>Group 3.—Wrought Iron, forged or in sheets, and Steel.</i>				
	<i>Group 4.—Copper and its Alloys.</i>				
70	shell or cement	0 60	0 50	Not separately mentioned.	—
71	Copper { of first fusion, and old copper	15 00	12 50	.. .. .	11 75
72	and brass, in bars and ingots, and old brass	27 00	22 50	.. .. .	18 60
73	Bronze, unmanufactured	12 00	10 00	.. .. .	9 30
74	Copper { in sheets and nails	42 00	35 00	.. .. .	33 15
75	and brass { in tubes and large pieces, partially manufactured, such as outsides of coal pans and bottoms of boilers.	60 70	58 00	.. .. .	46 20
76	Copper, brass, or bronze wire	48 00	40 00	.. .. .	20 60
77	Copper and bronze gauze, not further manufactured, up to 100 threads to the inch (Note 19).	90 00	75 00	.. .. .	41 25
78	Ditto, of over 100 threads to the inch (Note 19)	Per kilog. 2 40	Per kilog. 2 00	.. .. .	Per kilog. 0 41
79	Wares of copper, bronze, or brass, and all alloys of common metals in which copper enters, polished or not (Note 20)	1 65	1 25	.. .. .	0 87
80	The same, gilt, silvered, or nickeled (Note 20)	3 75	2 50	.. .. .	2 17
	<i>Group 5.—The other Metals.</i>				
81	Tin, in ingots	15 00	12 50	.. .. .	10 55
82	Zinc { in bars, lumps, or cakes	6 00	5 00	.. .. .	5 00
83	in sheets, nails, and wire	18 00	15 00	.. .. .	13 65
84	in manufactured articles, varnished or not (Note 21)	33 8	26 00	.. .. .	23 75*
85	All the other metals and alloys not enumerated in sheets, lumps, nails, tubes, &c.	2 00	1 60	.. .. .	1 60
86	Ditto, manufactured, varnished or not (Note 21)	48 75	37 50	.. .. .	15 60
87	The same metals and zinc, in wares gilt, silvered or nickeled (Note 21).	58 50	45 00	.. .. .	45 00
	CLASS III.				
	SUBSTANCES EMPLOYED IN PHARMACY, PERFUMERY, AND CHEMICAL INDUSTRIES.				
	<i>Group 1.—Simple Drugs.</i>				
88	Cocoa-nut and palm oil, and other heavy oils (Note 22)...	9 60	8 00	.. .. .	1 00
89	Other vegetable oils, excepting olive oil	27 60	23 00	.. .. .	23 00
90	Dyewoods and tannery bark	0 30	0 25	.. .. .	0 10
				Madder root	18 35
91	Seeds of rape, of flax, and other oleaginous seeds, including copra or cocoa-nut.	1 20	1 00	.. .. .	0 20
92	Colophony, pitch, and other resinous products of a similar kind.	5 40	4 50	—	—
93	Garancine, or madder, and other vegetable products, not specified under other headings.	12 00	10 00	{ Other vegetable products } { not elsewhere specified }	10 00
94	Products of the animal kingdom, employed in medicine ..	3 60	3 00	.. .. .	3 00
	<i>Group 2.—Colours, Dyes, and Varnishes.</i>				
95	Ochres and natural earths, for painting, including alumina	0 12	0 10	.. .. .	0 10
96	Indigo and cochineal (Note 23)	54 00	45 00	.. .. .	10 00
97	Dyeing extracts	9 40	7 80	.. .. .	3 00

* Whilst the Franco-Spanish Treaty continues in force 23.60 pesetas per 100 kilogs.

NEW SPANISH CUSTOMS TARIFF—*continued.*

No.	CLASSIFICATION OF ARTICLES.	Rates leviable by New Tariff of 1st February 1892.		CLASSIFICATION OF ARTICLES.	Rates leviable hitherto on Imports from United Kingdom.
		General Tariff.	Special Tariff.		
		Per kilog. Pes. cts. 28 80	Per kilog. Pes. cts. 24 0		Per kilog. Pes. cts. 18 00
98	Varnishes.....			.. .. .
99	Colours, in powder or in lump (Note 24)	9 00	7 50	.. .. .	4 80
100	Ditto, prepared, and inks	30 70	25 60	.. .. .	24 00
101	Ditto, derived from coal, and other artificial colours, and garancine and its mixtures with madder (Note 25)	3 00	2 50	{ (Garancine	0 75 0 65
<i>Group 3.—Chemical and Pharmaceutical Products.</i>					
102	Muriatic or hydrochloric, nitric, and sulphuric acids.....	Per 100 kilogs. 2 60	Per 100 kilogs. 2 20	Muriate and hydrochloric acids. Not separately mentioned.	Per 100 kilogs. 1 00
103	Natural mineral waters	Per hectol. 6 00	Per hectol. 5 00		—
104	Alkaloids and their salts	Per kilog. 36 00	Per kilog. 30 00		Per kilog. 27 50
105	Alum.....	Per 100 kilogs. 1 80	Per 100 kilogs. 1 50	.. .. .	Per 100 kilogs. 1 15
106	Sulphur	1 50	1 25	.. .. .	0 25
107	Alkaline carbonates, barillas, caustic alkalis, and ammo- nical salts, excepting sulphate	4 55	3 80	{ Barilla, natural, and artificial. { Alkaline carbonates, caus- tic alkalis, &c.	0 80 1 00
108	Chloride of lime.....	3 10	2 60	.. .. .	1 30
109	Chloride of potassium, sulphate of soda, chloride and car- bonate and sulphate of magnesia.....	0 60	0 50	.. .. .	0 50
110	Chloride of sodium (common salt)	3 90	3 25	.. .. .	0 54
111	Glues and albumen.....	14 40	12 00	.. .. .	12 00
112	Phosphorus	Per kilog. 0 85	Per kilog. 0 70	.. .. .	Per kilog. 0 55
113	Nitrate of potash (saltpetre)	Per 100 kilogs. 4 50	Per 100 kilogs. 3 75	.. .. .	Per 100 kilogs. 1 50
114	Nitrate of soda, and sulphate of ammonia.....	1 20	1 00	.. .. .	0 25
115	Oxides of lead.....	6 00	5 00	.. .. .	2 00
116	Sulphate of copper	1 24	1 00	Not separately mentioned.	—
117	Sulphate and acetate of iron.....	1 80	1 50	.. .. .	1 50
118	Pills, capsules, jujubes, and the like	Per kilog. 2 40	Per kilog. 2 00	.. .. .	Per kilog. 1 85
119	Pharmaceutical products not specified (Note 26).....	1 20	1 00	.. .. .	0 90
120	Chemical products not specified	0 12	0 10	.. .. .	0 10
<i>Group 4.—Various.</i>					
121	Starch	Per 100 kilogs. 18 00	Per 100 kilogs. 15 00	.. .. .	Per 100 kilogs. 9 15
122	Feculas, for industrial uses, and dextrin	2 40	2 00	.. .. .	1 00
123	Common soap	22 50	18 75	.. .. .	15 80
124	Mineral and vegetable wax in lumps	30 00	25 00	Not separately mentioned.	—
125	Paraffin, stearine, animal wax, and spermaceti in lumps	24 00	20 00	.. .. .	16 50
126	The same, and all manufactured waxes	60 00	50 00	.. .. .	33 90
127	Perfumery and essences	Per kilog. 2 60	Per kilog. 2 00	.. .. .	Per kilog. 1 75
128	Gunpowders, explosive compounds, and fuses for mines ..	0 60	0 50	.. .. .	0 47
CLASS IV.					
COTTON AND ITS MANUFACTURES.					
CLASS V.					
HEMP, FLAX, ALOE, JUTE, AND OTHER VEGETABLE FIBRES AND THEIR MANUFACTURES.					
CLASS VI.					
WOOLS, BRISTLES, HAIR, AND MANUFACTURES THEREOF.					

NEW SPANISH CUSTOMS TARIFF—continued.

No.	CLASSIFICATION OF ARTICLES.	Rates leviable by New Tariff of 1st February 1892.		CLASSIFICATION OF ARTICLES.	Rates leviable hitherto on Imports from United Kingdom.
		General Tariff.	Special Tariff.		
	CLASS VII. SILK AND MANUFACTURES THEREOF.	Per 100 kilogs. Pes. cts.	Per 100 kilogs. Pes. cts.		Per 100 kilogs. Pes. cts.
	CLASS VIII. PAPER AND ITS APPLICATIONS.				
	Group 1.				
196	Pulp or paste for paper-making (Note 39).....	1 50	1 00	Not separately mentioned.	—
	Group 2.—Paper for Printing or Writing.				
197	Paper (endless), white or coloured, unsized, whose weight does not exceed 35 grammes to the square metre.	45 50	35 00	} Paper in the roll "Papel continuo," unsized or half sized, for printing.	10 50*
198	Ditto, ditto, whose weight is comprised between 35 and 50 grammes to the square metre.	15 00	12 50		
199	Ditto, ditto, whose weight to the square metre is 51 grammes and upwards.	35 75	27 50	Paper in the roll for writing, lithographing, or engraving.	27 50
200	Ditto, ditto, white or coloured, of any weight; cut, hand-made, and pencil or ink ruled, and envelopes.	63 35	48 75	.. ..	43 75
	Group 3.—Paper, printed, engraved, or photographed.				
	Group 4.—Paper Hangings.				
205	Paper, printed on natural ground.....	35 75	27 50	} Paper printed with gold, silver, wood, or glass.	Per 100 kilogs. 130 00
206	Ditto, ditto, on glazed or lustrous ground.....	65 00	50 00		
207	Ditto, ditto, with gold, silver, flock, or glass.....	Per kilog. 2 60	Per kilog. 2 00	Ditto, of other kinds	23 84
	Group 5.—Pasteboard and various Papers.	Per 100 kilogs.	Per 100 kilogs.		
208	Straw paper, common packing paper, and smoothing paper	14 10	10 85	.. ..	10 85
209	Ditto, thin, of impure pulp, for packing fruit.....	36 00	20 00	Not separately mentioned.	..
210	Other papers not expressly mentioned.....	52 00	40 00	.. ..	35 00
211	Pasteboard and fine cardboard, glazed, and pressed in sheets.	36 40	28 00	Not separately mentioned.	..
212	Other pasteboards in sheets, and boxes lined with ordinary paper, and other articles of pasteboard and "cartonpierre," not finished (Note 42).	10 40	8 00	.. ..	6 95
213	The same objects finished, and pasteboard boxes with ornaments, or lined with fine paper or other materials.	Per kilog. 1 35	Per kilog. 1 50	.. ..	Per kilog. 1 35
	CLASS IX. WOOD AND OTHER VEGETABLE MATERIALS EMPLOYED IN MANUFACTURES, AND ARTICLES MANUFACTURED THEREFROM.				
	Group 1.—Timber.				
	Group 2.—Furniture and Wood Manufactures.				
	Group 3.—Various.				
223	Charcoal, firewood, and other vegetable combustibles	1 20	1 00	.. ..	0 50
224	Cork.....	1 15	0 90	.. ..	0 90
225	Esparto, not manufactured.....	1 30	1 00	.. ..	0 20
227	Rushes, vegetable hair, soft rushes, twigs, fine straw, palm, and other analogous materials, unmanufactured.	0 30	0 25	.. ..	0 20
228	The same materials, and esparto, manufactured.....	30 30	30 25	.. ..	30 24

* Duty applied during the duration of the Commercial Treaty between Spain and Belgium 10 pesetas.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

THE PRODUCTION AND CONSUMPTION OF GAS IN THE PRINCIPAL EUROPEAN CITIES.

Board of Trade Journal, March 1892, 263.

A volume has recently been issued from the Government Printing Office at Washington containing the reports received from the Consuls of the United States in different foreign countries in answer to a circular from the Department of State as to the gas industry in the various countries.

The following particulars with regard to the chief European cities are taken from the report in question:—

St. Petersburg.—The city of St. Petersburg, numbering, according to the latest estimate, 1,000,000 inhabitants, has several gas companies in active operation at the present time. The old gas company, as it is still called, was established in 1835, and manufactures gas from bituminous coal. These works comprise 242 retorts, with an average of seven retorts to each furnace, one Beale exhaustor, six gas-holders, with a total capacity of 750,000 cubic feet, and about 3,000 gasometers. The gas production is 180,000,000 cubic feet. There are 20 gas motors, ranging from 4 to 10 horse-powers. The aggregate length of the mains is 28 miles, with pipes varying from 2 to 30 inches in diameter.

The Metropolitan Gas Lighting Company of St. Petersburg supplies a large portion of the city with coal-gas, using 62,450 tons of coal per year. The price for lighting the streets for an aggregate of 3,200 hours has been 3*l.* 0*s.* 5*d.* per lamp. For Government buildings the price has been 6*s.* 1*d.*, and for private consumers 7*s.* 1*d.* per 1,000 cubic feet. Recently the company has reduced these prices to 4*s.* 8*d.* for technical purposes, 5*s.* 5*d.* for private consumption. These works contain three groups of condensers, six ordinary scrubbers, two "Standard" scrubbers, 32 purifiers, six gas-holders with a capacity of 2,000,000 cubic feet, five regulators, five gas-meters, and six steam engines. The gas production in 1887 was 637,496,200 cubic feet. There were 7,852 street lamps, 120,524 private burners, and 72 gas motors aggregating 319 horse-power. The total length of the gas mains is about 165 miles.

The gas works of Vassili Ostroff, an island on the north side of the river Neva, and forming a portion of the city of St. Petersburg, furnish a large portion of the gas for the inhabitants of the island. These works contain nine Biley's exhaustors, and manufacture gas from coal in the usual manner. The returns from these works consists of 44,469 tons of coke, 2893 tons of tar, and 5,416 tons of ammoniac water. The number of consumers is about 3,200, with an equal number of gasometers. The aggregate length of the main is about 27 miles.

The gas works of the Wiborg and old St. Petersburg portion of the city of St. Petersburg belong to a limited company and manufacture gas from Newcastle coal, the quantity of coal used being 7,717 tons per annum. The gas production in 1888 was 73,128,630 cubic feet. There were 1,457 street lamps and 10,500 private burners in the same year. The gas works of the Marshall Academy belong to the same company, and from both of these works there are obtained annually 5,152 tons of coke and 302 tons of tar.

In addition to the cities and towns enumerated above, employing gas for lighting and heating purposes, there are about 40 railway stations in the Empire lighted either with coal-gas or petroleum-gas and about 160 gas manufactories established in separate buildings for the use of factories, stores, banks, and other private enterprises of various descriptions.

The laws of Russia forbid the manufacture and use of water-gas, on the ground that the gas is injurious to health. There is a special article in the patent laws of the country to the effect that no mechanical device, nor any chemical combination producing articles injurious to the health of the people are patentable, and if patented under disguise or ignorance of this fact the patent becomes invalid. Many parties have made repeated efforts to introduce

water-gas in Russia, but all such applications have been rejected, invariably meeting with the unanimous opposition of the Imperial Society for the Preservation of Health.

Berlin.—In the city of Berlin there are two gas companies: (1.) The City Gas Company, owned and operated by the city; (2.) The Imperial Continental Gas Association, owned and operated by an English company.

The former company has four separate gasworks in the city. The latter company has three separate gasworks in Berlin and suburbs.

It appears that privileges were granted to the English company as far back as 1827. By contract made with the town of Schönberg in 1854, this company has the exclusive right to lay pipes in that quarter of Berlin, which has since been acquired from Schönberg. These privileges may to a certain extent account for the difference in price between the gas supplied by the city works and that supplied by the English company.

During the fiscal year ended March 31st, 1889, there were nearly 4,000,000 cubic metres less gas used in the city of Berlin than in the preceding year. This decrease is supposed to be due to the influence of the growth of electric lighting and especially to the successful efforts of the lamp makers in producing lamps with larger and better burners.

The number of electric lights in use in Berlin during the year ended March 31st, 1889, was 66,650.

During the calendar year 1887 the city of Berlin consumed 47,299 tons of petroleum, and in the year 1888, 54,138 tons, or an increase of 15 per cent.

The quantity of gas produced by the city gas works during the year 1889 was 90,000,200 cubic metres.

The number of jets fed by the city gas works was: Public, 17,509; private, 798,631; gas works and offices, 3,309; total, 819,449.

The quantity used by the public lights was 11,489,208 cubic metres; by the private lights, 68,608,759 cubic metres.

The city gas works used 314,264 tons of coal from the Silesian coal-fields, the product in gas for each ton of coal being 287·05 cubic metres.

The length of the net work of pipes used by the city gas works was 693,493 metres.

The value of the gas used in gas works and bureaux was estimated at 13½ pfennigs per cubic metre. The value of the gas used for other purposes than lighting was estimated at 12·8 pfennigs per cubic metre. The value of the gas used for lighting was estimated at 16 pfennigs per cubic metre.

The total income of the city gas works was as follows:—During the year 1889, from gas, 11,552,591 marks; use of gas metres, 268,323; coles, tar, &c., 4,443,357; total, 16,264,271.

The total expense of the city gas works during the same year was as follows: Cost of coal, 5,614,245 marks; firing, 701,626; purifying material, 10,596; wages, 588,918; interest on plant, 884,270·11; other expenses, taxes, insurance, &c., 3,414,789; total, 11,214,444.

These figures show an excess of receipts over expenses of 5,049,826·45 marks.

There are no official statistical data at hand respecting the income and expenses of the English company which supplies one-third of the gas consumed in the city of Berlin.

Paris.—The gas company known under the name of *Compagnie Parisienne d'éclairage et de chauffage par le gaz*, which has the sole permission to furnish the city of Paris with gas, was founded in the year 1855. The capital subscribed amounted to 3,377,500*l.*, divided into 336,000 shares at 10*l.* 1*s.* each. These are worth now about 52*l.* 1*s.* 8*d.*

The total receipts for the year 1889 amounted to 4,247,780*l.*, of which 3,243,410*l.* were for gas, 677,924*l.* for coke, and 142,112*l.* for other by-products. The expense, amounting to 2,645,909*l.*, comprised 847,379*l.* for coal, 175,483*l.* for labour, 63,356*l.* for engineers and salaried working staff, 42,535*l.* for the central administration, 12,062*l.* for the direction, 361,201*l.* for redemption of capital, 273,046*l.* for municipal charge, including the tax of 1*d.* per cubic metre.

The net profits for the year amounted to 1,588,229*l.*, of which 1,019,281*l.* go to the stockholders, and 360,614*l.* to the city of Paris. The dividend for the year was 3*l.* 2*s.* 6*d.*

The gas is manufactured from coal by the ordinary process and is assayed every day before delivery as regards its lighting power and purification by company agents, and also by agents appointed by the city authorities.

According to contract the gas delivered for consumption by the Parisian gas company must be perfectly purified and its lighting power under a pressure from 2 to 3 millimetres of water, and an average consumption of 105 litres of gas per hour, be equal to the light of a lamp burning 42 grammes of pure colza oil per hour.

The report of the Paris Gas Company for 1889 showed that the consumption in the year amounted to 312,000,000 cubic metres (11,013,000,000 English cubic feet).

The annual consumption of gas in Paris has gone up from 218,813,875 cubic metres in 1879 to 297,258,070 cubic metres in 1888.

The annual consumption of gas rose during the same period for the whole of France from 467,500,000 cubic metres in 1879 to 628,000,000 cubic metres in 1888.

The number of subscribers to the Paris Gas Company for 1889 was 224,119, an increase of 11,604 over the year 1888.

The substitution of electric lighting in a number of theatres, public establishments, and thoroughfares has been compensated by the increased use of gas for domestic purposes, and the day consumption now exceeds 26 per cent. of the total, and equals one-third of that in the dark hours.

The Paris Gas Company delivers the gas used for public lighting at the rate of 3*s.* 5*d.* per 1,000 cubic feet, and for private use at the rate of 6*s.* 8*d.* per 1,000 cubic feet.

The apparatus which permit the use of gas in kitchens (cooking stoves, ovens, griddles, &c.), in dressing rooms, kettles and bath heaters in private apartments (stoves), are becoming more and more frequently used.

The fact that in Paris one-fifth of the gas supplied by the gas works is consumed during the day indicates the importance of consumption other than for lighting purposes.

The men in charge of the furnaces are paid 2*s.* 8*d.* per 1,000 kilos. coal; they are on duty 12 hours each day, and their daily earnings are from 9*s.* 7*d.* to 12*s.* 1*d.* Coal carriers and cartmen are paid from 3*s.* 4*d.* to 4*s.* 2*d.* for a day's work of 10 to 12 hours.

The coal used in the manufacture of gas by the Paris company is obtained in France, Belgium, England, and Germany at an average price of 12*s.* 1*d.* to 1*l.* 7*d.* per ton.

Brussels.—Brussels has its own gasworks, maintained by the municipality. The suburbs are supplied by the Company General and Imperial Continental Gas Company.

Gas is obtained by the decomposition of coal by heat. The coal is heated in angular cylinders, holding about 200 lb. of broken coal. The gas is passed from the cylinders into coolers, is then purified and ready for use. Two hundred pounds of coal yield on an average about 25 cubic metres of gas, 8 lb. of coal tar, and 2½ bushels of coke. About one-third of the coke thus obtained is employed in heating the cylinders, the remainder is sold for domestic use.

The candle power is 7½ candles, or 105 quarts of gas per hour. Approximate annual output of the city of Brussels, 14,226,787 francs. Number of consumers, 19,152.

The price of gas differs more or less according to locality, varying 10 to 25 centimes per cubic metre, as follows:—

In the city of Brussels, day consumption, 10 centimes per cubic metre; night consumption, 15 centimes per cubic metre. The suburban consumers of Etterbeck, Forest, St. Gilles, Ixelles, Kocheberg, Molenbeck, and Peele, 15 centimes per cubic metre. St. Jean-Ten-Noode, 18 centimes; Schaerbeek, 20 centimes; and Laeken, 25 centimes per cubic metre.

Wages paid to workmen employed in the Brussels gasworks vary from 3 to 5 francs per day for 11 hours' work. In the provinces of Brabant, Haicant, and Namur, 11 and 12 hours' labour is exacted for wages varying from 2 to 4.50 francs per day.

Rome.—The Anglo-Romano Company for the lighting of Rome have the monopoly of supplying the city both with gas and electricity for purposes of illumination.

They have two gasworks, one on the Via dei Cherehi, and one on the Via Flaminia. The process described is that employed at the larger works on the Via dei Cherehi, but it is substantially the same at each.

The coal used is from Newcastle, mixed with 5 per cent. of Liverpool canal coal, and costs from 1*l.* 5*s.* 9*d.* to 1*l.* 6*s.* 7*d.* delivered at the works. At this price the company has a contract which has some time to run, although the market price has advanced to about 2*l.* 0*s.* 3*d.* per ton.

The retorts used are of clay, and measure 21½ in. wide, 11 in. high, and 9 ft. 6 in. long. They are made in Italy, are much better than the French manufacture, and are equal to the English, but cost less. They are placed in groups of seven and eight around the furnaces. There are 78 furnaces that heat 562 retorts. Each retort has a capacity of 160 kilos. (353 lb.) and is charged and drawn by hand.

All the furnaces are duplex, the invention of Mr. Walter R. Jones, the engineer of the works, who has secured patents on them in Europe and the United States. This pattern of furnace has been in use since 1884, and has given excellent results, all the regenerative furnaces having been transformed in preference.

The number of public gas lights in Rome in 1888 was 6,033, the public consumption of gas was 115,650,000, and private consumption 381,550,000 cubic feet. The cost per 1,000 cubic feet for public consumption was 5*s.* 7*d.*, for private 6*s.* 7*d.*

Twelve hours constitutes a day's labour, and the wages paid are about as follows:—Head mechanics per day, 4*s.*; mechanics and machinists, 2*s.* 10*d.*; superintendent of firemen, 4*s.*; firemen's corporal, 3*s.* 7*d.*; firemen, 3*s.* 2*d.*

For good conduct a bounty is given to the firemen's corporal of 8*s.* 1*d.* A pension of 4*s.* 2*d.* per week is paid to the widows of workmen so long as they remain widows.

Constantinople.—Gas has been in use in the city of Constantinople for the last 30 years, but was limited to one part of the city, namely, Pera, and is the residence of all Europeans and foreigners in general, as well as of all the ambassadors, ministers, consuls, &c.

There are two gas companies in Constantinople. The first is a Turkish company, under the general management of and belonging to the Imperial Turkish Government, and is called Imperial Gas Works. The factory of this company is situated in Dolma Baghtché, a suburb on the Bosphorus, and furnishes gas for the use only of Pera, the Imperial palaces on the Bosphorus, the lower end of Pera, which is called Galata, and of one or two villages on the Bosphorus.

The second company is a Belgian-German concern, which obtained the necessary concession from the Turkish Government about two years ago, and is called *Société Ottomane pour l'Eclairage de la ville de Constantinople*. This company has established a factory at the Seven Towers, on the Sea of Marmora, and has the privilege of supplying gas only to the other side of the city of Constantinople, properly called Stamboul, which is largely inhabited by the Turks, including the suburb of Eyoub in the Golden Horn.

It is impossible to ascertain the amount of money invested in the industry by the first Government company. The amount invested by the second, the Belgian-German, is 152,078*l.*

Process of manufacture: The factory of the Belgian-German company was constructed by Mr. Kloenne de Dortmund. It has a gasometer of 12,000 cubic metres, with furnaces and four batteries, with eight retorts each. The other machinery is in proportion.

The machinery hall is 90 metres long by 15 metres wide; the furnace hall is also 90 metres long by 15 metres wide.

Brilliance of gas, 12 to 14 candles.

The approximate annual output is 1,000,000 cubic feet in Stamboul, and 3,000,000 cubic feet in Pera and Galata.

Number of consumers: The Belgian-German company has about 10,000 to 12,000 flames for the present. No statistics can be obtained from the Government company.

The price of gas per 1,000 cubic feet is 7s. 4d., with 25 per cent. discount for public fixtures.

The use of gas stoves for heating and cooking is quite limited.

The wages of the employes of the Belgian-German company range as follows: Director, 1,000*l.* per annum; chief engineer, 680*l.*; quartermaster, 165*l.*; other employes, 40*l.* The hours of labour are about 12, with rests two or three times during the day or night.

The material used is English Newcastle and Cardiff coal. The price is 1*l.* 6s. 3d. to 1*l.* 7s. 3d. per ton.

Christiania.—Christiania, the capital of Norway, situated at the inner end of the Christiania Fiord, has a population of 145,000.

The Christiania gas works belong to the community. The amount invested by the city is reported to be 91,960*l.*

The gas produced is the ordinary coal-gas. The process done by sulphurous acid and ferric oxide.

The power of gas is equal to 16 candles.

The annual output is 167,000,000 cubic feet. Number of consumers, 3,205.

Price of gas for illumination, 4s. 9d. per 1,000 cubic feet with 5 or 10 per cent. discount for consumers, in proportion to quantities used. Price of gas for cooking and technical purposes, 3s. 2d. per 1,000 cubic feet without discount.

Number of gas stoves for heating, 20; cooking, 300; gas motors, 13.

Wages of employes, from 2s. 3d. to 3s. 4d. for 12 hours of labour per diem.

New Pelton coal from Newcastle. Their cost in 1889, 1*l.* 1s. English per ton.

Copenhagen.—In the year 1886 Danish gas works manufactured 989,631,720 cubic feet of gas. Out of this amount Copenhagen produced 594,517,300 cubic feet, or about 60 per cent. of the whole kingdom's gas, and $1\frac{1}{2}$ times more than all the other gas works in Denmark together. If the suburb of Frederiksberg be counted as part of the capital, Copenhagen consumes more than twice as much gas as the rest of the country.

Of gas manufactured in Denmark, 83·8 per cent. is produced by municipal gas works, and only 16·2 per cent. from private works. A steady increase has taken place during the last years. In 1881 the production was 705,731,600 cubic feet, and the increase has therefore been 38·9 per cent. The increase in the gas production at the Copenhagen gas works was during the same period 1881—86, 27 per cent., or about $4\frac{1}{2}$ per cent. a year. The other municipal gas works had at the same time an increase of 63 per cent., while private works had about 60 per cent., equal to a yearly increase of about 10 to 12 per cent.

Berne.—The money invested in the gas works at Berne amounts to 1,728,569 francs.

Process of manufacture: gas is manufactured exclusively in retort stoves. The manufacture of carbonated gas is not known in Switzerland.

It is prescribed here that a gaslight consuming 150 litres per hour must have at least a power of 16 Amplaectats lamps.

Approximate annual output: in 1889, 1,872,470 cubic metres gas were produced at Berne.

At the end of 1889 Berne had 1,741 gas metres for lighting purposes, 22 for machines, and 244 for gas stoves; total consumers, 2,027.

Price of gas for illuminating purposes, 25 centimes per cubic metre.

The use of gas stoves is annually increasing. The price of gas for this purpose and machines is 20 centimes per cubic metre.

Wages: stokers receive from 3·60 to 4 frs. for nine hours' work; still their presence is required for 12 hours, of which time they have three hours idle.

For the manufacture of gas, Saar (Germany) and St. Etienne (France) coals are now used, with boghead of Autun (France), Tyne boghead (England), and pitch coal from Bohemia to gain the prescribed light power.

Price of coal at the gas works, Berne: Saar, per 100 kilogrammes, 3·24 frs.; St. Etienne, 3·22 frs.; French boghead,

7·30 frs.; Tyne boghead, 6·50 frs.; Bohemian pitch coal, 4·70 frs.

Greece.—Cities using gas: Athens, Piræus, Patras, and Corfu.

Names of companies: Athens, *Compagnie d'Éclairage pour le Gaz pour la France et l'Étranger, Siège social, Paris*. Piræus, *Société Belge*. Patras, the municipality is owner of the gas works. Corfu, English company.

Amount of money invested in the industry: Athens, 2,000,000 frs.; Piræus, 1,050,000 frs.; Patras, 800,000 frs.

The process of manufacture is by distillation of coal.

The candle power of gas is 5·16 and 10 candles, counted in carrels.

The approximate annual output cannot be given.

Number of consumers: Athens, 1,400; Piræus, 350; Patras, 300.

Price of gas per 1,000 cubic feet: Athens, 37 lepta the cubic metre; Piræus, 35; Patras, 27.

Some gas stoves used for cooking, none for heating.

Wages, 3 frs. to 3·50 frs. per day. Hours of labour, 9 to 10.

The material used in the manufacture of gas is coal—Cardiff and Newcastle; about 35 drachmas delivered in the harbours of Piræus, Corfu, or Patras.

BURNT CLAY MORTAR.

United States Consular Reports, October 1891, 181.

In the frequent eruptions of Mount Etna in times past great beds of clay have been covered by lava which has burnt and converted them into a fine red gravel or powder. This burnt clay, when mixed with a little lime and water, forms a mortar locally considered superior to any other cement for building purposes. Every building in Catania is constructed of lava liberally cemented with this mortar, giving a peculiar soft pink colour to all the unpainted buildings. In building, small irregular stones are used just as they happen to come, and a smooth surface is afterwards given by a thin coating of mortar inside and out, which can then be divided by a trowel to imitate blocks of stone. The harbour breakwater (which extends for three-quarters of a mile into the sea) was constructed in this way ten years ago, and is as good to day as when first built.

—G. H. B.

WHITE WAX IN CHINA.

United States Consular Reports, October 1891, 201.

In Western China, not far from the Tibetan frontier, flourishes the tree *Ligustrum lucidum*, called by the Chinese "evergreen tree," bearing thick dark green glossy leaves with clusters of small white flowers in the summer, which are succeeded by fruit of a dark purple colour. Early in the spring numerous brown pea shaped scales appear on the boughs and twigs of the tree containing the larvae of the wax insect whose scientific name is *Coccus pe-la*. These scales are gathered by the Chinese, wrapped in packages, and conveyed about 200 miles to Chia-ting, the centre of the industry. The scales are here made up into small packets with leaves and are suspended under the branches of a species of ash. The insects on emerging from the packets creep up to the leaves of the tree and afterwards descend to the twigs and branches where the wax is deposited by the male insects. After 100 days the deposit is complete and the branches are then cut down, the wax scraped off, and what remains on the twigs is separated by boiling with water, which destroys the insects and necessitates a fresh supply of larvae in the next year from outside districts. A pound of larvæ scales will produce 4 or 5 lb. of wax, a ton of which is worth about 1,000 dollars at Shanghai. A tree from which the branches are removed is only available again after three years. The product is a clear white wax melting at 160° F., and is chiefly used to cover candles made of animal and vegetable tallow. It is also used for sizing paper and cotton goods, as a glaze for silk, and a polish for furniture. The introduction of foreign kerosene has had a discouraging influence on the production of white wax by diminishing the demand for candles.

—G. H. B.

THE PITCH LAKE OF TRINIDAD.

United States Consular Reports, October 1891. 254.

The sum of 26,744*l.* was derived in revenue from the pitch lake in 1890. The extension of the concession of the pitch lake was approved for an additional year for every 4,000*l.* which shall be paid by the concessionnaires before February 1st, 1909, over and above the minimum sum of 140,000*l.* payable in respect of the first term of 14 years, and the further sum of 28,600*l.* payable in order to obtain the extension of seven years from February 1st, 1902. One of the conditions imposed was that on February 1st, 1891, the concessionnaires should make a special payment to the colony of 10,000*l.*, in addition to the regular payment of 10,000*l.* due on that day under the terms of the concession, both payments being taken as against shipments of the year commencing on that day. Further, the Trinidad Asphalt Company agreed that if by February 1st, 1892, the concessionnaires had not paid to the Colonial Government 100,000*l.* in addition to the permanent deposit in London of 10,000*l.* the company should on that day give to the Crown free on all the land it now possesses in Trinidad a general security for the balance then remaining of the 140,000*l.*, the payment of which to the Colonial Government the company has undertaken.—G. H. B.

SULPHUR MINING IN SICILY.

United States Consular Reports, November 1891. 363.

The mining and fusing of sulphur in Sicily is still carried on in a primitive fashion owing to want of capital. Machinery is very little used and hand labour is universal. The two processes mostly used for obtaining sulphur are carried on in furnaces heated by the sulphur rock, and the acid fumes given off are very destructive to vegetation. A process recently imported from Spain gives a much improved yield, a sulphur ore containing 15 per cent. of sulphur giving a yield of 12.2 per cent. of sulphur, while the ordinary process yields only 5.6 per cent. of sulphur from the same material. The richness of the mineral in the mines is subject to great fluctuation, the risk of which becomes an objection to the erection of expensive plant. The Sinopoli furnace, which is much in use, consists of a number of iron cases about two metres long, three metres high, and a quarter metre wide; they are surrounded by walls and heated by two furnaces. When the requisite temperature is attained the sulphur melts and runs off through holes in the lower part of the cases, the operation lasting about 30 hours. Nine dollars per ton is given as a low estimate for the cost of mining and fusing of the sulphur. The prices of the various grades of sulphur differ by only small increments as shown in the following list of prices per 100 kilos. :—

Description.	Price.
	Lire.
First grade (best).....	10.71
Second grade :—	
Best	10.57
Good	10.44
Current	10.12
Third grade :—	
Best	9.85
Good	9.77
Current	8.70

—G. H. B.

THE CHEMICAL INDUSTRY OF BERLIN.

United States Consular Reports, November 1891. 403.

In the year 1890, taken as a whole, the chemical industry of Berlin was in a very satisfactory condition in spite of

constantly increasing cost of production, due to increased prices of coal, raw materials, and labour, and to the burdens imposed by State legislative measures adopted for the good of the working classes, but on account of increasing competition, sale prices did not improve. The production did not decrease in quantity, but, on the contrary, in some articles increased very considerably. The price of sulphate of ammonia averaged 26 marks, ammonium carbonate 65, while crystallised sal-ammoniac 58 to 60, and liquor ammoniac (sp. gr. 0.91) 33 marks per 100 kilos. Quotations for potassium carbonate of 96 to 98 per cent. were 36 to 37 marks per 100 kilos. The trade in oxalic acid was very active at cheap prices, averaging 55 marks. In potassium chlorate there was decided over-production, and the price fluctuated between 90 to 100 marks. The increased cost of alkali used for sodium silicate did not lead to increased price of the product as there was an over-production, although the demand increased. Soda ash and caustic soda rose steadily in price, but soda crystals were over-produced and prices did not continue to rise. Sulphuric acid of 66° was equal to the demand at 7 marks per 100 kilos. Prices for Chili saltpetre rose near the end of the year. The quotation for nitric acid of 36° was 23 marks. The condition of the tar industry was uninterruptedly satisfactory. Benzol rose 25 per cent. in price and the manufacture of naphthalene was especially lucrative. Toluene also found increased demand. Anthracene found steady sales at unchanged prices. The value of crystallised carbolic acid, previously in large demand at enhanced prices for military purposes, fell from 11½*d.* to 5½*d.*, but a rise is now to be expected. Prices of coal-tar colours were unchanged and any hopes of renewed success in this branch lies in patented specialities. The demand for aniline oil and aniline salt was unusually strong and prices rose considerably. The prices of chemical mineral colours advanced 15 per cent. over those of 1889. In Berlin and its vicinity, where wages are high and the entire cost of manufacture dear, only first class wares can be manufactured, whilst the cheap products (earth colours, &c.) are made in provincial factories.

On the whole the Berlin chemical mineral colour industry fully maintained its position in the trade of the world, except in a few countries from which it is kept out by Customs duties. Chemicals for pharmaceutical, photographic, and technical purposes were in active demand, but profits arising from their manufacture were not increased.

The requirements in regard to chemical purity of various pharmaceutical preparations have considerably increased since the publication of the third edition of the German Pharmacopœia, but the increased expense necessitated in obtaining the desired qualities finds little expression in increased prices. The price of bromine remained unchanged, but the prices of bromine preparations fell on account of continued competition among manufacturers. The consumption of chloral hydrate decreased on account of the increased use of other hypnotics, and the price fell 50 per cent. The selling price of potassium cyanide was not affected by the rise in price of its raw material, yellow prussiate of potash. The glycerin market, on the whole, was stagnant in 1890, and quotations for refined or distilled wares, owing to sharp competition, at no time during the year showed the proper relation to the value of raw material.—G. H. B.

GENERAL TRADE NOTES.

PALM OIL.

J. Soc. Arts, 40, March 18, 1892, 407—408.

The total import of palm oil into England is about 50,000 tons, valued at over 1,000,000*l.*, but it is considered that this is an exceedingly small commerce compared to what might be the case were the enormous resources fully, or even moderately, utilised. For miles along the west coast of Africa, extending between Cape Bianco and St. Paul di Loando, there are vast forests of palms, the oleaginous fruit of which has, for centuries, rotted unused upon the ground. The oil-palm

forests at the back of the coast-line of Cape Palmas and Elmina are said to be practically inexhaustible; and so also in the neighbourhood of Fernando Po, immense tracts are covered with the trees.

Lagos furnishes the purest oil; for there are in commerce regular and irregular oils. When analysed, if the water and impurities exceed 2 per cent., an allowance is made; for often these oils contain 10 to 15 per cent. of water and impurities.

Palm oil is eaten as butter by the natives, and used for anointing their bodies. Here it is used in the manufacture of soap and candles, and in South Wales in the preparation of tin plates. Its non-drying qualities render it valuable as a preservative of the surface of the heated iron sheet from oxidation until the moment of dipping into the bath of melted tin, the sheets being rapidly transferred to that from the hot oil-bath, which consists almost entirely of palm oil.

In 1871, as well as in 1880 and 1891, the imports of palm oil into the United Kingdom exceeded 1,000,000 cwt. From 10,000 to 15,000 tons of palm oil are shipped direct from Africa to the Continent. The price of the oil has ranged from 35s. per cwt. in 1883 to 23s. in 1890.

INCREASED CONSUMPTION OF BORIC ACID IN FRANCE.

In 1881, 2 kilos. of boric acid sufficed for the whole of the Paris hospitals, but, thanks to the progress of antiseptic surgery, though consumption began to increase in the year following, by 1884 the quantity rose to 1,057 kilos., and in 1890 there was required 8,085 kilos. of the acid. There has never been the slightest fluctuation, simply a steady increase. —*Chemist and Druggist*.

SYNTHESISING TARTARIC ACID.

M. Genvesse has discovered a simple way of synthesising tartaric acid. He starts with glyoxalic acid ($\text{CHO} \cdot \text{CO}_2\text{H}$), the acid peculiar to gooseberries, grapes, and similar fruits; and, by acting upon it with nascent hydrogen liberated by the action of acetic acid upon zinc-dust in contact with the glyoxalic acid, two molecules of glyoxalic acid are joined together by two hydrogen atoms, and that union gives tartaric acid, or rather the optically inactive form of it known as racemic acid, there being apparently equal molecules of the dextro- and levo-varieties produced. The product was separated and examined. This new synthesis of tartaric acid would appear to throw some light upon the natural formation of tartaric acid; for, remembering the close relationship between glyoxalic and oxalic acids, which latter is one of the most readily formed in vegetable tissues, and the reducing agencies which appear to be connected with chlorophyll, we have all the means at hand to account for the natural synthesis of tartaric acid. —*Ibid*.

THE ALKALI INDUSTRY.

The United Alkali Company (Limited) have closed their works at Clyde Bank, and are greatly restricting the production at their Irvine and Eglinton establishments. They have arranged with another firm to control the production of bleaching-powder. Chemical works are to be established close to the salt works, situated some miles beyond Fleetwood, and the erection of buildings is expected to be commenced immediately. Employment will be afforded to 1,000 workmen. The North chemical works at St. George's, Bristol, have been reconstructed so as to increase their powers of production. The North British chemical works at Glasgow are being dismantled, and most of the plant, which is said to be the best of its kind in the country, is to be removed to one of the other works of the Alkali Union, with which the concern has been incorporated. —*Ibid*.

THE PORTLAND CEMENT INDUSTRY.

Bradstreet's for the 13th February publishes the following abstract of a paper by M. Pierre Giron, recently read before the Engineers' Club at Philadelphia:—

"The present annual production of Portland cement in Europe amounts to over 20,000,000 barrels, and its commercial value to over 36,000,000 dols. The first factory was established at Northfleet, on the Thames. The process was so crude that in 1850 only four factories were in operation.

In England there are now over 8,300,000 barrels made each year. The process used there is about the same as it was 20 years ago. The raw materials are chalk and clay, both very pure, and, although inferior processes are used, they make a satisfactory cement. A few years ago the entire product of the kilns was put on the market, but the fineness of the continental cements led English makers to improve their qualities, although even now English cement is not, as a rule, as firm as Geneva or French Portland.

"The manufacture was first introduced into Germany in 1852. To-day there are 60 large works, having the same annual production as England. The raw materials are of exceedingly unfavourable character, but the makers have made a serious study of the properties and uses of Portland cement, and the producer now knows exactly what rules to follow to regulate his operations, and the consumer can depend on the product offered him. The Association of Manufacturers has had much to do with the immense development of the industry in Germany.

"In France the industry grew slowly, the total output in 1880 hardly exceeding 750,000 barrels a year. To-day the output is 1,800,000 barrels. The works of the Company of French Cements at Boulogne-sur-Mer form the largest Portland cement factory in the world, turning out about 800,000 barrels a year. In Russia the first works were established in 1857, and there are now eight Portland cement works, making 900,000 barrels a year. In Belgium there are four works, producing 800,000 barrels. In Italy the Portland cement industry does not properly exist, although a certain kind of natural Portland is made. In Denmark, Norway, and Sweden there are 10 factories, making about 800,000 barrels.

"Portland cement was imported into the United States as early as 1868. In 1882 the amount imported was 370,406 barrels, and last year it exceeded 3,000,000 barrels. But little effort has been made to develop the manufacture there. The materials for manufacture are as hard to handle as any in Germany, and the processes are similar. These are:—1, Grinding the rock into fine powder; 2, moulding it into bricks; 3, drying the bricks; 4, burning in an intermittent kiln with alternate layers of coke; 5, grinding the clinkers.

"These operations require about eight days, and require great care to produce a uniform product. The cost of the system is too great to make it successful in America. The process used in the Portland cement works at Coplay, Pa., has entirely revolutionised the science of cement-making. Here the raw compound is burnt in a powdered condition while travelling in an inclined rotary furnace in an intensely hot petroleum flame, and a few hours is sufficient to finish the process. The cement is guaranteed to stand 400 lb. in seven days, 500 lb. in a month, and 600 lb. in three months, and to leave no more than 10 per cent. residue on a No. 80 sieve."

GERMAN CHEMICALS IN INDIA.

The development of the German steam service with the East reveals the growing power of Germans in the Indian market in a manner that would have been impossible if nearly all goods were still shipped by way of this country, as in former days. The official Indian statistics recently published give the following particulars of some of the imports into British India from Germany:—

	1889-90.	1890-91.
	Rupces.	Rupces.
Chemicals (undennominated)	18,507	43,311
Quinine	6,312	24,256
Medicines	48,430	70,964
Opium	10	100
Aniline dyes	208,355	297,014
Other dyes	1,020	2,902
Instruments and apparatus	40,471	100,470

The total value of all goods imported into India from Germany has been:—In 1886–87, Rs. 1,603,000; 1887–88, Rs. 1,944,920; 1888–89, Rs. 2,480,160; 1889–90, Rs. 5,639,120; 1890–91, Rs. 16,916,490.—*Chemist and Druggist*.

THE PRODUCTION OF PHOSPHORUS.

Until a few years ago the countries of Central and Northern Europe obtained nearly the whole of their phosphorus from England, while France sent part of her surplus production to Spain and Italy. But gradually Russia has secured a not inconsiderable share of the Central European trade, a fact plainly shown in the German statistics concerning the importation of phosphorus, which are as follows:—

Imports from	1885.	1887.	1889.	1890.
	Tons.	Tons.	Tons.	Tons.
England	177	176	212	67
France .....	..	..	2	9
Russia .....	..	17	38	21
Other countries	2	2	..	25
Total	179	195	252	120

—*Ibid.*

COMMERCIAL MUSEUM AT CONSTANTINOPLE.

An intimation has been received from Messrs. Richard Shaw and Co., of Liverpool, to the effect that a permanent exhibition for displaying samples of produce and manufactures has been established at Constantinople.

Its object is to draw attention to and make known throughout the Ottoman Empire, as well as in foreign countries, the different kinds of hand and machine-made goods, and to give a larger extension to the demand for these goods by having permanently on show, in premises specially adapted for the purpose, properly classified samples, and by this means to contribute towards the extension of the commercial relations of the country with other States. The exhibition will be divided into two sections.

The first will contain samples of raw material produced in the Empire, specimens of manufactures, and other articles of Turkish make; while in the second section will be classed samples of British and foreign manufactures and products of all kinds. The museum will include a special bureau of commercial and industrial information, which will supply all possible details as to Customs tariffs, cost of goods at the place of production and their selling prices at the markets of consumption, the cheapest means of conveyance by sea and land, the charges attending the import and export trade with Turkey, and how such may be reduced to their lowest possible limits, with every other information on commercial matters that may be required.

The directors of the museum have the option of acting as intermediaries on behalf of manufacturers or merchants, who, with a view to protect their wares against spurious imitations, may be desirous of benefiting by the provisions of the law relating to trade marks, &c., or on behalf of inventors desirous of obtaining patents. A special book will be kept at the store in which entries will be made of the nature, quantity, value, place of origin, and the names of the senders of all goods exhibited in the magazin and sold through the medium of the directors, as also particulars of any improvements effected in the different articles of industrial produce.

The following are the rates for space in the museum:—1*l.* 7*s.* 3*d.* per square metre per annum; 18*s.* 2*d.* per $\frac{2}{3}$ of a square metre per annum; 13*s.* 8*d.* per $\frac{1}{3}$ of a square metre per annum; 9*s.* 1*d.* per $\frac{1}{4}$ of a square metre per annum, for samples of any article or product whatsoever.—*Board of Trade Journal*.

PETROLEUM PRODUCTION IN THE UNITED STATES IN 1891.

Bradstreet's of the 30th January says that:—

"The petroleum production in the United States in 1891 was the largest in the history of the industry. In 1889 the total production was 35,163,513 barrels, of which Pennsylvania and New York produced 21,487,135 barrels; Ohio, 12,471,466 barrels; West Virginia, 544,113 barrels; Colorado, 316,476 barrels; California, 303,220 barrels. The remainder was produced in Indiana, Kentucky, Kansas, Texas, and Missouri. No detailed figures have been published for 1890, but production was in the neighbourhood of 46,000,000 barrels, of which about 29,000,000 were produced in New York, Pennsylvania, and Northern West Virginia, a little over 1,000,000 in the Macksburg district, over 15,000,000 in Lima, and 1,000,000 in other districts, making a total of 46,000,000. The production in 1891 was approximately 50,150,000 barrels, of which Pennsylvania, New York, and West Virginia produced about 34,500,000 barrels; Macksburg, less than 100,000 barrels; Lima, about 14,500,000 barrels; California, 350,000 barrels; Colorado, 325,000 barrels; and the rest of the country 50,000 barrels."—*Ibid.*

THE ADULTERATION OF FERTILISERS.

The Departmental Committee which Mr. Chaplin has appointed to inquire into the question of Agricultural Fertilisers consists of the following members:—Mr. J. S. Gathorne-Hardy, M.P., Sir Jacob Wilson, Dr. James Bell, C.B., F.R.S., Mr. J. F. Rotton, Q.C., Mr. Channing, M.P., Mr. P. McLagan, M.P., and Mr. Albert Pell, with Mr. R. T. Crauford as secretary. The following are the terms of reference:—"To inquire into and report upon the representations made by Chambers of Agriculture and other bodies or persons with reference to the adulteration of artificial manures and fertilisers and feeding stuffs used in agriculture, and to receive and report upon any evidence which may be forthcoming on the subject, and to consider whether special legislative provisions for the prevention and detection of the adulteration of the commodities referred to appear to be necessary, and if so, the nature of those provisions."—*Standard*.

NEW PATENT LAW OF GERMANY.

In a recent report to his Government, the United States Consul-General at Berlin encloses the following translation of an extract from the *Hanover Courier* concerning the provisions of the new patent law of Germany:—

The new patent law, which went into force on October 1st, contains a number of provisions which differ very materially from the former requirements of law, and a knowledge of these new provisions is therefore of great importance both to producers and consumers of patented articles. While formerly the industrial use of products manufactured according to a patented process was not under patent protection, a paragraph added to section 4 of the new law provides that the effect of the granting of a patent for a process extends also to articles produced directly by such process. Accordingly, a dyer who obtains and uses in Germany dyestuffs which are patented in Germany, but which are produced in Switzerland without the consent of the owner of the patent, makes himself liable for breach of patent. This point was doubtful under the old law. The prosecution for such breach of patent is rendered easier for the owner of the patent in so far as, in accordance with section 35 of the new law, he is relieved of the burden of proof that the patented article placed on the market is produced according to this patented process; in future, in suits for infringement of patent, the burden lies on the defendant to prove that the article in question was produced by another process than the patented one. The above provisions are still more sharpened by the fact that, according to the new structure of the law, not only those can be sued for damages who violate a patent knowingly, but also those who do so out of gross carelessness. All of these new provisions make it advisable that in interested industrial circles, and especially among small tradesmen, in future patented products should be handled with the greatest possible circumspection, with careful consideration of the

new provisions of law, in order to protect themselves against the disadvantages arising from a breach of patent.—*Board of Trade Journal.*

A NEW COMMERCIAL OIL.

A Chicago glucose company is now turning out 1,500 barrels per day of a new commercial product, which they call "corn oil." It is (says the *Shipping and Commercial List*) a yellow liquid much resembling linseed oil in appearance, and can be used in making paint, varnish, or soap. The oil is contained in the germinal part of the grain. In the process of manufacture the germ is separated from the kernel, and the oil obtained by hydraulic pressure. The oil has heretofore been a waste product, which was lost in the ordinary method of making starch and glucose. The proportion of oil in whole corn is about 4 per cent.—*Chemist and Druggist.*

BOARD OF TRADE RETURNS

SUMMARY OF IMPORTS.

	Month ending 29th February	
	1891.	1892.
Metals.....	£ 1,891,649	£ 1,752,223
Chemicals and dyestuffs.....	864,218	941,833
Oils.....	522,098	592,953
Raw materials for non-textile industries.....	2,180,652	2,413,257
Total value of all imports....	33,311,554	34,877,991

SUMMARY OF EXPORTS.

	Month ending 29th February	
	1891.	1892.
Metals (other than machinery)	£ 2,850,721	£ 2,629,389
Chemicals and medicines.....	756,000	701,022
Miscellaneous articles.....	2,539,893	2,349,355
Total value of all exports.....	20,470,621	19,328,753

IMPORTS OF OILS FOR MONTH ENDING 29TH FEBRUARY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Cocoa-nut..... Cwt.	7,849	12,487	£ 10,849	£ 14,125
Olive..... Tuns	1,000	2,118	40,084	77,747
Palm..... Cwt.	61,562	77,626	78,232	90,004
Petroleum..... Gall.	9,779,717	10,450,723	202,283	196,212
Seed..... Tons	2,509	1,978	58,726	52,967
Train, &c..... Tuns	954	1,134	22,029	24,670
Turpentine..... Cwt.	33,522	45,780	47,500	58,002
Other articles .. Value £	..	..	63,386	79,226
Total value of oils ...	..	..	522,098	592,953

IMPORTS OF METALS FOR MONTH ENDING 29TH FEBRUARY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Copper:—			£	£
Ore..... Tons	5,262	5,738	18,184	28,510
Regulus..... "	11,113	8,243	307,680	218,950
Unwrought "	2,358	2,630	131,000	123,579
Iron:—				
Ore..... "	307,653	386,277	239,958	278,187
Bolt, bar, &c.... "	4,393	4,945	40,281	36,526
Steel, unwrought.. "	380	388	4,748	4,138
Lead, pig and sheet "	12,065	14,630	157,767	158,410
Pyrites..... "	49,932	59,194	98,025	104,812
Quicksilver..... Lb.	1,237,895	417,905	142,016	39,158
Tin..... Cwt.	58,264	58,644	264,800	263,824
Zinc..... Tons	3,896	3,675	89,969	73,023
Other articles ... Value £	..	..	368,121	423,106
Total value of metals	..	..	1,891,649	1,752,223

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 29TH FEBRUARY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Bark, Peruvian .. Cwt.	13,593	12,717	£ 39,504	£ 28,544
Bristles..... Lb.	249,700	176,360	32,610	23,059
Caoutchouc..... Cwt.	22,945	31,531	277,965	375,265
Gum:—				
Arabic..... "	3,138	6,335	10,774	20,813
Lac, &c..... "	8,795	8,122	32,422	32,498
Gutta-percha "	6,793	3,816	87,362	47,591
Hides, raw:—				
Dry..... "	32,143	31,374	80,820	89,647
Wet..... "	18,836	34,304	108,490	71,346
Ivory..... "	637	530	30,527	27,734
Manure:—				
Guano..... Tons	1,482	4,081	12,012	29,526
Bones..... "	13,457	7,542	70,621	33,707
Paraffin..... Cwt.	53,445	41,903	72,908	60,128
Linen rags..... Tons	2,187	2,448	21,306	23,725
Esparto..... "	17,625	24,817	84,958	117,684
Palp of wood "	12,237	17,578	68,417	77,834
Rosin..... Cwt.	134,656	216,139	31,130	41,360
Tallow and stearin "	55,491	101,495	71,510	133,121
Tar..... Barrels	6,240	2,338	4,662	1,591
Wood:—				
Hewn..... Loads	82,428	126,947	132,203	214,898
Sawn..... "	49,009	78,551	121,829	203,443
Staves..... "	3,315	5,666	17,976	35,868
Mahogany..... Tons	5,275	5,531	47,501	60,567
Other articles.... Value £	..	..	723,745	682,361
Total value .....	..	..	2,180,652	2,413,257

Besides the above, drugs to the value of 85,414, were imported as against 53,609, in February 1891.

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH
ENDING 29TH FEBRUARY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Alkali..... Cwt.	5,349	2,937	3,211	2,654
Bark (tanners, &c.) "	33,194	10,766	9,389	16,776
Brimstone..... "	24,745	38,673	6,655	11,105
Chemicals..... Value £	..	..	97,759	131,951
Cochineal..... Cwt.	551	256	3,175	2,080
Cutch and gambier Tons	2,993	3,216	69,567	77,361
Dyes:—				
Aniline..... Value £	..	..	21,580	16,785
Alizarine..... "	..	..	31,339	26,039
Other..... "	..	..	1,079	258
Indigo..... Cwt.	17,672	16,150	361,851	332,317
Nitrate of soda.... "	195,455	159,872	76,554	75,199
Nitrate of potash . "	26,666	30,253	24,387	25,772
Valonia..... Tons	1,379	1,326	29,614	63,223
Other articles... Value £	..	..	124,968	156,383
Total value of chemicals	..	..	864,218	941,933

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH
ENDING 29TH FEBRUARY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Gunpowder..... Lb.	813,400	460,100	18,816	11,372
Military stores.. Value £	..	..	67,591	62,009
Candles..... Lb.	1,022,200	1,553,200	29,710	30,043
Caoutchouc..... Value £	..	..	97,939	98,087
Cement..... Tons	44,544	39,780	88,666	76,225
Products of coal Value £	..	..	136,402	130,805
Earthenware ... "	..	..	141,932	157,824
Stoneware..... "	..	..	9,323	14,331
Glass:—				
Plate..... Sq. Ft.	276,127	242,951	17,086	12,800
Flint..... Cwt.	8,469	8,249	19,181	17,511
Bottles..... "	68,452	61,282	31,666	28,948
Other kinds.... "	17,126	13,322	15,753	10,757
Leather:—				
Unwrought.... "	13,522	11,006	116,882	100,799
Wrought..... Value £	..	..	32,777	24,904
Seed oil..... Tons	5,655	6,435	123,906	128,121
Floorcloth..... Sq. Yds.	1,480,700	1,869,400	79,980	74,846
Painters' materials Val. £	..	..	126,846	123,774
Paper..... Cwt.	70,913	83,731	125,626	142,812
Rags..... Tons	3,689	4,658	24,519	33,953
Soap..... Cwt.	36,938	43,599	43,183	48,182
Total value.....	..	..	2,539,893	2,349,355

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR
MONTH ENDING 29TH FEBRUARY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Brass..... Cwt.	8,844	8,827	38,701	39,295
Copper:—				
Unwrought..... "	58,376	78,539	165,752	188,515
Wrought..... "	30,631	33,778	101,379	101,628
Mixed metal.... "	18,634	29,015	53,559	75,361
Hardware..... Value £	..	..	195,847	180,074
Implements..... "	..	..	99,343	98,516
Iron and steel..... Tons	218,581	184,310	1,961,309	1,694,132
Lead..... "	3,179	4,257	48,699	55,847
Plated wares... Value £	..	..	26,511	23,712
Telegraph wires, &c. "	..	..	22,306	31,006
Tin..... Cwt.	9,689	8,414	43,223	39,719
Zinc..... "	14,000	14,920	14,652	14,887
Other articles... Value £	..	..	75,820	86,667
Total value.....	..	..	2,850,721	2,629,589

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING
29TH FEBRUARY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Alkali..... Cwt.	514,640	420,176	182,992	152,855
Bleaching materials "	97,712	116,384	32,983	46,972
Chemical manures, Tons	24,306	27,620	197,637	202,462
Medicines..... Value £	..	..	81,893	83,660
Other articles... "	..	..	257,495	215,120
Total value.....	..	..	756,000	761,022

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

2908. H. Salmon. Acid condenser and smoke arrester, the object of which is to clear the atmosphere. February 15.

3013. N. Hunting. Improvements in apparatus for distilling water in the presence of air, and for communicating heat thereto, and for supplying water and air thereto and delivering water therefrom. Complete Specification. February 16.

3042. R. Harrison. Improvements in and relating to means for heating or vaporising. February 16.
3215. C. Pryce. Improvements in kilns. February 18.
3708. F. H. Danchell. See Class XVI.
3834. E. G. Constantine. Improvements in or applicable to annealing and other furnaces. February 27.
4237. F. P. Hill, A. J. E. Hill, and W. Freeman. Adapting glass or earthenware bottles and vessels of a kindred nature for the purpose of containing hydrofluoric acid or compounds containing hydrofluoric acid. March 3.
4907. J. Lee and S. Lancaster. Apparatus for producing an atmospheric or Bunsen smokeless flame from liquid hydrocarbons as fuel. Complete Specification. March 12.
4911. T. O. Easton, A. Watt, and J. Buchanan, jun. Improvements in or appertaining to apparatus for filtering saccharine or other liquids and method of working the same. March 12.

COMPLETE SPECIFICATIONS ACCEPTED.*

1890.

- 20,166. F. M. Robertson. Process and apparatus for evaporating and drying. March 16.

1891.

5342. H. L. Callendar. Electrical thermometers or pyrometers. March 2.
6057. W. H. Munn.—From G. Kaffenberger. Digesting apparatus. March 9.
6587. H. Hencke. Method and apparatus for drying and evaporating, suitable for use in breweries, distilleries, sugar and starch manufactories, and other industries. March 16.
7464. A. Hof. Carburating or carbonising apparatus. March 16.
7446. W. Birch. Apparatus applicable to the cleansing or filtration of sewage and other liquids. March 9.

1892.

154. A. T. Danks. Appliances for saturating air, oxygen, or other gases with the vapours of ether or other volatile fluids. February 24.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

3025. H. Axtmann. Apparatus for producing light by the combustion of magnesium or other highly luminiferous bodies. February 16.
3026. J. A. Dubbs. Improvement in the manufacture of asphaltum. Complete Specification. February 16.
3053. G. A. Fuels. Improvements in the manufacture of coal-dust brieks from bituminous coal, charcoal, coke, ore dross, brown coal, and the like. February 16.
3092. R. L. Barr, J. Macfarlane, E. J. Mills, and S. Young. Improvements in obtaining cyanides. February 17.
3305. O. Saporì. Improvements relating to the manufacture and utilisation of gas, and to apparatus therefor. Complete Specification. February 19.
3326. J. Addie and J. Cuninghame. Improvements in the treatment of spent lime and gas liquors and of blast furnace and other gases for the recovery of cyanides therefrom. February 20.
3355. E. W. Harding. Improvements in means or apparatus for the manufacture into blocks or moulded forms of carbonaceous matter for use as fuel. Complete Specification. February 20.

3442. J. B. Butler. Improvements in the manufacture of artificial fuel. February 22.

3619. T. Zohrab. An improved method of and apparatus for the treatment of peat and the conversion of peat into charcoal. February 24.

3959. J. Johnson.—From H. Kennedy, United States. Improvements in coke ovens. Complete Specification. March 1.

3981. J. Addie and J. Cuninghame. Improvements in the treatment of blast furnace illuminating and other gases, and of spent lime and gas liquors for the recovery of cyanides therefrom. March 1.

3995. A. J. Boulton.—From the Chicago Heat Storage Co., United States. Improvements in or relating to the manufacture of fuel-gas. Complete Specification. March 1.

4032. T. R. Osbourn. Apparatus for quenching coke. Complete Specification. March 1.

4033. T. R. Osbourn. Apparatus for the manufacture of coke. Complete Specification. March 1.

4041. I. S. McDougall and J. T. McDougall. Improvements in the treatment of mineral oils or spirits to facilitate the manufacture of gas therefrom. March 1.

4241. P. D. Ferriè and H. J. B. Thiroux. Improvements in apparatus for enriching ordinary gas by means of naphthalene. March 3.

4246. J. Woodward and F. W. Crossley. Improvements in apparatus for charging and discharging gas retorts. March 3.

4411. J. H. Parkinson. Improvements in the separation of oxygen, nitrogen, or other mechanically-mixed fluids, and obtainment thereof. March 5.

4440. C. Kilpatrick and The Ferriè Sewage and Water Purification Co., Lim. See Class X.

4556. A. Jones and E. Shepherd. Improvements in or connected with means or apparatus for consuming smoke and economising fuel. March 8.

4728. J. Moeller. Improved apparatus for making gas from oils, fatty substances, and other material. March 10.

4907. J. Lee and S. Lancaster. See Class I.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

- 19,888. J. Love. Manufacture of gas and apparatus therefor. March 9.

1891.

578. N. Bourgoïn and H. Decoree. Apparatus for making gas. March 16.

5960. B. J. B. Mills.—From E. L. Clarke. Machinery for the manufacture of peat fuel. March 9.

6947. W. T. Cotton and E. F. B. Crowther. Gas retorts. March 2.

7846. B. Egger. Automatic apparatus for indicating the presence in or absence from a space of gases of different specific gravity from the ordinary gaseous contents of such space. March 16.

- 21,223. W. R. Alpe. Apparatus for the manufacture of fuel blocks. March 2.

1892.

848. G. B. Field. Means for burning straw, cornstalks, and such like fuel. February 24.

965. W. E. Vickers and G. A. Everett. Machinery or apparatus for effecting the complete mixture of inflammable gas or vapour with air. March 2.

* See Note (*) on previous page.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

2953. C. D. Abel.—From The Actiengesellschaft für Anilin-Fabrikation, Germany. Manufacture of new bases and colouring matters therefrom. February 15.

3698. I. Roos. Manufacture of a new compound resulting from the reaction of a methylphenylhydrazine and salicylaldehyde. February 25.

3718. J. V. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in and relating to the manufacture and production of dyes derived from triphenyl-methane and of leuco compounds thereof, and of intermediate products in the said manufacture. February 25.

3791. A. J. Boulton.—From The Firm of W. Bruns, Germany. Improvements in the manufacture of colours specially applicable for colouring photographs. Complete Specification. February 26.

4109. A. Bang.—From G. A. Dahl, Germany. A new black azo dye-stuff, and the production of the same. March 2.

4110. A. Bang.—From G. A. Dahl, Germany. A black cotton dyestuff, combinations of the same, and processes for the production thereof. March 2.

4406. O. Imray.—From The Farbwerke vormals Meister, Lucius, und Brüning, Germany. Manufacture of beta-amido crotonic anilide and of beta-methylamido-crotonic anilide. March 5.

4407. O. Imray.—From The Farbwerke vormals Meister, Lucius, und Brüning, Germany. Process for the production of a red colour on textile fibres. March 5.

4677. P. Monnet. The manufacture of new colouring matters or dyes. Complete Specification. March 9.

4766. O. Imray.—From Messrs. Küchler and Buff, Germany. Process for the production of methylenediphenyl di-imide and its homologues and the conversion thereof into diamidodiphenylmethane and its homologues and into fuchsine. March 10.

4932. E. Geromont and H. Goldenberg. Improvements in the manufacture of colouring matters. March 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

3270. A. Fischesser. Process for producing azo colouring matters. March 2.

4871. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of colouring matters derived from anthraquinone. March 16.

5984. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture or production of azo-colouring matters. February 24.

6376. Brooke, Simpson, and Spiller, Lim., and A. G. Green. Production of new bases and of azo-colouring matters therefrom. March 16.

6972. S. Pitt.—From L. Cassella and Co. Production of amidonaphtholsulpho acids and of dyestuffs therefrom. March 9.

7258. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture and production of dyes belonging to the rhodamine series, and of new materials for use in their preparation. March 9.

7713. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture and production of diazo dyes, and of intermediate products in their preparation. March 16.

7963. O. Imray.—From The Farbwerke vormals Meister, Lucius, und Brüning. Manufacture of nitro- and amido-methyl-phenylpyrazolon and a derivative of the latter. March 16.

7964. O. Imray.—From The Farbwerke vormals Meister, Lucius, und Brüning. Production of blue colouring matters. March 16.

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATIONS.

3210. A. Rowbotham. Improvements in the treatment of vegetable textile materials such as cotton, jute, and the like, for the purpose of deodorising, cleaning, and restoring the same, and in apparatus for use in connexion therewith, which improvements are also applicable to the treatment of sponges. February 18.

3268. R. Brown and J. C. Allardice. An improved composition for finishing linen and other fabrics. February 19.

3369. T. Thomson. Improvements in compositions for waterproofing paper, woven fabrics, and other materials. February 20.

3650. J. Clegg. An improved method for carbonising or extracting vegetable or other foreign matter from wool, woollen, or worsted fabrics. February 25.

3979. J. A. Wilson and D. Nicoll. Treating vegetable fibres either in the raw or in the manufactured state in order to arrest or retard decay. March 1.

4692. J. Villieus. A process for producing fibre from the hop plant for textile purposes or pulping. March 9.

COMPLETE SPECIFICATION ACCEPTED.

1891.

6698. J. G. Smith.—From F. Doller. Waterproofing textile materials. March 16.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

2939. A. Ophoven. Improved art or process or colouring pictures or textile fabrics. Complete Specification. February 15.

3413. C. Owens. An improved method of bleaching raw cotton or other vegetable fibres. February 22.

4278. H. Thies and E. Herzig. Improvements in bleaching. Complete Specification. March 4.

4823. C. J. E. de Haën. Improvements in or relating to the bleaching of vegetable and animal fibres or other organic substances. March 11.

COMPLETE SPECIFICATION ACCEPTED.

1892.

2096. W. Searle and W. H. Elliot. Apparatus for dyeing or chemically treating and drying paper, felt, or other fabrics. March 16.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

2991. J. J. Knight. Improved treatment of chloride of ammonium produced in the manufacture of soda by the ammonia-soda process to obtain carbonate of ammonia and chlorine. February 16.

3491. The Manchester Oxygen (Brin's Patent) Company, Limited, and W. M. Jackson. Improvements in the manufacture of carbonic acid. February 23.

3794. G. W. Sharp and C. H. Harvey. Improvements in or relating to converting ferrous chloride into ferric chloride, and in apparatus therefor. February 26.

3880. E. Rijn. Improvements in the manufacture of oxalic acid and cellulose. Complete Specification. February 27.

4346 P. E. Singer. Improvements in the manufacture of the hydrides of the metals of the alkalis. March 5.

4527. C. G. Collins. An improved process for the purification of brine. Complete Specification. March 8.

4657. H. C. Ball and G. W. Sharp. Improvements in or connected with the manufacture of ferric chloride. March 9.

4765. H. W. Crowther. Improvements in treating liquors containing sulphocyanides for the purpose of separating the said sulphocyanides therefrom. March 10.

4851. F. Ellershausen. Improvements in the manufacture of soda and potash. March 11.

4903. M. N. d'Andria. Improvements in the manufacture of sulphocyanides. March 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

4314. C. F. Claus. Manufacture of the aluminates, sulphates, and carbonates of soda and potash, and the production or recovery of alumina and other by-products. March 16.

4712. J. Pedder. Using a combination of sulphuric acid for the decomposition of chlorides, sulphides, sulphates, and of sulphuretted hydrogen. March 16.

6509. J. W. Wilson and C. H. G. Harvey. Treating waste liquor from galvanising works and other similar liquors to obtain ferric chloride. February 24.

8006. E. L. C. Martin. Manufacture of caustic soda and caustic potash. March 16.

8018. G. Lunge and J. Dewar. Process for the recovery of sulphur, carbonate of soda, and iron oxide from double sulphide of sodium and iron. March 2.

8844. A. F. M. L. Paillard. Manufacturing and regenerating salts of peroxide of iron. March 9.

17,130. F. Perez - Gutierrez. Process for moulding common salt (chloride of sodium) by melting it previously. February 24.

20,713. C. Kellner. Manufacture and production of chlorine and alkaline carbonates. February 24.

1892.

212. S. C. C. Currie. Improvements in the art of producing insoluble chlorides direct from the metals. March 2.

2389. L. Brunner and A. Zauner. Process for preparing at the same time neutral chloride of soda and precipitated phosphate of lime. March 16.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

3586. C. Armstrong. Improvements in kilns or ovens for burning and glazing sanitary ware and the like. Complete Specification. February 24.

3817. J. Hughes and C. Billington, jun. Improved construction of spurs, stilts, and thimble-pins for use in supporting pottery ware whilst being fired. February 27.

4525. H. D. Fitzpatrick.—From M. Schreiber and L. Ottinger, Germany. Improvements in the method of manufacturing glass bricks. Complete Specification. March 8.

4545. H. H. Pitt. Improvements in the process of the manufacture of pressed glass articles, and in apparatus therefor. March 8.

4585. F. Wright and C. Rawle. Improvements in the manufacture of articles of glass, and in apparatus therefor. March 8.

COMPLETE SPECIFICATION ACCEPTED.

1891.

21,997. J. K. Thompson. Fire-resisting bricks and material for lining, facing, or coating fireplaces, fireboxes, furnaces, ovens, and kilns of every kind. February 24.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

2957. H. Hartmann. Improvements in the manufacture of a resistible material, chiefly designed for building purposes. Complete Specification. February 15.

2970. E. Robbins. Improvements in buildings, structures, and decorative works, in vitreous, cementitious, and other materials, plant, and machinery therefor. February 16.

3079. C. R. Cowens. Improvements in or relating to the calcination of limestone, ironstone, or the like substances, and in the recovery and utilisation of by-products and residuals for commercial purposes. February 17.

3125. J. M. Bridson. An improved brick for building purposes. February 17.

3315. W. Thompson. Improvement in the method of calcining limestone. February 20.

3539. H. Brunson and E. W. Gillett. Improvements in building or paving blocks. Complete Specification. February 23.

4131. J. T. Knowles. — From Die Actiengesellschaft "Cimbria," Denmark. A process for the treatment of raw materials to be used in the production of Portland cement. March 2.

4149. W. H. Charlesworth. Improvements in slurry-drying structures used in the manufacture of cement. March 2.

4295. J. W. Ardin and J. Brown. An improvement in the construction of blocks or bricks for street pavements. March 4.

4408. C. J. Dobbs. Improvements in the manufacture of scoria or slag blocks for paving and other purposes. March 5.

4496. J. S. Holliday. Improved artificial stones. Complete Specification. March 7.

4499. J. Lyle. Improved combination of ingredients to form asphalt compounds, specially adapted for road and paving purposes generally. March 7.

4511. S. Turner. An improved fireproof floor. March 8.

4540. G. M. Graham. Improvements in building or paving blocks. Complete Specification. March 8.

4553. J. W. Knights. An improvement in burning Portland cement. March 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

7184. W. W. Horn.—From W. L. Mason, T. W. Blakey, and J. A. Wright. Artificial stone. March 2.

10,137. H. H. Lake.—From H. B. Seely. Construction of floors. March 9.

22,198. F. H. Willis and R. Astley. Fireproof floor. March 16.

1892.

795. E. Websky. Treating gypsum casts. February 24.

1827. W. Brown. Method of jointing concrete paving. March 9.

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

2927. H. Pidot. Improvements in the production of aluminium. February 15.

3024. A. G. Brookes.—From B. C. Molloy, South Africa. Improvements in precipitating and collecting metals from solutions containing them. February 16.

3090. A. D. Leyshon. An improvement in the process of coating tin and terne plates, and in apparatus therefor. February 17.

3237. R. A. Hadfield. Improvements in the manufacture of cast steel projectiles. February 19.

3308. M. N. d'Andria. Improvements in the recovery of hydrochloric acid and ferric oxide from ferrous chloride. February 19.

3422. A. E. Tucker and F. W. Harbord. Improvements in the linings of steel converters, Siemens and other metallurgical furnaces. February 22.

3493. R. L. Sentinella. An improved treatment of iron and steel for casting the same from crucibles. February 23.

3844. T. Twynam. Improvements in the separation of tin from tin scrap. February 27.

3854. T. M. Ash and H. W. Gill. Improvements relating to the depositing of metals. February 27.

3947. B. Talbot, sen. Improved form of furnace for iron and steel manufacture. March 1.

4173. P. Rossigneux. Improved method or means of desulphurising castings or alloys of certain metals. Date applied for, October 28, 1891, being date of application in France. Filed March 2.

4215. F. G. Fuller. Improvements in the extraction and recovery of gold and silver. March 3.

4333. F. Sugden and T. Sugden. Treatment of cast iron. March 4.

4334. J. Jones. Improvements in the manufacture of sheet iron. March 4.

4440. C. Kilpatrick and the Ferrie Sewage and Water Purification Company, Limited. A new or improved process for the utilisation of oxide of iron obtained as a by-product in the smelting or extraction of copper from cupreous ores, or from spent oxide obtained as a by-product in the purification of gas. March 7.

4460. W. P. Thompson.—From W. J. Miles, jun., H. S. Deming, and A. Herz, United States. Improvements in metallic alloys. Complete Specification. March 7.

4488. T. Evans and H. C. Bunkell. Improvements in amalgamating the precious metals and their ores, and the like, and in apparatus therefor. March 7.

4644. J. Nicholas. An improved means of extracting precious and other metals from their ores. March 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

3957. C. A. Faure. Manufacture or production of aluminium alloys. February 24.

5851. W. Sowerby and E. Casper. Casting metals. March 16.

6942. W. Beardmore. Manufacture of armour plates and apparatus therefor. March 2.

8083. L. Mond. Manufacturing nickel alloys. March 9.

8495. A. W. Warwick. Process for extraction of antimony from its ores, and separation of other metals therefrom. March 16.

9013. A. M. Clark.—From The Deutsche Gold und Silber Scheide-Anstalt, vormals Roessler, through Wirth and Co. Process for desilverising argentiferous lead. March 9.

9757. R. Heathfield. Process for coating or cleaning metals. February 24.

1892.

581. G. Pickhardt. Improvements in connexion with the use of aluminium and aluminium alloys. March 16.

1984. D. Dyrenforth. Manufacture or treatment of iron or steel. March 9.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

2913. G. Nahnsen. Improvements in the electro-metallurgic extraction of zinc. Complete Specification. February 15.

3114. C. Thompson. Improvements in electrical primary batteries. February 17.

3120. P. H. Bertrand. Improvements relating to galvanoplasties or the electro-deposition of metal. February 17.

3512. G. D. Davis. Improvements in the process of electrolysing alkaline salts. February 23.

3514. G. D. Davis. Improvements in the process of electrolysing alkaline salts. February 23.

3523. O. Imray.—From C. Wasmuth, Germany. Improved galvanic element. February 23.

3559. S. W. Kimble. See Class XIII.

3881. K. Kababka. Improvements in electrical accumulators. Complete Specification. February 27.

4103. R. Goodwin. Electro-deposition of aluminium on metals. March 2.

4154. E. Viarengo. Improvements in electric batteries. March 2.

4190. F. M. A. Laurent-Cely and E. Pinot. Improvements in electrical batteries. March 3.

4316. E. G. Hoffmann. Improvements in electric welding and in apparatus therefor. March 4.

4456. R. W. James.—From G. E. Gale, United States. A process for electro-plating. March 7.

4458. R. W. James.—From G. E. Gale, United States. An electrode for electro-plating. March 7.

4576. J. V. Sherrin. Improvements in secondary batteries. March 8.

4579. S. A. Rosenthal and J. V. Sherrin. Improvements in galvanic batteries and battery liquids. March 8.

4758. W. Boggott. Improvements in the method and means of obtaining electricity. March 10.

4768. S. W. Maquay. Improvements in electric batteries. March 10.

4820. L. Mereky. Improvements in primary batteries. March 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

2471. T. W. Bash and M. Doubleday. Manufacture of hydrolysed lead cells for electrical or storage batteries. March 9.

5167. F. E. Elmore and A. S. Elmore. Manufacture of tubes by electrolysis. March 2.

6243. S. M. L. Patz and R. Grebner. Galvanic batteries. February 21.

6247. J. V. Johnson.—From F. Gendron. Automatic regulating apparatus employed in connexion with galvanic batteries. February 24.

6793. P. C. E. Champion. The application of electricity for the production of pyrotechnic and other effects, applicable also for signalling and advertising purposes, and apparatus therefor. March 16.

7697. C. P. Eliason. Electrical accumulators or storage batteries. March 9.

8227. W. P. Thompson.—From H. O. Tudor. Electrodes for electric accumulators. March 2.

8845. R. Hadden.—From I. Cabanyes. Galvanic batteries. March 9.

1892.

1391. The London Metallurgical Co. and S. O. Cowper-Coles. Coating articles with a new metallic alloy by electro-deposition. March 2.

1484. J. B. Entz and W. A. Phillips. Secondary batteries. March 2.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

3239. C. H. Ridsdale. Improvements in lubricating with solid lubricants. February 19.

4174. J. Porteous. Improvements in the manufacture and preparation of soap or pieces of soap for sale or use. March 2.

4250. R. Zurrer. Improved process for transforming the unsaturated oleaginous fatty acids into less fusible saturated fatty acids. Filed March 3. Date applied for August 4, 1891, being date of application in France.

4447. O. Tilley. A new or improved cleansing composition and process of cleaning and purifying foul casks or barrels and the like. March 7.

4649. J. Gibson and C. Estcourt. Improvements in the manufacture of soap. March 9.

4883. H. Shaw. Improvement in the manufacture of soap. March 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

4451. R. Stone. Manufacture of soap and utilisation of the residue of the substances used therein. March 9.

7251. W. N. Hartley and W. E. B. Blenkinsop. Thickening oil. February 24.

21,438. C. L. Field. Manufacture of super-fatted soap. March 2.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

3142. H. Taylor. Improvement in the manufacture of paints and varnishes, also in materials for use of same. February 17.

3347. J. C. Margetson. A method of devulcanising vulcanised india-rubber, so as to recover raw rubber and the materials contained in the vulcanised rubber. February 20.

3559. S. W. Kinde. Improvements in the manufacture of compositions for insulating or other purposes. February 23.

4169. E. C. Williams, M. E. Williams, and C. May. Improvements in or relating to bronze or other metallic paints. March 2.

4252. D. Rigole. Improvements relating to the extraction of gutta-percha, and to apparatus therefor. Complete Specification. March 3.

4522. W. Thompson. An improvement applicable to blocks of laundry blue, black lead, and similar compositions. March 8.

4650. J. Gibson and C. Estcourt. Improvements in the manufacture of washing blue. March 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

5977. J. Robson. Preservative coatings for iron or other structures. February 21.

7036. G. Hand Smith. Treatment of gums and the preparation of varnishes therefrom. February 24.

8022. A. Honnan and B. Vulliez. Process and apparatus for the manufacture of white lead. February 24.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

3105. C. Cosinerie. Improvements in the manufacture of a light coloured albumen from blood. February 17.

4783. J. Pullman, W. R. Pullman, and A. Pullman. An improved process for treating skins and hides. March 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

8796. B. Wright and D. Wright. Machinery or apparatus for staking, softening, and penehing leather. March 16.

1892.

951. L. Bertram. Process and apparatus for extracting glue or gelatin and grease out of hide and skin waste, and of bones at comparatively low temperature. February 24.

XV.—AGRICULTURE AND MANURES.

APPLICATIONS.

3029. H. H. Lake.—From the Biolytic Gypse Co., United States. An improved insecticide and fertiliser. Complete Specification. February 16.

3301. B. Willecox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. See Class XX.

3806. E. Groc and E. Ramond. A composition or dressing for vines and other trees. February 26.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

8402. A. Knorre. Manufacture of artificial manure. March 16.

22,192. L. Lamattina. Conversion into manure of the refuse and foul matter from cities and towns. February 21.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

3241. A. G. Brookes.—From F. Paetow, Germany. Improvements in refining or purifying sugar. February 19.

3708. F. H. Danchell. Improvements in the cleaning and revivifying of charcoal in filters for saccharine juice, water, and other liquids, and in and connected with the construction of such filters. February 25.

COMPLETE SPECIFICATION ACCEPTED.

1891.

21,477. W. P. Thompson.—From J. Hirsch. Manufacture of cuhe, loaf, and similar sugar. March 2.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

3010. W. P. Thompson.—From C. F. Lawton, United States. Improvements in the process of manufacturing beer, ale, wine, cider, or the like. Complete Specification. February 16.

3011. W. P. Thompson.—From C. F. Lawton, United States. Improvements in the method of and apparatus for manufacturing beer, ale, wine, cider, or the like. Complete Specification. February 16.

3798. W. L. Wise.—From A. Antheaume, France. Improvements in the manufacture of beer. February 26.

3890. A. R. Waddell. A beverage. February 29.

4682. A. J. Boulton.—From The Pfaudler Vacuum Fermentation Co., United States. Improvements in the manufacture of beer. Complete Specification. March 9.

4688. A. J. Boulton.—From The Pfaudler Vacuum Fermentation Co., United States. Improvements in the manufacture of beer. Complete Specification. March 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

7272. W. P. Thompson.—From A. H. Jacques. Apparatus for converting amylaceous substances into soluble products. March 9.

20,649. C. Hof.—From Schneider. Production of colour malt. March 16.

21,698. P. A. Attout, called Tailfer. Distilling and apparatus therefor. March 9.

1892.

1044. J. F. Henderson. Manufacture of unfermented wine. February 24.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

3377. H. H. Lake.—From La Société Mateu del Cano et Cie., France. Improvements relating to the preservation of meat. February 20.

3462. S. Pitt.—From J. Mariosa, Brazil. An improved process for the preservation of meat. February 22.

3470. G. E. Redfern.—From G. H. Neuhauss, J. F. H. Gronwald, and E. H. C. Oehlmann, Germany. Improvements in or applicable to apparatus for sterilising milk and other fluids. Complete Specification. February 22.

3592. P. McArdle. The preserving of fresh eggs. February 24.

4928. G. D. Sutherland. An improved food. March 12.

C.—Disinfectants.

3933. G. Kraemer. Process for the preparation of sulphonate salts from phenylised ethane derivatives and the preparation of disinfectants therefrom. February 29.

3977. S. Armitage and A. Gadot. An improved compound for disinfecting, deodorising, antiseptic, preservative, and similar purposes. March 1.

4205. W. Garthwaite. A new and improved method of disinfecting infected places, called a disinfecting smoke block. March 3.

COMPLETE SPECIFICATIONS ACCEPTED.

B.—Sanitary Chemistry.

1891.

4177. W. H. Watson. Means employed for the purification and decolourisation of water, dye, and other manufacturing refuse liquors, sewage, or other aqueous or saline liquids. March 2.

7466. W. Birch. See Class I.

8271. H. Whitley. Improved destructor furnace for refuse, and apparatus connected therewith. March 16.

22,531. W. Horsfall. Furnaces for destroying the refuse and dealing with the sewage, sludge, and other offensive material of towns. March 16.

22,747. J. T. Wood. A new or improved method or process for purifying sewage or foul water. March 2.

C.—Disinfectants.

1891.

17,421. H. B. Thornton. Manufacture of disinfectant tablets, blocks, or the like for use in water-closets, urinals, drains, and other places or articles. February 24.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

3091. J. Luke, jun. Improvements in and relating to the manufacture of paper. February 17.

3103. F. T. Jefferson. A new or improved manufacture of paper for the copying books of manifold writers for making tracings and for other like purposes. February 17.

3260. J. Luke, jun. Improvements in and relating to the manufacture of paper. February 19.

4973. P. Winterhoff. A new process for producing water or surface-marks in paper. March 2.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

826. R. Brown and G. Mackay. Paper-making machines for making the surface of the paper equal on both sides. February 24.

3061. J. Feirabend. Process for the manufacture of cellulose wadding. February 24.

20,224. T. Lumb. Machinery or apparatus for the manufacture of press papers, glazed boards, and the like. March 16.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

3147. A. Bang.—From G. A. Dahl, Germany. An antipyretic and anti-neuralgic chinolin derivative, and processes for the production of the same. February 18.

3301. B. Willeox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in, or means for the treatment of trees or plants for destroying caterpillars of *Liparis monacha* and other insects injurious to plant life. February 19.

3435. B. Willeox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture and production of pharmaceutical compounds. February 22.

3698. I. Roos. See Class IV.

4497. B. Willeox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of pharmaceutical compounds. March 7.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

6786. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture of hydrazine or diamidogen and its salts. February 24.

7026. B. Willeox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of iodine substitution products of phenols and cresols. February 24.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

3500. E. Irelund. A new or improved method of producing coloured photographs. February 23.

3791. A. J. Boulton.—From W. Bruns and Co., Germany. See Class IV.

4498. J. Hauff. A process for developing photographic images. March 7.

COMPLETE SPECIFICATION ACCEPTED.

1891.

7312. W. W. J. Nicol. Photographic printing processes. March 2.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

3605. A. Broek. Improvements in material for fireworks. February 24.

3957. H. P. Merriam. Improvements in fuzes. Complete Specification. March 1.

4146. A. V. Newton.—From A. Nobel, France. Improvements in the manufacture of explosives. March 2.

4421. R. W. S. Griffith and G. H. Wadsworth. Improvements in the treatment of explosives. March 5.

4659. A. Philip. Improvements in the manufacture of nitro-glycerin. March 9.

4660. A. Philip. Improvements in the manufacture of nitro-glycerin. March 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

7256. V. Alder. Manufacture of priming caps or exploders. March 16.

12,303. E. W. Anderson. Machinery for the manufacture of cordite and like explosives. March 16.

17,319. W. E. Fidler. Detonating fog-signalling apparatus, and detonators for use therewith for signalling on railways. March 16.

PATENT UNCLASSIFIABLE.

APPLICATION.

3475. J. E. Fletcher. The earno-preservative film. February 23.

THE JOURNAL OF THE Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 4.—VOL. XI.]

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NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list will retire from their respective offices at the forthcoming Annual General Meeting.

Dr. John Evans, F.R.S., has been nominated to the office of President; and Professor J. Emerson Reynolds, F.R.S., has been nominated Vice-President under Rule 11.

Dr. F. Hurter, Dr. W. H. Perkin, F.R.S., Mr. John Spiller, and Professor T. E. Thorpe, F.R.S., have been nominated Vice-Presidents under Rule 8; and Mr. Thos. Tyrer has been nominated an Ordinary Member of Council under Rule 17, in the place of Mr. John Spiller, nominated a Vice-President.

Mr. Ludwig Mond, F.R.S., has been nominated Foreign Secretary; and the Treasurer has been nominated for re-election.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

Extract from Rule 18:—"No such nomination shall be valid unless it be signed by at least ten Members of the Society who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's Office, at least one month before the date of the commencement of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

ANNUAL GENERAL MEETING.

The Annual General Meeting will be held in London on the 20th, 21st, and 22nd July next. An outline programme appears in this issue. Tickets of membership will be issued in time for the meeting, and will form, as heretofore, vouchers for visits to works and excursions.

Post Office Orders should be made payable at the General Post Office, London, to the Honorary Treasurer, E. Rider Cook, and should be forwarded to him at Bow, unless it be desired to notify a change of address.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by MESSRS. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is prepared to offer 5s. apiece for copies of the Society's Journals for January 1883 in saleable condition.

LIST OF MEMBERS ELECTED, 22nd APRIL 1892.

Bradley, Fred. J., 52, Arboretum Street, Nottingham, light leather dresser.

Bull, Johannes C., Erith, Kent, chemical and mechanical engineer.

Croft, Arthur, 10, Abbey Street, Old Lenton, Nottingham, leather dresser.

Exley, Arthur, Meanwood Grove, Meanwood, near Leeds, tanner.

Farmer, Thos. H., 35, Oliver Street, Boston, Mass., U.S.A., pharmaceutical chemist.

Fischesser, Alfred, Lutterbach, near Mulhouse, Alsace, dye manufacturer.

Harvey, E. Feild, 1, Montpellier Square, Rutland Gate, S.W., chemist.

Horrocks, Wm. A., 8, Aldred Street, Crescent, Salford, bleacher and finisher.

Knecht, Dr. E., 239, Moss Lane East, Manchester, analytical chemist.

Little, Geo. A., 37, Moorland Avenue, Leeds, student.

Lowe, Jas. S., 1, Atholl Place, Edinburgh, sugar planter.

McElroy, Karl P., 1412, Sixteenth Street, N.W., Washington, D.C., U.S.A., agricultural chemist.

Morrell, Jno. B., Holdgate House, York, cocoa manufacturer.

Newall, John F., 8, Market Place, Manchester, merchant.

Preston, Edw. S., University College, Liverpool, civil engineer.

Terne, Dr. Bruno, 1512, South Sixth Street, Philadelphia, Pa., U.S.A., chemical works manager.

Torsell, Chas. T., McKees Rocks, Allegheny Co., Pa., U.S.A., chemist.

Townsend, Chas. W., Port Dundas, Glasgow, chemical manufacturer.

Townsend, Oliver C., Port Dundas, Glasgow, chemical manufacturer.

Whitehead, Cutell, 1114, New Hampshire Avenue, Washington, D.C., U.S.A., assayer to the U.S. Mint.

CHANGES OF ADDRESS.

Auer, Dr. H., 1/o Widnes; 71, Island Road, Garston, Liverpool.

Campbell, Colin M., 1/o Glasgow; c/o Long and Robertson, Habana, Mackay, Queensland.

Clark, R. Ingham, 1/o Park Prospect; 3, Albert Hall Mansions, Kensington Gore, W.

Clements, H. C., 1/o Putney; 79, Burton Road, Brixton, S.W.

Conrad, E. C., 1/o Holland; Portland Road, Gravesend.

Crawford, D., 1/o Alexandria; Kersal Vale Works, Higher Broughton, Manchester.

Crumbie, W. D., 1/o New York; 146, Washington Street, East Orange, N.J., U.S.A.

Davidson, J. E., 1/o Neweastle; 40, Percy Gardens, Tynemouth.

Freestone, J. W., 1/o New Ferry; 7, Wilton Road, Rock Ferry, Cheshire.

Galt, H. A., 1/o Philadelphia; c/o J. B. Ford Chemical Co., Wyandotte, Mich., U.S.A.

Gamble, J. C., 1/o Hardshaw Brook; Cowley Hill, St. Helens.

Garrett, F. C., 1/o South Shields; College of Science, Newcastle-on-Tyne.

Gibbs, W. P., 1/o Clydebank; Ely Paper Works, Cardiff.

Hart, Peter, 1/o Faulkner Street; c/o Tennants and Co., Chemical Works, Clayton, Manchester.

Henderson, Prof. G. G., 1/o The University; The Technical College, George Street, Glasgow.

Jackson, A. G., 1/o G.P.O.; Gotha Street, Valley, Brisbane, Queensland.

Jackson, R. Val., 1/o Hillhead; c/o Scotch and Irish Oxygen Co., Polmadie, Glasgow.

Joseland, W. H., 1/o Manchester; Talke, Stoke-on-Trent.

Laycock, Dr. W. F., 1/o Stowmarket; 2, Park Street, Dewsbury.

Lennard, F.; Journals to Enfield Lodge, St. John's Road, Blackheath, S.E.

Lindeman, Dr. G., 1/o Langereihe; Wilhelminenstrasse 1, H., St. Pauli, Hamburg.

Morris, Herb. N.; Journals to University Laboratory, Zurich, Switzerland.

Napier, J., 1/o St. Matthew's Place; 89, London Road, Ipswich.

Neilson, Thos., 1/o Kilmarnock; c/o Oregon Iron and Steel Co., Oswego, Oregon, U.S.A.

Richmond, H. D., 1/o Cairo; 50, Clanricarde Gardens, Bayswater, W.

Smith, H. Wood, 1/o Manchester; c/o May and Baker, Lim., Garden Wharf, Battersea, S.W.

Speakman, Jas., 1/o Cree Hill; Penhold P.O., Calgary, Canada.

Thornton, D. H., 1/o Bradford; Brookfoot Dyeworks, Brighouse, Yorks.

Trimble, Prof. H., 1/o Marshall Street; 145, North Tenth Street, Philadelphia, Pa., U.S.A.

Turner, H. B. H., 1/o Calcutta; 14, Jesus Lane, Cambridge.

Winsloe, H., 1/o Faulkner Street; c/o Tennants and Co., Chemical Works, Clayton, Manchester.

CHANGE OF ADDRESS REQUIRED.

A. E. Davies, 1/o 6, Rumford Place, Liverpool.

MEMBERS OMITTED FROM JANUARY LIST.

J. H. M. Fallon, c/o Peruvian Corporation, Lima, Peru.

D. Wesson, The American Cotton Oil Co., Guttenberg, N.J., U.S.A.

Death.

G. H. Makins, Danesfield, St. Albans.

London Section.

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The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies, and will take office in July next:—*Chairman*: Wm. Thorp. *Secretary*: John Heron. *Committee*: C. C. Hutchinson, B. E. R. Newlands, F. G. Adair Roberts, A. Gordon Salamon, T. Tyrer, and Frank Wilson.

SESSION 1891-92.

1892:—

May 2nd:—

Professor Wm. Ramsay, F.R.S., and Mr. J. C. Chorley. "The Distillation of Wood."

Dr. S. Rideal. "Notes on the Composition of some Indian Gums of known Origin."

May 30th:—

Mr. J. A. Nettleton. "Vinegar."

Dr. S. Rideal. "The Petroleum Jellies of Commerce."

June 13th:—

Professor V. B. Lewis. "Oil Gas."

Mr. Watson Smith. "The soluble Bituminous Constituents of certain Japanese Coals."—*cont.*

Meeting held Monday, 7th March, 1892.

MR. THOS. TYRER, IN THE CHAIR.

ON FLUID SPECIFIC GRAVITY DETERMINATION FOR PRACTICAL PURPOSES.

BY C. R. ALPER WRIGHT, D.S.C., F.R.S.

IN the practical determination of the "specific gravity" or "relative density" of a given fluid a very moderate degree of exactitude is often sufficient for the purpose in view; and in such cases various corrections and refinements may be safely omitted, which are simply *indispensable* when a higher amount of accuracy is desired. Thus when the value is only required to a degree of accuracy of three places of figures with a possible error of \pm one unit in the third place (*e.g.* when a liquid is found to have the sp. gr. 0.927, implying that the value lies between 0.926 and 0.928), corrections may be ignored that *must* be taken into account when 4, and *a fortiori* when 5, places of decimals are required; as when the specific gravity is said to be 0.9268, implying that it is between 0.9267 and 0.9269 or when it is said to be 0.92683, implying that it is between 0.92682 and 0.92684. For certain special technical purposes such high accuracy is requisite; in such cases the author has found certain modifications of the appliances ordinarily used, and various tables for corrections, of considerable practical use.

Before discussing these in detail it is as well to point out that in current technical literature the terms "density," "relative density," and "specific gravity" are frequently confounded together and used as though they were interchangeable, which strictly is by no means the case. By "density" is meant the *mass of a unit of volume*, a quantity not the same as the *weight of a unit of volume*. The former is independent of the gravitating force at the spot of observation; the latter not, being a quantity less by some 0.5 per cent. at the equator than at the pole, *ceteris paribus*. The "relative density" of a body A (as compared with another, B) implies the numerical value of the ratio between the density of A and that of B; if A and B are both examined at the same place (or at places where the force of gravity is the same) this ratio is identical with the ratio between the weight of a given volume of A and that of the same volume of B; but not otherwise. If B be some substance chosen as a standard, *e.g.* water (or hydrogen), when A is said to have such and such a "specific gravity," what is meant is that this value expresses the ratio of the density of A to that of the standard substance water (or hydrogen, &c.). If both A and B are at the same temperature, t , A is said to have the "sp. gr. at t " when the density of A is s times that of B, both being examined at t . If, on the other hand, the temperature of A is t_1 , different from that of B = t_2 , A is said to have the "sp. gr. at t_1 " when the density of A at t_1 is s times that of B at t_2 .

It results from the above that if $t_2 = 4^\circ \text{C.}$ and B be water, 1 grm. being the weight of 1 cc. of water at 4 at the place of observation, the value of s at $\frac{t_1}{4}$ is the weight in grammes of 1 cc. of substance examined at the temperature t_1 . If, on the other hand, t_2 be not 4, if d be the weight of 1 cc. of water at t_2 , the weight of 1 cc. of substance at t_1 is $s \times d$.

For various reasons it would be convenient to express all values relating to the relative density of bodies on the absolute scale of "weight per cc.," but inasmuch as the experimental data usually do not give this result without a little calculation, it is more frequently the practice to express the values either as "sp. gr. at t " or as "sp. gr. at t_1 ," where t (or t_2) is not 4°C. The result is that it is possible for different observers to obtain values apparently notably different through using different temperatures for the water of comparison, when really their results are identical. For instance, if a sample of vegetable oil at 20°C. is found by one observer to have the sp. gr. 0.92475 referred to water at 4° , by another the sp. gr. 0.92560 referred to water at 15.5° , and by the third the sp. gr. 0.92635 referred to water at 20° , it is impossible to say at sight whether these figures are sharply concordant or not; but if all three are reduced to "weight per cc.," it is obvious that they are identical; for the values of d for 4° , 15.5° , and 20° are respectively 1.00000, 0.99908, and 0.99827, and those of $s \times d$ respectively are—

$$0.92475 \times 1.00000 = 0.92475$$

$$0.92560 \times 0.99908 = 0.92475$$

$$0.92635 \times 0.99827 = 0.92475$$

The Pycnometer and Corrections Applicable thereto.

A pycnometer is a vessel so constructed that fluids can be poured therein so as to fill it to a sharply-defined level. Being weighed empty, and then filled to the given level with water and weighed again, the increment in weight represents the weight of water filling the instrument to the given level at the temperature obtaining = t . If again filled with another fluid also at t , the excess of weight over the empty vessel now represents the weight of the same volume of fluid. Calling the weight of water W , and that of fluid w , the value of $\frac{w}{W}$ is the "specific gravity of the fluid at t ," as above defined.

If, however, the water be weighed at t_1 , and the fluid at t_2 , the ratio $\frac{w}{W}$ will represent neither the sp. gr. at t

nor that at t_2 ; but will furnish an approximation to the value of the sp. gr. at $\frac{t_2}{t_1}$, which will be closer the less the vessel has altered in volume by expansion or contraction between t_1 and t_2 .

Usually the vessel is of glass, the coefficient of cubical expansion of which may be taken as $0.000025 = \frac{1}{40000}$ per 1°C. If $t_2 > t_1$ the volume of fluid contained is greater than that of the water by $\frac{t_2 - t_1}{40000}$ part of the latter. This is a quantity practically negligible when t_2 and t_1 do not differ much, even when four places of decimals are required; but if $t_2 - t_1$ have a considerable value, it is not negligible even when the specific gravity value is only required to be exact to within \pm one unit in the three places of decimals.

The following table indicates the correction to be subtracted for the over-estimation of w on account of the expansion of the vessel as the temperature rises from t_1 to t_2 (of course, to be added if $t_2 < t_1$):—

TABLE I.

$t_2 - t_1$	Correction to be subtracted.		
$^\circ \text{C.}$			
5	0.0025 per cent. of value	=	$\frac{1}{40000}$
10	0.005	"	$\frac{2}{40000}$
15	0.0075	"	$\frac{3}{40000}$
20	0.01	"	$\frac{4}{40000}$
30	0.015	"	$\frac{6}{40000}$
40	0.02	"	$\frac{8}{40000}$
50	0.025	"	$\frac{10}{40000}$
60	0.03	"	$\frac{12}{40000}$
70	0.035	"	$\frac{14}{40000}$
80	0.04	"	$\frac{16}{40000}$
90	0.045	"	$\frac{18}{40000}$
100	0.05	"	$\frac{20}{40000}$

Hence, if the water were weighed at 15° and the fluid at 100° , so that $t_2 - t_1 = 85^\circ$, the correction to be subtracted would be 0.2125 per cent. of the value; *i.e.*, for an oil, &c. of apparent sp. gr. 0.9535 at $\frac{100}{15}$ the correction would be -0.0020 , and for a heavier fluid of apparent sp. gr. 1.7385, -0.0037 ; quantities obviously affecting the third decimal place by more than one unit.

When the weights w and W are determined in air, the observed values are less than the true weights by an amount representing the weight of a quantity of air occupying a volume equal to the difference in bulk between the water or fluid and the counterpoising weights. These are generally of brass, about $8\frac{1}{2}$ times as heavy as water. Hence, the correction for "air buoyancy" to be applied to w and W is $\frac{15}{17} V a$, where V is the volume of fluid in cubic centimetres (practically, the weight in grammes of the water), and a is the weight of 1 cc. of air; a value varying with the temperature and pressure at the time of weighing, but for an average temperature of 15.5°C. , and average pressure of 760 mm., having the value 0.001223; whence $\frac{15}{17} a = 0.001079$.

If the pycnometer hold V cc. of fluid, the true specific gravity is consequently not $\frac{w}{W}$, but $\frac{w + V \times 0.001079}{W + V \times 0.001079}$. When w and W are nearly the same (specific gravity near unity), this correction may be ignored, as also, in most cases, when only three places of decimals are required; if, however, four are desired, the following table gives sufficiently nearly the relations between these two fractions:—

TABLE II.

Value found for $\frac{10}{W}$	Correction to be added.
0.25	+ 0.0008
0.5	+ 0.0005
0.75	+ 0.0003
1.0	Nil.
1.25	- 0.0003
1.5	- 0.0005
1.75	- 0.0008
2.0	- 0.0011
2.25	- 0.0014
2.5	- 0.0016
2.75	- 0.0019
3.0	- 0.0022

When five places of figures are required, it is not sufficient to take the mean value of a for 15.5°C ., and 760 mm. as above; but the appropriate value for each case must be taken from the following table; *e.g.*, for 20° and 730 mm. $a = 0.001157$; for 10° and 770 mm. $a = 0.001263$, and so on.

TABLE III.

Temp.	730 mm.	740 mm.	750 mm.	760 mm.	770 mm.
0	0.001242	0.001259	0.001276	0.001293	0.001310
2	0.001233	0.001249	0.001267	0.001283	0.001300
4	0.001224	0.001240	0.001257	0.001274	0.001290
6	0.001215	0.001232	0.001248	0.001265	0.001281
8	0.001206	0.001223	0.001239	0.001256	0.001272
10	0.001198	0.001214	0.001231	0.001247	0.001263
12	0.001189	0.001205	0.001222	0.001238	0.001255
14	0.001181	0.001197	0.001214	0.001230	0.001246
16	0.001173	0.001189	0.001205	0.001221	0.001237
18	0.001165	0.001181	0.001197	0.001213	0.001229
20	0.001157	0.001173	0.001189	0.001204	0.001220
22	0.001149	0.001165	0.001181	0.001196	0.001212
24	0.001141	0.001157	0.001173	0.001188	0.001204
26	0.001134	0.001149	0.001165	0.001180	0.001196
28	0.001126	0.001142	0.001157	0.001172	0.001188
30	0.001119	0.001134	0.001149	0.001165	0.001180

Modified Pyknometer.

Certain forms of pyknometer in common use (specific gravity bottle with perforated stopper, with or without internal thermometer, Sprengel U-tube, &c.) have the disadvantage that if the temperature of the balance is above that at which the instrument is filled, expansion is apt to take place whilst weighing, so that the liquid runs over, and if volatile is partly lost. Moreover, with all such forms, to make valuations at different temperatures, a fresh weighing must be made for each temperature.

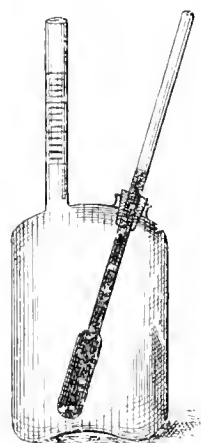
The following modifications of the ordinary long-necked flask with a mark on the stem have been found by the author extremely serviceable not only in obtaining values exact to five places of figures, if requisite, but also in avoiding the above inconveniences and in obtaining a series of valuations at different temperatures with comparatively little trouble.

Figs. 1 and 2 represent two varieties; the first is conveniently constructed by sealing up the lower end of an

Fig. 1.



Fig. 2.

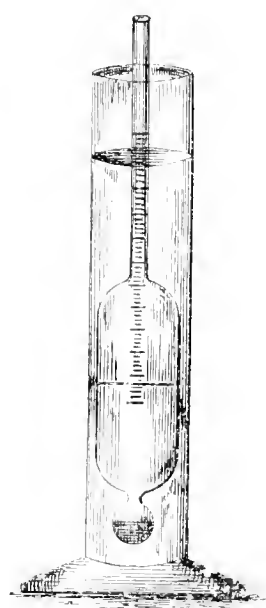


ordinary pipette (10, 25, 50, or 100 cc.), and etching a millimetre scale on the stem. For weighing, this is supported by wire holder, Fig. 3, hung on to the hook of

Fig. 3.



Fig. 4.



the balance. The second is a flat-bottomed flask with two necks: one a long narrow tube with millimetre scale, as before; the other, a ground tubulus, into which a stopper fits provided with a thermometer for reading off the temperature of the contents of the flask. This form is especially convenient for cleansing and re-filling, the second neck allowing air to enter in a way impracticable with the first form, especially with small-sized instruments.*

In order to standardise the instrument for all purposes, it is requisite to know the quantity of water contained when filled up to a given level at a given temperature, and to have the means of thence calculating the quantity contained when filled up to any other level at any other temperature. This is effected by determining the quantity of water

* The construction of a ground stopper with a thermometer passing through (fused, not cemented) is a rather delicate piece of workmanship. The instruments exhibited by the author were made for him by Messrs. Negretti and Zambra, Holborn Viaduct.

contained at a given standard temperature when filled up to the commencement of the scale, and the further quantity of water corresponding to each millimetre of the scale. If the first quantity be w , and the second a , the quantity of water contained when filled up to a level of n millimetres on the scale, W_n , is given by the formula—

$$W_n = w + n a.$$

In order to deduce the variations in the value of W_n with different temperatures, a special table is employed, described below.

To determine the constants w and a , the empty vessel is weighed (noting the temperature and pressure in order to obtain data for the air-buoyancy correction), and water poured in to a convenient level, a little above the commencement of the scale. The instrument is then immersed in a large pan of water provided with a stirrer and thermometer, the temperature being slightly below that at which the standardising is to be effected. When the temperature of the bath is obtained, and the level of the water in the pyknometer does not alter, the level and temperature are read off. The bath is slightly raised in temperature by pouring in a little warm water, well stirred, and the process repeated, and so on until the series of temperature readings averages the required standard amount; then the average of the level readings is the level for that temperature. The instrument is wiped dry and weighed again, so that the weight of water contained up to that level at the standard temperature is known. More water is now poured in, and the rise of level carefully noted, also the increment in weight. This operation is repeated at different parts of the scale, so as to obtain various valuations of a .

Thus, with a particular instrument, the following data were obtained, the scale being 30 millimetres long; mean temperature reading, 15.5°C ; mean level for that temperature, 4.6 millimetres; weight of water contained (weighed in air at 15 and 758 millims. pressure), 50.573 grms. Further weighings on calibrating the tube:—

Rise of Level.	Weight of Water added.	Water per Millimetre.
From 1.5 to 28.1	1.205	0.0453
From 1.3 to 19.8	0.833	0.0452
From 15.1 to 28.9	0.627	0.0454
Mean value of a		0.0453

Obviously the bore of the tube was sensibly uniform at both top and bottom of scale.

Water contained (in air) up to 4.6 millimetres ...	50.573
Subtract 4.6×0.0453	0.208
Value of w (in air)	50.365

The correction for air buoyancy is—

$15 \times 50.3 \times 0.001223 = 0.054$ gram; whence the value of w (corrected to vacuum) $= 50.365 + 0.054 = 50.419$.

Hence, when filled up to a level n millimetres with water at the standard temperature 15.5° , the weight of water, W_n , contained is—

$$\begin{aligned} \text{In air} \dots W_n &= 50.365 + n \times 0.0453 \\ \text{In vacuo} \dots W_n &= 50.419 + n \times 0.0453 \end{aligned}$$

When high accuracy is required, several valuations of W_n should be thus made, and averaged.

The instrument being thus standardised, if it be required to determine the specific gravity of a fluid at T° where T is the temperature of standardising and T° some other temperature, all that is necessary is to determine the weight w_n of fluid that fills up the pyknometer to the level n

millimetres at the temperature T° ; then the value required is approximately given by the formula—

$$S = \frac{w_n}{W_n}$$

To obtain the exact value, this result must be corrected by means of Table I. (*supra*), so as to allow for the variation in capacity of the vessel between T° and T° . Of course W_n is corrected to vacuum if w_n is so corrected and not if the air-weighing only is taken.

In order to find the value of w_n exactly the same process is gone through as in the case of standardising the instrument: the pyknometer, filled with fluid, is placed in a bath of water at a temperature a little below T° ; the level being read, the temperature is slightly raised, and a new pair of readings taken, and so on until the mean of the temperature readings is T° . When desired, a whole series of valuations can thus be made for mean temperatures T_1, T_2, T_3, \dots only one weighing of the fluid being requisite throughout. By using a pyknometer holding 50 or 100 cc., weighing to half a milligramme, and using several level and temperature readings for averages in each case, and finally correcting by means of Table I., valuations of specific gravity at T_1, T_2, T_3, \dots &c. can be readily obtained with comparatively little trouble, exact to within ± 0.00001 , or at most ± 0.00002 (\pm one or two units in the fifth decimal place).

For example, using the 50 cc. pyknometer above described as illustration, the following figures were obtained with a sample of vegetable oil:—

Weight in air * of contained oil $w_n = 48.763$.

Reading on Min. Scale.	Corresponding Temperatures.
7.9	19.1
8.7	20.1
9.2	20.8
—	—
Average 8.6	Average 20.0
11.9	24.5
12.2	25.0
12.6	25.5
—	—
Average 12.23	Average 25.0

Weight in air of water filling up to 8.6 mm. at 15.5° :
 W_n (at 15.5°) $= 50.365 + 8.6 \times 0.0453 = 50.755$
 Weight in air of water filling up to 12.23 mm. at 15.5° :
 W_n (at 15.5°) $= 50.365 + 12.23 \times 0.0453 = 50.919$

$$\text{Uncorrected sp. gr. at } \frac{20}{15.5} = \frac{w_n}{W_n} = \frac{48.763}{50.755} = 0.96075$$

Correction from Table I.: 4.5° temperature difference represents -0.01125 per cent. $= -0.00011$

$$\text{Corrected sp. gr. at } \frac{20}{15.5} \dots \dots \dots = 0.96064$$

$$\text{Uncorrected sp. gr. at } \frac{25}{15.5} = \frac{w_n}{W_n} = \frac{48.763}{50.919} = 0.95766$$

Correction from Table I.: 9.5° temperature difference represents -0.02375 per cent. $= -0.00023$

$$\text{Corrected sp. gr. at } \frac{25}{15.5} \dots \dots \dots = 0.9574$$

* The specific gravity being not much below unity, the correction for air buoyancy is negligible when only four places are required, only affecting the fifth decimal place by a few units (*vide* Table II., *supra*).

Hence, taking values to four places only, 0.9606 and 0.9574 are the specific gravities of the oil at 20° and 15.5° respectively.*

TABLE IV.

T = Temperature.	D = Weight of 1 cc. of Water.	1 + $\frac{T - 4}{10000}$	D × $(1 + \frac{T - 4}{10000})$	Difference per 1°.
0	0.99988	0.99990	0.99978	..
2	0.99997	0.99995	0.99992	+ 0.00007
4	1.00000	1.00000	1.00000	+ 0.00004
6	0.99997	1.00005	1.00002	+ 0.00001
8	0.99989	1.00010	0.99999	- 0.00002
10	0.99974	1.00015	0.99989	- 0.00005
12	0.99956	1.00020	0.99976	- 0.00007
14	0.99930	1.00025	0.99955	- 0.00011
16	0.99900	1.00030	0.99930	- 0.00013
18	0.99866	1.00035	0.99901	- 0.00015
20	0.99827	1.00040	0.99867	- 0.00017
22	0.99785	1.00045	0.99830	- 0.00019
24	0.99738	1.00050	0.99788	- 0.00021
26	0.99689	1.00055	0.99744	- 0.00022
28	0.99635	1.00060	0.99695	- 0.00024
30	0.99579	1.00065	0.99644	- 0.00026
35	0.9944	1.00077	0.9951	- 0.00027
40	0.9924	1.00090	0.9933	- 0.00036
45	0.9904	1.00102	0.9913	- 0.00040
50	0.9884	1.00115	0.9892	- 0.00042
60	0.9834	1.00140	0.9847	- 0.00045
70	0.9778	1.00165	0.9794	- 0.00053
80	0.9718	1.00190	0.9736	- 0.00058
90	0.9656	1.00215	0.9675	- 0.00061
100	0.9586	1.00240	0.9599	- 0.00076

When it is required to determine the specific gravity of a fluid at some temperature T° different from that at which the instrument is standardised (i.e. referred to water *also* at T°), the following table enables the weight of water W_{HT} contained at T° up to any given level in millimetres, to be deduced from the weight W_n contained at the standard temperature. The first column gives the temperature T° ; the second the relative density of water at that temperature with respect to water at 4° C. as unity (or otherwise, the weight of 1 cc. of water at T°); the third the capacity at T° of a glass vessel holding 1 cc. at 4° ; and the fourth the products of the corresponding numbers in the third and fourth columns representing the relative weights of water contained at the various temperatures. If a be the tabular

* From these figures the rate of expansion of the oil between 20° and 25° is deducible, 95743 volumes at the lower temperature becoming 96061 volumes at the higher temperature; whence 100 volumes at 20° expand to 100.335 at 25° , i.e. the oil expands 0.067 per cent. in volume per 1° . Or the increment in bulk may be directly deduced from the readings; thus—

Rise of fluid in stem on heating from 20° to $25^{\circ} = 12.23 - 8.6$, or 3.63 mm., corresponding with $3.63 \times 0.0453 = 0.164$ cc. Fluid occupies about 50.7 cc.; expansion of glass through 5° consequently represents an increased capacity of about $50.7 \times \frac{5}{40000} = 0.006$ cc.

Hence, total increment in volume is $0.164 + 0.006 = 0.170$ cc. = 0.034 cc. per 1° , representing $\frac{100}{50.7} \times 0.034 = 0.067$ per cent. expansion per 1° , as before.

The modified pycnometer is, in fact, a form of dilatometer.

number in the fourth column corresponding with T° , and b that corresponding with the temperature at which the instrument is standardised, t , then

$$W_{HT} = W_n \times \frac{a}{b}$$

To determine the specific gravity at T° , it is simply requisite to determine, as before, the weight W_1 of substance filling the pycnometer to the level n millimetres at the temperature T° ; then the sp. gr. S is given by the formula—

$$S = \frac{w_n}{W_{HT}} = \frac{w_n}{W_n} \times \frac{b}{a}$$

Thus in the case of the preceding example of vegetable oil, suppose that it is required to determine the specific gravity at 20° , and also at 25° , from the data given. The instrument being standardised at 15.5° , the value of b from the table is 0.99936; similarly for 20° , $a = 0.99867$; and for 25° , $a = 0.99766$. At 20° (when the fluid stands at 8.6 millimetres) $w_n = 48.763$ and $W_n = 50.755$, whence—

$$\text{specific gravity at } 20^{\circ} = \frac{48.763}{50.755} \times \frac{0.99936}{0.99867} = 0.96141.$$

At 25° (when the fluid stands at 12.33 millimetres) $W_n = 50.919$, whence—

$$\text{specific gravity at } 25^{\circ} = \frac{48.764}{50.919} \times \frac{0.99936}{0.99766} = 0.95929.$$

When it is required to calculate the weight of fluid per cubic centimetre at any given temperature, if the specific gravity of the fluid at that temperature be known ($= S$) with reference to water at any given temperature (the same as the fluid, or different) $= T^{\circ}$, the weight of 1 cc. is given by the formula—

$$\text{weight of 1 cc.} = S \times D,$$

where D is the value in the second column of the above table corresponding with the temperature T° .

Thus the oil possessing the sp. gr. 0.95929 at 25° , and 0.96141 at 20° , will weigh—

$$0.95929 \times 0.99711 = 0.95652 \text{ grms. per cc. at } 25^{\circ}$$

$$0.96141 \times 0.99827 = 0.95975 \text{ grms. per cc. at } 20^{\circ}$$

As above explained, this mode of expressing results (weight per cc. at a temperature T°) is far preferable to any other method for relative density valuations.

Immersion Method and Corrections applicable thereto.

A heavy suspended body (conveniently a glass plummet) is weighed in air and then when immersed in the fluid to be examined at a temperature t_1 ; similarly it is weighed in water at t_2 ; if W_1 be the weight in air, W_2 in the fluid, and W_3 in water, the ratio of the losses of weight experienced when weighed in the two fluids $\frac{W_1 - W_2}{W_1 - W_3}$ gives an approxi-

mation to the relative density at t_1 ; from which the true value is obtained by subtracting a correction for the alteration in volume of the plummet between t_1 and t_2 . When the plummet is of glass this correction is obviously identical with that applying in the case of a glass pycnometer, and may accordingly be deduced from Table I. *supra*.

Precisely the same correction for air buoyancy applies in the determination of the values $W_1 - W_2$ and $W_1 - W_3$ as in the case of the pycnometer; hence, when only four places of decimals are requisite, the correction may be deduced from Table II.; and when five are required, by means of Table III.

When the weight of water displaced by the plummet has been determined for some one temperature, that displaced at any other temperature is calculable by means of Table IV., precisely as in the case of the contents of a hollow glass vessel, the tabular values taking into account both the expansion of the glass and the diminution in density of water with rise of temperature.

When results accurate to \pm one unit in the fourth or fifth decimal place are required, it is indispensable that the weighing should be made by means of an accurate chemical balance; but when only three places are required,

"hydrostatic balances" on the steelyard principle (*e.g.* Westphal's) are sufficiently accurate for the purpose. Such instruments as sold are often sufficiently delicate to yield concordant figures to four places; but the results obtained with different instruments often show differences considerably exceeding the limits of variation of any one of them. With any given instrument of fairly good construction, figures accurate to within \pm one or two units in the fourth decimal place (*e.g.* giving the value 0.9264, implying something between 0.9262 and 0.9266 or between 0.9263 and 0.9265) may be readily obtained by constructing a table of errors for the instrument by carefully comparing the results obtained therewith and with a delicate pycnometer, using the same fluids at the same temperature for each, and applying the corrections from Tables I. and II. when necessary. This involves a good deal of trouble; but unless an instrument has been thus checked it is never safe to rely on its indications beyond the third place of decimals. When, however, only three places are required, a hydrostatic balance is an extremely convenient instrument, especially for observations at higher temperatures, *e.g.*, near 100° C.

Aerometric Method.

Aerometers (hydrometers) as generally sold are instruments decidedly wanting in precision, excepting when prepared for certain special purposes, *e.g.* alcoholometry; so that their indications are rarely exact within less than \pm one or two units in the third decimal place. Moreover, the uncertainty as to the exact level of the liquid, owing to the curvature of its surface through adhesion to the stem, often prevents any extreme degree of delicacy being attainable. Unless the liquid is very dark coloured the level is best read off as with a burette, the lowest point of the meniscus of the upper surface of the liquid being viewed horizontally against the stem of the hydrometer.

With hydrometers as ordinarily sold it results from the nature of the graduation that no means exists of accurately checking the indications at different parts of the scale, excepting the rather tedious process of preparing a series of fluids of different densities, reading off the hydrometer levels therein at a standard temperature, and determining carefully the true specific gravities of the various fluids at that temperature by means of an accurate pycnometer carefully handled. A much simpler plan the author finds is to construct a table for the instrument by means of a few easily-made readings for the determination of a certain constant, by means of which the specific gravity of a liquid can be readily known with an accuracy of about ± 0.0001 or ± 0.0002 (± 1 to 2 units in the fourth decimal place). To effect this the ordinary hydrometer graduations are abolished, and instead a simple divided scale (conveniently of millimetres) etched on the stem.

The valuation of the constant k to be determined for such an instrument is arrived at as follows: The hydrometer is floated in a fluid of such specific gravity D_1 at the standard temperature that nearly the whole of the graduations of the stem are above the surface (in the case of an instrument intended for specific gravity values less than 1.0 the fluid may be water). The reading on the scale representing the level of the fluid is then carefully noted as the *zero point* of the instrument. A suitable weight w is then attached to the top of the stem,* and the level of the surface again read off. Let l be the difference between the two readings, *i.e.* the additional length of stem now immersed; and let W be the weight of the hydrometer (without the additional weight w); then—

$$k = \frac{w}{W l}$$

* It sometimes happens that attaching an extra weight at the top outside the fluid prevents the hydrometer from floating properly upright, and so interferes with the sharpness of the readings; this is more especially not to occur with the modification, described below, where the scale is on the jar, and the reading taken by means of a ring etched on the hydrometer like an Erdmann float. In such cases it suffices to attach to the lower bulb of the hydrometer by means of wire, a bit of brass or lead, or a lump of glass, the weight of which, together with the wire, has been previously ascertained to be w , when weighed immersed in the standard fluid.

To determine the relative density D_2 of a second lighter liquid in terms of that of the first (*i.e.* to determine the value of $\frac{D_2}{D_1}$) the hydrometer is floated in the second liquid at the standard temperature and the level to which it sinks noted. If the difference between this point and the zero point be n millimetres (*i.e.*, in the instrument sink so that the zero point is immersed n millimetres below the surface); then—

$$\frac{D_2}{D_1} = \frac{1}{1 + n k}$$

The following table gives the values of $\frac{1}{1 + n k}$ over a considerable range when the product $n k$ is known.†

$n k$	$\frac{1}{1 + n k}$	Difference.	$n k$	$\frac{1}{1 + n k}$	Difference.
0.01	0.9901	0.0099	0.21	0.8264	0.0069
0.02	0.9804	0.0097	0.22	0.8197	0.0067
0.03	0.9709	0.0095	0.23	0.8130	0.0065
0.04	0.9616	0.0093	0.24	0.8064	0.0063
0.05	0.9524	0.0092	0.25	0.8000	0.0061
0.06	0.9434	0.0090	0.26	0.7937	0.0063
0.07	0.9346	0.0088	0.27	0.7874	0.0063
0.08	0.9259	0.0087	0.28	0.7812	0.0062
0.09	0.9174	0.0085	0.29	0.7752	0.0060
0.10	0.9091	0.0083	0.30	0.7692	0.0060
0.11	0.9009	0.0082	0.31	0.7634	0.0058
0.12	0.8929	0.0080	0.32	0.7576	0.0058
0.13	0.8850	0.0079	0.33	0.7519	0.0057
0.14	0.8772	0.0078	0.34	0.7463	0.0056
0.15	0.8695	0.0076	0.35	0.7407	0.0056
0.16	0.8621	0.0075	0.36	0.7353	0.0054
0.17	0.8547	0.0074	0.37	0.7299	0.0054
0.18	0.8475	0.0072	0.38	0.7246	0.0053
0.19	0.8403	0.0072	0.39	0.7194	0.0052
0.20	0.8333	0.0070	0.40	0.7143	0.0051

Instead of having the millimetre scale engraved on the stem of the hydrometer, it may be etched on the jar itself, a ring being also engraved on the belly of the hydrometer like an Erdmann float (Fig. 4). The readings are then taken by reading the level of the meniscus of the fluid surface on the millimetre scale, and also that of the ring; the difference between the two when the hydrometer floats in the standard liquid at the standard temperature is carefully noted, representing a second constant for the particular instrument = a millimetres. When the hydrometer floats

† The above formula is arrived at thus:—Let L be the "equivalent length" of the hydrometer with respect to the first liquid, *i.e.*, the length of a column of that liquid of section equal to that of the hydrometer stem (considered uniform) that would weigh W at the standard temperature.

Then—

$$L : L + l :: W : W + w$$

Whence—

$$L = \frac{W}{w} l$$

And—

$$k = \frac{1}{L} = \frac{w}{W l}$$

Again—

$$D_2 : D_1 :: L : L + n$$

Whence—

$$\frac{D_2}{D_1} = \frac{L}{L + n} = \frac{1}{1 + n \times \frac{1}{L}} = \frac{1}{1 + n k}$$

in the second liquid, the corresponding difference of readings is noticed = d . Then $d - a = n$ in the preceding formula.

The advantage of this form of instrument is that whereas only one reading is practicable when the scale is engraved on the hydrometer stem and the instrument floated in a fluid, any number of different pairs of readings can be taken and averaged for higher accuracy when the scale is etched on the jar. When one pair of readings (meniscus and ring) has been taken, a few drops more liquid are carefully added to the contents of the jar, or pipetted out of it, thus furnishing two different level readings, and consequently a second valuation of their difference; and so on as often as may be desired.

In making these various readings it is convenient to vary the temperature slightly (e.g. by immersing the jar in a large beaker of water), so that the average of the various temperature readings may be that required, precisely as with the modified pycnometer above described.

The level of the meniscus at the top of the fluid can be read somewhat more accurately by constructing the jar of a U shape, each limb having a millimetre scale etched upon it. One limb is made wide enough to enable the areometer to ride freely therein, the scale being sufficiently prolonged to take in all possible positions of the ring etched on the hydrometer; the other may be narrower, but should be sufficiently wide to prevent any errors through varying capillarity with different fluids. On this limb a shorter scale suffices, as the meniscus of the top level only is read thereon. Of course each scale commences at the same horizontal level, so that the difference between the readings (meniscus in narrower limb, ring in wider limb) represents the depth of the ring below the surface.

The following figures illustrate the modes of standardising and use of the millimetre jar areometer. The same jar was used throughout; the weighings were *not* corrected for air buoyancy.

Areometer A; intended for fluids of sp. gr. 1.000 to 0.850:—

Weight of areometer, W	26.077 grms.
Additional weight, w	3.548 "
Depth of ring below meniscus when immersed without additional weight in distilled water at 15.5° (average of 8 concordant readings) = a	47.76 mm.
Do. do. with additional weight = b	135.76 "

Hence $l = b - a = 88.00$ mm.

$$\text{and } k = \frac{w}{W \times l} = \frac{3.548}{26.077 \times 88.00} = 0.001546 "$$

Areometer B; for liquids of sp. gr. 1.000 to 0.900:—

$W = 59.846$ grms.
$w = 3.548$ "
$a = 109.4$ mm.
$b = 183.3$ "

Hence—

$$l = 183.3 - 109.4 = 73.9 \text{ mm.}$$

and—

$$k = \frac{3.548}{59.846 \times 73.9} = 0.0008022$$

Areometer C; for liquids of sp. gr. 1.850 to 1.600:—

$W = 106.561$ grms.
$w = 8.088$ "

Depth of ring below meniscus when immersed at 15.5° without additional weight in sulphuric acid of specific gravity at 15.5° 1.83538 (determined by pycnometer) = a 59.02 mm.

Do. do. with additional weight $w = b$ 151.01 "

Hence—

$$l = 151.01 - 59.02 = 91.99 \text{ mm.}$$

and—

$$k = \frac{8.088}{106.561 \times 91.99} = 0.0008251$$

Determination of Specific Gravity at 15.5° of Diluted Alcohol with Areometers A and B.

Areometer A. Depth of ring below meniscus when immersed in liquid at 15.5° (average of several readings) = d 76.29 mm.
 Ditto when immersed in water (*supra*) = $a = 47.76$ mm.

Then—

$$n = d - a = 76.29 - 47.76 = 28.53$$

and—

$$nk = 28.53 \times 0.001546 = 0.04411$$

From the table the corresponding value of $\frac{1}{1+nk}$ is 0.9578, i.e., the specific gravity at 15.5° is 0.9578.

Areometer B. Mean value of d at 15.5° ... 164.0 mm.

Value of a (*supra*) ... 109.4 "

Hence—

$$n = d - a = 164.0 - 109.4 = 54.6 \text{ mm.}$$

and—

$$nk = 54.6 \times 0.0008022 = 0.04380 \text{ mm.}$$

From the table the corresponding value of $\frac{1}{1+nk}$ is 0.9581.

Valuations of the same fluid with three different modified pycnometers as above described gave the following results at 15.5°:—

No. 1. Pycnometer of pattern shown in Fig. 1, holding about 100 cc.	0.95791
No. 2. Another pycnometer of pattern shown in Fig. 1, holding about 25 cc.	0.95786
No. 3. Pycnometer of pattern shown in Fig. 2, holding about 100 cc.	0.95789
	<hr/>
	0.95789

In similar fashion, the following figures were obtained with a sample of stronger alcohol:—

Areometer A. $n = 83.07$ mm.

Hence—

$$nk = 83.07 \times 0.001546 = 0.1284.$$

Corresponding specific gravity value from table 0.8862.

No. 3. Value found with pycnometer No. 3 *supra* 0.88624

No. 4. Pycnometer of pattern shown in Fig. 1, holding about 50 cc. 0.88623

Determination of Specific Gravity at 15.5° of Slightly Diluted Oil of Vitriol.

Areometer C. Depth of ring below meniscus

at 15.5° = d 143.68

Value of a (*supra*) 59.02

Hence—

$$n = d - a = 84.66$$

and—

$$nk = 84.66 \times 0.0008251 = 0.06985$$

The value of $\frac{1}{1+nk}$ corresponding to this from the table is 0.9347; whence, since $D_1 = 1.83538^*$ the specific gravity of the acid, D_2 at 15.5° is—

$$D_1 \times \frac{1}{1+nk} = 1.83538 \times 0.9347 = 1.7155$$

Value found with pycnometer No. 1 (*supra*) ... 1.71568

" " No. 4 1.71563

DISCUSSION.

MR. DAVID HOWARD said that for those who really wished to make industrial chemistry a scientific matter, Dr. Wright's paper was of extreme value. Every chemist, whatever his qualifications, was under the impression that he could take a specific gravity. But if the determinations made were compared with those of others, it would be seen

* The value for D_1 at 15.5° was found to be—

By pycnometer No. 1	1.83539
No. 1	1.83537
Mean	1.83538

that men of ability, careful manipulators and observers, differed to an astonishing degree. It was the minute details which Dr. Wright had insisted upon, which should be carefully investigated. If chemists wished to keep pace with the times, they were bound to make sure that their observations were of real accuracy. No instrument could be trusted until it had been tested; and no determination could be relied upon until the scientific values, as well as the mere mechanical values, had been fully considered.

Mr. ARNOLD PHILIP said that he had recently had occasion to take the specific gravity of a sample of petroleum residue at a temperature near 100°C . This he had done in the usual manner by means of a Sprengel's tube, and in calculating out the results he had been inclined to think that some correction should be applied for the actual alteration of the internal cubical capacity of the tube, due to the alteration of form on heating. The usual correction for the cubical expansion of glass, which Dr. Wright had mentioned, would, of course, be absolutely all that was necessary if one were dealing with a solid mass of glass, but if one were employing a hollow vessel, it was difficult to imagine that no internal distortion of form occurred on raising the temperature through from 70° to 80°C . If such distortion did take place, it seemed difficult to make a correction for it. What he imagined would be the best method, would be to weigh the vessel full of mercury (or some other pure fluid of high boiling point, whose coefficient of expansion was accurately known) at 100°C ., and calculate out the volume which the weight of mercury thus obtained should occupy at this temperature. He would be glad if Dr. Wright would elucidate this difficulty, and point out to the meeting the most simple method of making such a correction if it were necessary.

Dr. MURRAY THOMSON insisted on the necessity for the greatest accuracy in taking specific gravities. The author had suggested many necessary corrections, but there was one point which, though not mentioned, could hardly have been overlooked, and that was the narrowness of the vessel used with the hydrometer. It was well known that in using an instrument of that kind it was almost impossible to avoid producing friction against the side of the vessel. All the methods for eliminating such friction were more or less apt to fail; and the only way out of the difficulty was to make a great number of determinations, and take the mean of them. Again, in introducing the specific gravity instrument into a liquid, one was apt to find air bubbles adhering to the sides of the apparatus, though almost invisible to the eye. This effect could only be avoided by holding the instrument up and down in the liquid—thus leading to another inaccuracy.

Mr. OSCAR GUTTMANN said that he was much interested in the determination of the expansion of liquids at increasing temperatures which he might call the inverse of the specific gravity. In a factory with which he was connected, specific gravity calculations were made every day by the dozen. These determinations were made with the very best instruments obtainable, and as much care as possible was taken; yet he would like to say that he had learned from Dr. Wright a great deal in regard to the matter of taking an accurate specific gravity. But he would like to know whether in the instrument proposed by Dr. Wright, supposing it was adjusted for 15°C . and a liquid was poured into it at 100°C ., the glass cylinder would not be likely to expand. As the divisions were already spaced off on the glass cylinder, the instrument would by the expansion of the glass (which he thought was very likely to happen) then, very probably, be inaccurate, and it might be necessary to have different cylinders for different temperatures. He had noticed the very same thing when determining the expansion of liquids. If a very narrow glass tube were used, and it was filled up to a certain level, with one liquid, say at 15° , then put into a cylinder filled with water and this heated to a higher temperature, a different volume would be found; and by the two readings it might be possible to determine the rate of expansion of the two liquids. He had done it at various temperatures with different liquids, such as sulphuric acid, nitric acid, muriatic acid, and nitro-glycerin. He had

found that the tables and formulae he had consulted in that connexion did not agree with his observations, and he could not find the proper ratio. Even taking the expansion of water as a standard, and calculating by the usual formulae he could never get a proper result. He had tried to take into account a factor for the expansion of the glass, but he was bound to say that he had never arrived at satisfactory results, and he would be very glad to see the question taken up by someone competent to deal with it.

Mr. CLAYTON BEADLE thought that Dr. Wright had demonstrated that the difference in the expansion of liquids was to be accounted for by the fact that they had been formed at varying temperatures. It seemed to him that they could not be read at one and the same temperature, unless it was known that the coefficients of the expansion of the fluids and water were the same. If a fluid was taken at 100°C . and compared with water at 100°C ., the specific gravity could not be the same as if determinations were made at 0°C ., unless it were certain that the coefficients of expansion in the waters were identical.

Dr. SAMUEL RIDEAL thought that Dr. Wright's suggestion with reference to the outer cylinder was a very good one; but that it would not be applicable in the case of dark liquids.

Mr. ARNOLD PHILIP thought that Mr. Guttman's question and his own were very much the same, namely, how to distinguish the difference between the expansion of a solid substance like glass, and the expansion of such a substance in the form of a tube or a hydrometer float.

Dr. WRIGHT, in reply, said that as regarded the remarks that had fallen from Mr. David Howard, he cordially agreed with that gentleman, and thanked him for his corroboration of some points, especially the extreme desirability of not trusting implicitly to instrument makers, who were not infallible; even with the best it was necessary (just as in the case of a variety of other political and social matters) to look carefully after and verify the products of their industry, which were, in many respects, wonderfully delicate. He would not like to say a word against the skill of instrument makers, after having obtained from them such excellent instruments as he had exhibited to the meeting that evening. But when an extremely high degree of accuracy was required, unless the instruments used had been carefully checked, no one was warranted in placing implicit confidence in the numerical results obtained. Even with such an instrument as a chemical balance, it was absolutely imperative that each weight should be checked against the others, so that the relative values of all the weights should be exactly known. Unless that were done, the results would always be affected by a certain amount of inaccuracy, due to imperfect adjustment of the weights. One or two speakers had referred to the expansion of glass, questioning whether the same rate of expansion would apply to a solid block of glass as to a hollow vessel. He did not see why it should not. A tube might be regarded as a solid block of glass, from which the inside of the block had been removed; then, what would apply to the outside would equally apply to the inside; and any argument which applied to the outermost layer, would also apply to the innermost layer. For the present purpose, they might be satisfied with the fact that all physical inquirers who had used glass instruments for such matters as the determination of the rate of expansion of mercury, and such like intricate physical problems, had satisfied themselves that within the limit of observation the principle was true, that the capacity of a hollow glass vessel increased by an increment of temperature at the same rate as the bulk of a solid block of the same material. He thought that if that was stated as a warrantable deduction in the present state of knowledge, it perhaps met the difficulties that seemed to have occurred to the gentlemen referred to. Regarding Mr. Guttman's difficulty with reference to the determination of specific gravity, that the value found at one temperature is not the same as that obtained at another temperature, that must necessarily be the case, unless the standard fluid and the substance compared with it expanded at

exactly the same rate. If an inexpandible fluid were compared with water at 100° C., its specific gravity at that temperature would be something like 4 per cent. higher than the value obtained at 15° C.; whilst if the fluid were more expandible than water, its specific gravity would be less at the higher temperature, and *vice versa*; so that, in the one case, the specific gravity would be greater, and in the other case, less at 100° C. than at 15° C. It was to points of that kind that he had wished more particularly to refer in his opening remarks in pointing out that current technical literature was attended with a considerable degree of uncertainty as regards the exact meaning of certain numerical quantities, through the improper use of terms and the incorrect application of them in defining quantities of this description. He did not like to appear invidious, but might mention as an example that one very well-known author had spoken of the ratio of the weight of a given volume of melted fat at 100° F. to the weight of the same volume of water at the same temperature as being the "actual density," a wholly improper expression; for the term density involved a conception of something more than a simple numerical ratio; it involved the fundamental notions of mass and volume, and the use of a phrase of that kind implied a considerable confusion of ideas; apart from which the "actual density" at 100° F. as thus defined was a value which was absolutely identical with the "specific gravity at 100° F.," and was, therefore, a needless expression, even if correct. Two speakers had referred to the possibility of error on account of the sticking of the hydrometer against the side of the vessel; and another possibility of error through the formation of bubbles upon the instrument. The former difficulty was less likely to occur with hydrometers of cylindrical belly, floating perfectly upright in a smooth surfaced jar; the latter source of error was a very considerable difficulty in all cases, but it applied equally to all forms of instrument with which he was acquainted. The two fluids (diluted spirits of wine, and sulphuric acid) on the table had not liberated any bubbles during their use as examples, but it was quite possible that others might have done so. As regarded the bobbing up and down of the hydrometer, there was a very simple way of getting over the error that might occur through the adherence of a film of liquid to the upper part of the stem; and that was, simply to lift it up about an inch or so, carefully wipe the stem, and gently let it go so that it would quietly subside. Mr. Fulton had referred to an instrument (see below) which he (Dr. Wright) had not had the pleasure of being able to examine thoroughly; and he confessed that he did not quite understand its *modus operandi*; but it appeared to him that the part which corresponded to the shank of a hydrometer was somewhat wide; and, therefore, it could hardly be expected to compare in delicacy with the instruments he had exhibited. The instruments he had on the table had equivalent lengths of 750 to 1,250 millimetres equal to some 30 to 50 inches, so that each millimetre of stem represented about $\frac{1}{750}$ to $\frac{1}{1250}$ of the whole instrument; i.e., for an instrument standardised with water a difference in specific gravity of 0.0001 represented about one-tenth of a millimetre. But in the instrument brought before the meeting by that gentleman, it appeared to him (Dr. Wright) that the graduated tube was very much wider, so as to seriously impair the sharpness of its reading. He spoke under correction, as he had not had an opportunity of closely inspecting the apparatus; but that was the objection which occurred to him at the first blush. A speaker had referred to the expansion of the liquid, and had asked whether the indications of a "millimetre areometer" would be exact at a temperature higher than that at which it was standardised. Certainly not, unless it was known what was the rate of expansion of the substance dealt with relatively to water so as to make the necessary correction. If a given instrument were calibrated and set for a particular temperature, say 15° C., it could be used at that temperature with a fair degree of accuracy; but if it were required to work at a widely different temperature, say 100° C., it should be calibrated at that temperature also. The same principles applied as in the case of a pycnometer; so far as the effect of expansion was concerned, that could be calculated in

much the same way as that described for pycnometers in the paper; but there was another point to consider, viz., that if the temperature of the jar varied, the length of the millimetre scale etched thereon also varied, so as to represent a lesser length than 100 millimetres at a temperature below the normal one for the instrument, and *vice versa*, involving an additional correction. Dr. Rideal's experience with the Westphal instrument seemed to have been more unfortunate than his (Dr. Wright's) and worse than that of most others who had used it. The results which he (Dr. Wright) had obtained with it and similar instruments, had led him to believe that, except in determinations involving accuracy to more than three places of figures, it was sufficiently accurate to be of considerable practical use. One speaker had stated his opinion that the use of an arrangement of the kind described by him would be limited to fluids not deeply coloured. It was perfectly true that in the case of a dark fluid it was difficult to read the meniscus, but in that case the level of the top of the liquid could be easily read; whilst with a properly proportioned jar, not too wide, the etched rim could also be easily read, there being only a thin column of fluid round the bulb of the instrument.

SPECIFIC GRAVITY APPARATUS.

BY H. B. FULTON, F.C.S.

It seemed to me that while the little piece of apparatus which I have now the pleasure of exhibiting is perhaps scarcely important enough in itself to merit an independent communication to the Society, it might, in connection with Dr. Wright's paper "On Specific Gravities for Practical Purposes," be not altogether devoid of interest.

In bringing this before the Society, I make no claim of originality, having seen the principle applied some years ago in America, where a common test tube was employed for the purpose. I have, however, suggested the addition thereto of a bulb for mercury or shot to weight the tube as in the case of an ordinary hydrometer.

The apparatus consists of a glass tube, having as uniform a diameter as possible, graduated from zero upwards—a scale of millimetres being a convenient one—and weighted with mercury so as to maintain a vertical position when floated in water. The neck by which the mercury bulb is attached is comparatively a long one, so that the centre of gravity may be as low as possible. The lower part of the tube may with advantage be blown so as to have a small flattened protruding bulb to act as a fender (Fig. 1), and thus insure more accurate readings by preventing the tube from clinging to the sides of the test jar; or the same result may be accomplished by other means.

The *modus operandi* is as follows:—

Water is first poured into the tube to fill it at least to zero on the scale. A little more does not matter, and there must be sufficient to cover completely the specimen whose specific gravity is about to be taken. Suppose it to have been filled exactly to zero, the tube is now floated in a jar of water, and the level at which it floats is read off. This may be, say 20 (as at Fig. 2). The specimen, perhaps a piece of galena, either as a lump or in powder, is now dropped carefully into the tube, which at once sinks, say to 55 (as at Fig. 3), and the weight of the specimen is thus ascertained as 55—20 = 35.

At the same time, however, the volume is obtained by noting the displacement of the water *inside* the tube; and again assuming this reading to be 5, we have at once

$$\text{sp. gr.} = \frac{35}{5} = 7.$$

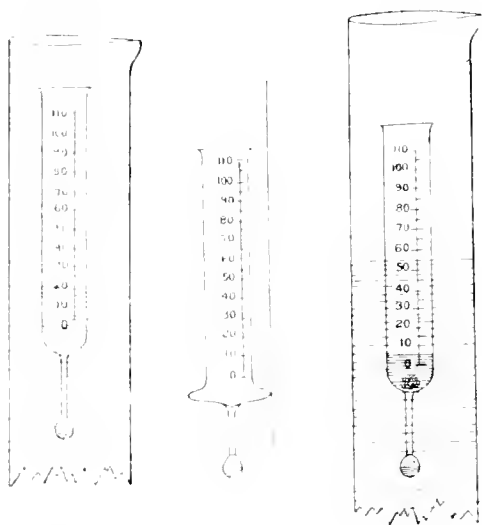
Although, obviously, determinations cannot thus be made with the same accuracy as with the balance, yet the apparatus admits of the specific gravity of vesicular bodies, such as slags, being taken rapidly and easily in the state of grains or powder, with sufficient exactness for most practical purposes. By diminishing the diameter of the tube, greater

delicacy can of course be attained, and I suggested to Messrs. Townson and Mercer, who made the tube now before you, that they should prepare tubes for sale, of three different diameters, perhaps 10 mm., 18 mm., and 25 mm.

Fig. 2.

Fig. 1.

Fig. 3.



1st position.

2nd position.

FULTON'S SPECIFIC GRAVITY TUBE.

STUDIES ON ARTIFICIAL MUSK.

ALBERT BAUR, PH.D.

SOME years ago, together with W. Kelbe, I isolated from rosin spirit (Harzessenz), a butyltoluene, which proved to be a meta-derivative. (Ber. 16, 2559.)

According to my more recent investigations on this subject I have succeeded in proving that by the action of nitric and sulphuric acids on this hydrocarbon, a crystallisable compound is formed which possesses in a very marked degree the odour of musk. The production of this artificial musk is now patented in all countries. The preparation is known in commerce under the name "Musk Baur." (This Journal, 1889, 1004.)

In the Compt. Rend. 1890, 111, 238, and also Chem. Zeit. 1890, [67] (this Journal, 1890, 964), there is a notice published by me showing that artificial musk is a trinitro-derivative of butyltoluene of the formula $C_6H_4(CH_3)(C_4H_9)(NO_2)_3$. I have extended this investigation, and now beg to communicate the further results obtained, (this Journal, 1891, 1024).

The hydrocarbon of rosin spirit, like the compound synthesised from tertiary butylchloride and toluene, both of which yield artificial musk, are shown to be one and the same thing, viz., tertiary butyltoluene.

Mononitrobutyltoluene $C_6H_4(CH_3)(NO_2)C(C_4H_9)_3$. When fuming nitric acid is slowly added to the solution of the hydrocarbon in glacial acetic acid, an oil is obtained which refuses to solidify even in a freezing mixture, and can be volatilised with steam. On distillation under the atmospheric pressure it decomposes, but *in vacuo* it distils without decomposition at 160° – 162° . It is a yellowish oil

of peculiar odour, not pleasant, and unlike that of musk. On long standing in the air it becomes brown.

By the action of excess of nitric acid this mononitro-compound is converted into the trinitro-compound ("artificial musk").

By warming the oil for some time on the water-bath and precipitating with water, a solid product was obtained smelling of musk, and crystallising from alcohol in yellowish white needles, melting at 96° – 97° .

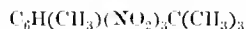
Dinitrobutyltoluene, $C_6H_4(CH_3)(NO_2)_2C(C_4H_9)_3$

When the hydrocarbon is allowed to drop into fuming nitric acid of sp. gr. 1.5, the liquid being strongly refrigerated, and the mixture afterwards let stand at the ordinary temperature, a mixture of mononitro-, di-, and trinitro derivatives is obtained. On distillation with steam the mononitro product first passes over, and then follows a mixture of mono- and dinitro-compound. The trinitro-derivative remains behind on steam distilling, and contains a small quantity of dinitrobutyltoluene.

On allowing the original product to stand for some time at rest, the trinitro-derivative for the most part crystallises out.

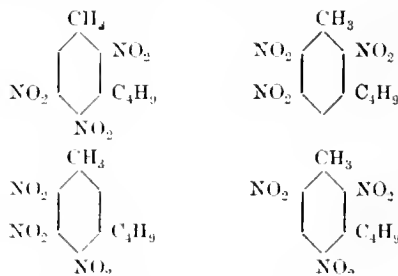
To obtain the dinitro-compound from the residual oil, the latter is submitted to distillation *in vacuo* repeatedly. The fraction received over at 224° – 225° is pure dinitrobutyltoluene. It is a brown oil of very unpleasant odour, not solidifying in a freezing mixture. When this oil is treated with excess of the sulphuric nitric acid mixture, trinitrobutyltoluene results.

Trinitrobutyltoluene (Artificial Musk)—



The simplest method of preparation is from the hydrocarbon direct. By allowing the hydrocarbon, butyltoluene, slowly to drop into 5 times its weight of a mixture of 1 part of nitric acid of 1.5 sp. gr., and 2 parts of fuming sulphuric acid of 15 per cent. of anhydride and warming the mixture on the water-bath for about 8–9 hours. On pouring into water a crystalline mass is precipitated, consisting of trinitrobutyltoluene, but not quite pure. To obtain a perfectly pure article, capable of giving good analytical figures, it is necessary to nitrate the product once more. By crystallising the product from alcohol, yellowish-white needles melting at 96° – 97° are obtained, and these have an intense odour of musk. The compound is insoluble in water, but easily soluble in alcohol, ether, petroleum spirit, benzene, and chloroform. It is only very slightly volatile on attempted steam distillation. By dissolving equal molecular weights of trinitrobutyltoluene and naphthalene in boiling alcohol and heating the solution for some time under inverted condenser, on cooling large yellow plates are obtained, melting at 89° – 90° .

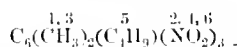
With regard to the constitution of the trinitrobutyltoluene there are four formulae possible—



The three first have the common peculiarity that in each case one nitro-group exists in the ortho position to another nitro-group, whilst in the fourth formula all three nitro-groups are respectively in the meta position to each other. Now, the investigations of Laubenheimer, Hepp, &c. have shown that the compounds in which the nitro-groups stand to each other in the ortho position, very easily exchange one of these nitro groups for an OH, NH_2 , or NHC_6H_5 group when treated with alkalis, ammonia, or aniline

respectively. In the first two cases the nitro-group is eliminated as nitrite, in the third case it converts the aniline into diazoamidobenzene, $C_6H_5 \cdot N : N \cdot NC_6H_5$. If the nitro-groups are not in the ortho position, then alkalis and ammonia are without action, and aniline gives rise to addition products. No alteration with alkalis and ammonia taking place, and an addition compound with aniline without any formation of diazoamidobenzene being obtained, the fourth formula is confirmed as the true one.

Homologues and Isomerides of Artificial Musk.—A series of these has been very carefully prepared and qualitatively tested. Very many of them possess the smell of musk, but as far as regards technical value they are all inferior to the trinitrobutyltoluene. For example, the trinitro-compound of butylmethylxylene has been prepared. It possesses a strong odour of musk, and has the formula—



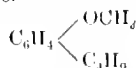
By-products formed in the Preparation of Butyltoluene.—Butyltoluene is by no means the only product of the action of butylbromide upon toluene in presence of aluminium chloride. To purify the substance, it is necessary to subject the product of the reaction to repeated fractionation. Even by the use of perfectly pure toluene and pure isobutylbromide, besides butyltoluene, also butylbenzene, butylxylene, butylethylbenzene with dibutylbenzene, dibutyltoluene, and other products as yet undistinguishable, are obtained.

The formation of butylbenzene, xylene, and ethylbenzene is explained by the fact that in the reaction of Friedel and Crafts (Compt. Rend. 101, 1218) toluene splits up under the influence of aluminium chloride partially into benzene on the one hand, and xylene and ethylbenzene on the other, and these naturally become butylated, like the toluene itself.

Among the products distilling between 170° and 200°, which I have specified in my patent as applicable for nitration, all these compounds are contained, and the corresponding trinitro-derivatives find their way into the crude artificial musk. Later on, it was however found best, even for technical purposes, to subject the butyltoluene to a complete purification to begin with.

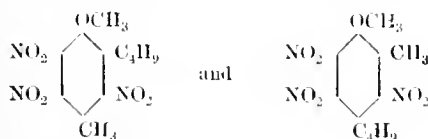
When the bromide is employed, which has been prepared from the ordinary commercial butyl alcohol and which always contains amyl alcohol, the crude hydrocarbon mixture, as per patent, boiling at 170°–200°, contains besides butyl derivatives, also the corresponding amyl derivatives. These also on nitration yield substances smelling of musk, but of a coarser description of odour, and which are much more difficult to crystallise. For technical purposes, then, pure butyl bromide must be employed.

Anisol and Cresol Derivatives, and another Form of Musk.—On account of the analogies of the phenol ethers with the hydrocarbons, it seemed to me of interest to include them in the scope of my investigations. I have, to begin with, introduced the butyl group into anisol, $C_6H_5 \cdot OCH_3$, by means of the Friedel and Crafts' reaction, and then subjected the butylanisol—



thus obtained, to nitration. The Di- and Trinitrobutylanisol are crystalline bodies possessing no smell of musk.

The Trinitro-derivatives of the butylated *p*-cresol- and *o*-cresol-ethers have, according to my researches, the following constitution—

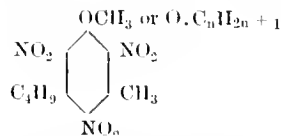


They exhibit no odoriferous properties worthy of notice or remark.

The butyl-group in these ethers is of course also the tertiary.

The trinitro-derivative of the butylated *o*-cresol ether is a beautifully crystalline product. It forms shining yellowish-white needles melting at 69°–70°. This ether was also obtained from the *m*-butyltoluene sodium sulphate by fusion with potash, and by nitration and subsequent etherification of the phenol thus obtained (Ber. 16, 2561).

The trinitro-derivative of the butylated *p*-cresol ether, on the other hand, is obtained in the crystalline form with very great difficulty. When, however, pure *m*-cresol ether is boiled with isobutyl bromide or pseudobutyl chloride and aluminium chloride, a butylated *m*-cresol ether is obtained, boiling at 222°–224°, and which on treatment with the nitro-sulphuric acid mixture yields a trinitro-derivative of intense musk-like odour. This compound possesses the formula—



This ether crystallises from alcohol in beautiful yellowish-white plates. A British patent has been recently granted for the preparation of this musk-like cresol ether.

If meta-cresol be treated with butyl alcohol and then with chloride of zinc, and the mixture boiled under the inverted condenser, an unsymmetrical butyl-cresol is obtained, which when etherified and nitrated, yields a product possessing an odour closely resembling the so-called civet ("civet").

DISCUSSION.

The paper having been read by Mr. WATSON SMITH.

Dr. ALDER WRIGHT wished to ask him whether the author had examined the nature of the products obtained by the methods patented by Valentiner (Eng. Pat. 15,687 of 1890; this Journal, 1891, 571), where certain benzene hydrocarbons, oil of turpentine, &c., were treated with butyl or other homologous alcohols in presence of sulphuric acid, whereby condensation was brought about, producing hydrocarbons and sulphonic acids thence derived, the former of which gave an insoluble musk on nitration, and the latter a soluble musk. It would thence seem as if a variety of homologous nitro-derivatives existed, all more or less possessing the odour of musk. Were any particular members of this group better suited than others for technical purposes? and if so, which?

Mr. PETER MACLEW said there was no doubt that the subject before the meeting, from a commercial point of view, was of immense interest; but in his opinion it was of equal interest that the meeting should know that artificial musks, from the point of view of the consumer, had not been quite the success which had been anticipated. This fact was probably due to the assumption that musk was used *per se* as a perfume. It was not so; the principal use of musk being to develop, fix, or "round off" the odours of other perfumes. This property did not appear to be possessed by the artificial musks. There was another fact in regard to artificial musk which he had noted on its introduction, and that was, that it underwent some modification in presence of acids, which fact had a very material influence upon the use of such substances in confectionery, in which trade there was undoubtedly very large quantities of musk employed, as was also the case in tobacco manufacture. It would be of immense advantage to those industries in which musk was used if Dr. Baur would extend his studies to the investigation of the reactions or decompositions between artificial musk and those bodies with which it was likely to come in contact. It was necessary that they should have knowledge on this point before they could say whether artificial could take the place of natural musk. The supply of the latter could not last for ever, and although the extermination of the musk deer

might not be a question for the present generation, it certainly would be for the next, or the following one; and what there would be to fall back upon then it was difficult to conjecture, unless a satisfactory artificial article could be produced.

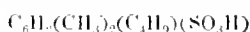
Mr. A. G. GREEN inquired whether it had not been shown in a recent number of the *Berichte* of the German Chemical Society, that the soluble musk obtained according to Valentiner and Schwarz's patent, owed its smell to a small quantity of trinitrobutyltoluene with which the commercial product was contaminated, and that the pure sulphonate was odourless. The fact that the trinitrobutyltoluene was insoluble in water would not disprove its presence, as it might be dissolved in small quantity by the sulphonate; *a priori*, it was difficult to conceive of the sodium salt of a sulphonic acid having an odour, on account of the extreme non-volatility of such bodies.

Mr. WATSON SMITH, in reply, said that Dr. Baur had already investigated the homologues of the butyltoluene musk, and he had stated definitely that none of them possessed an odour comparable with that of his pure trinitro-product for fineness and purity. With regard to the question of the blending capacity of the artificial musk, he, Mr. Watson Smith, had found on reference to Piesse's work on perfumes, that it had not that property in the same degree as natural musk. What he understood by this was that whilst natural musk had an extraordinary power of blending its perfume with other odours to agreeable results, the artificial product lacked this capacity. Natural musk resin had an entirely different composition. With reference to soap manufacture, in connexion with the question of any superiority or inferiority of the water-soluble sulphonated musks for scenting purposes, it appeared to him to be a question of how much of such soluble products were required to scent one ton of soap as compared with the musk of M. Baur. Manufacturing practice would soon settle this point. Otherwise he was perfectly at one with the opinion of Mr. A. G. Green.

Mr. MACEWAN remarked that the artificial article made from oil of amber was used in the manufacture of certain soaps, in which natural musk could not possibly be used owing to its high price.

Mr. WATSON SMITH, continuing his reply, said that it was a current opinion that the most valuable application of artificial musk would be in the scenting of soaps.

Dr. A. BAUR replied to the following effect by letter:—Not only he, but also Professors Graebe, Noeling, Nietzki, and Witt had repeated the process described in the specification No. 19,687 of October 3rd, 1890, of Valentiner. By the reactions which take place when concentrated sulphuric acid acts upon butyl alcohol and oil of turpentine, small quantities of butylated aromatic hydrocarbons are formed, which are volatile with steam, and on nitration yield impure and ill-flavoured musks. The larger portion of the product is non-volatile with steam, and furnishes on nitration no musk at all. As regards the reaction with the butyl alcohol and sulphuric acid, on the one hand butylxylene is formed, which on nitration yield Baur's trinitro-derivative, whilst on the other, butylxylene sulphonic acid—



is produced. Now on nitration of this latter compound, trinitrobutylxylene sulphonic acid is produced which is, as Mr. A. G. Green suspected, without odour; and on continued nitration, suffers decomposition with loss of the sulphy group and formation of trinitrobutylxylene. A complete report on this subject is given by Noeling in the *Berichte*, 1892, 789, where he states:—"The so-called Soluble Musk of Valentiner owes its odour to small quantities of trinitrobutylxylene." Trinitrobutylxylene, although insoluble in water, dissolves to some extent in the solution of the nitrated sulphonic acid and its salts. A really soluble artificial musk does not exist. He (Dr. Baur) had heard from various perfumery experts and firms that the artificial musk had proved itself extremely well adapted for mixing

with other perfumes, and that, like natural musk, it possessed the power of fixing the latter as well as amalgamating with them.

Whilst he was working out his process, it subsequently appeared that two other German chemists, Messrs. Sehmanfer and Hupfeld, had been working on the same lines. Whilst later, as to date of application in Germany, these chemists were first in England, viz., Eng. Pat. 18,521, December 18, 1888, whilst his patent, No. 4963, was dated March 21, 1889. This matter was now fully settled, both patents being in the hands of the same firm, the *Fabriques de produits chimiques de Thann et de Mulhouse*, and the further scientific investigation of the subject now rested solely with himself.

NOTES ON ROSIN OIL.

BY F. H. LEEDS, F.I.C., F.C.S.

CHENEVIER (*Monit. Scient.* 1890, 4, 685–689; this *Journal*, 1890, 825) has stated that rosin oil "of the first distillation" may be distinguished from that of the second by the amount of free acid present, and gives as the limits of the acidity from 4 to 10 per cent., the molecular weight of the acids being assumed to be 302.

Rosin oil "of the first distillation," *i.e.*, an oil which has been distilled once, the spirit it contains being subsequently removed either by steam or fire heat, varies considerably in its composition, according to the design of the stills, and the consequent greater or less ease with which the rosin can volatilise unchanged during the distillation; the acidity of commercial samples varying from about 15 to 24 per cent. These crude oils usually have a blue fluorescence, but by heating to a temperature of 150° C. for 3–4 hours, to remove the last traces of spirit, they lose from 1 to 5 per cent. by weight, and the fluorescence becomes green. Oils containing a higher percentage of non-acid substances are also met with, and with little trouble may be prepared, having only about 0.4 per cent. of acids.

The figures for acidity given above are obtained by titration of the alcoholic* solution of the oil with caustic potash and phenolphthalein; their molecular weight being taken at the figure given by Chenevier (*cf. ante*). By boiling the oils with excess of alcoholic potash and titrating back with acid, another—higher—figure is obtained, the difference between the two varying from 1 to 9 per cent., but having, as reference to Table I. will show, apparently no connexion with the degree of purity of the oil.

TABLE I.

Sample.	Acid by Titration.	Acid by Saponification.	Difference Per Cent.
A	22.71	31.07	8.36
B	14.51	22.20	7.68
C	0.45	9.72	9.27
D	13.11	14.52	1.41
E	0.36	1.84	1.48

Of these samples E was a laboratory oil, prepared in glass, and D was a mixture of about equal parts of A and B, prepared for a special purpose.

The first three samples were exposed in evaporating basins to the air of the laboratory for five months from April to September, to see the effect of partial drying. At the end of the time they were found not to have increased notably in viscosity, but A was dry at the edges; they were then well mixed up by the aid of heat and

* In the case of the crude oils, solution is much aided by the addition of a few drops of toluene.

thorough stirring and again titrated; the results being shown in Table II.:

TABLE II.

Sample.	Acid by Titration.	Acid by Saponification.	Difference Per Cent.
A	23.28	24.90	1.62
B	11.48	16.09	1.59
C	9.55	12.21	3.66

It is to be noticed that the figures in the first column show hardly any change—the decrease in B being probably an experimental error. Some of the A oil after exposure was poured on to glass plates and again exposed till dry to the touch; the film was then scraped off the glass, and gave, on analysis:—by titration, 24.60 per cent., by saponification, 37.00 of acids.

By boiling with alcoholic potash and treating as described in Allen's Commercial Organic Analysis for the estimation of saponifiable matter, figures agreeing well with those obtained volumetrically could not be obtained; sample B giving gravimetrically 16.12 per cent. of acids instead of 14.52: further experiments, which are still in progress, showing that the molecular weight of the resins is higher than 302 (Chenevier, *loc. cit.*). The author hopes to give further results in a future communication.

Liverpool Section.

UNIVERSITY COLLEGE, BROWNLOW STREET.

Chairman: H. Brunner.

Vice-Chairman: A. Norman Tate.

Committee:

E. Carey.
V. C. Driffield.
F. Gossage.
W. D. Herman.
C. L. Higgins.
F. Hurter.

A. H. Knight.
D. McKerchnie.
E. K. Muspratt.
Henry Tate.
A. Watt.

Hon. Treasurer: W. P. Thompson.

Hon. Local Secretary.

Dr. Chas. A. Kohn, University College, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies, and will take office in July next:—*Vice-Chairman*: E. Carey. *Committee*: J. Campbell Brown, Jos. C. Gamble, G. Schack-Sommer, and A. Norman Tate.

Meeting held Wednesday, April 6th, 1892.

MR. A. NORMAN TATE IN THE CHAIR.

ADJOURNED DISCUSSION ON MR. A. E. FLETCHER'S PAPER ON MODERN LEGISLATION IN RESTRAINT OF THE EMISSION OF NOXIOUS GASES FROM MANUFACTURING OPERATIONS. (See Vol. XI., page 120.)

MR. EUSTACE CAREY opened the discussion, and said—

I purpose this evening to make some remarks, which shall be few and brief, by way of introducing a discussion upon the subject of Mr. Fletcher's interesting paper of January last, with the intention of proposing a resolution and

of obtaining the views of this Section as to what, if any, amendment of the Alkali Works Regulation Act should be recommended in the interest of the public, amendments which shall be at the same time without injury to the manufacturer.

In making the following remarks I wish it to be understood that I am giving only my own individual opinion, I do not pretend to represent any particular manufacture, and though, of course, I can only speak from my experience as an alkali manufacturer, I shall endeavour without fear or favour to speak in the interest of chemical industry generally, and I hope with a due regard to the interest of the public of which we form a part.

So far the alkali manufacturer has been in the eyes of the public and of the Legislature the first and chief object of attention, though it has all along been obvious and admitted that there are other industries which have hitherto received no attention whatever which deal with and of necessity evolve into the atmosphere the very same gases as those produced in the manufacture of alkali. The Act of 1863 was directed against alkali works alone, and though the subsequent Acts have been concerned with some other industries their chief object has been the regulation of alkali works.

One reason for this is readily seen, viz., that in alkali works the gases are evolved in such a manner that they can be regulated and their escape controlled with comparative ease. Another reason is that the foremost alkali makers, when legislation was first proposed, happened to be men of singularly open mind, public spirited, and sagacious (as many of these men have passed away, I trust that I may be permitted this tribute to their memory). They began by frankly admitting the fact that the gases evolved from their works had done harm to vegetation, that within reasonable limits the escapes of these gases might be controlled, and they expressed themselves willing to incur reasonable expense in erecting plant for the more perfect condensation of such gases. They went further; they cordially assisted the Government in framing a working Act, and when that Act was passed they treated the inspectors, who had been appointed, in a thoroughly friendly way, and gave them, so far as I know, every assistance in their power. They were sagacious enough to see two things; one was that a reasonable regulation of escapes would be ultimately in favour of the manufacturer who was possessed of capital and skill; secondly, that the fact of their works being so conducted as to meet the requirements of the inspectors would tend, and rightly tend, to protect them from vexatious actions for damage. These views and their action have been justified by the event, for, the Acts being framed in a reasonable manner, manufacturers generally have found no great difficulty in complying with the regulations, escapes have been greatly lessened, vegetation in the neighbourhood of alkali works suffers less than it did 20 or 30 years ago, notwithstanding the fact that alkali works have largely increased during that period, the public have been protected and the manufacturer, to say the least, has not suffered.

So much for the past; let me, with equal brevity, now speak of the future.

Firstly, then, with regard to Mr. Fletcher's suggestion, that works should be no longer scheduled but that gases should; that is to say, instead of naming a list of the works that are to be inspected and the operations of which are to be controlled as to their means of preventing escapes, a list of gases should be named, and that all works that are liable to evolve these gases should be brought under inspection and eventually under reasonable regulations with a view to the prevention of escapes. With this suggestion I quite agree, the present system of naming certain works and only certain works results in glaring anomalies and affords another instance of the old saying that "while one man may steal a sheep another may not look over a hedge." Under the present system *ex. gr.*, as has been often pointed out before, the alkali maker in the manufacture of sulphate of soda is tied down by stringent regulations; he must catch and condense all or nearly all his HCl, he must catch and condense all or nearly all his chamber SO₂ and SO₃; but the glass manufacturer on the other hand buys sulphate of soda and in many cases common salt and calmly decomposes those

substances with SiO_2 and makes no attempt to catch and condense either his SO_2 or HCl . The whole of these gases escape into the atmosphere, and as the alkali manufacturer and the glass manufacturer are often next-door neighbours the unfortunate alkali maker is frequently held responsible for annoyance and damage to which perhaps he does not contribute more than one hundredth part. The same observations hold good in respect to copper smelting; the smelter by the dry process is under no inspection and under no obligation to even try to condense his SO_2 , while the wet process metal extracting works are defined to be alkali works and therefore under regulations as stringent as those of ordinary alkali works.

Of course it will be argued that in the case of glass works and dry process copper works, there is no means—no practicable means—of condensing these gases. That may be very true at present and no person outside a lunatic asylum would dream of placing the same restrictions upon them as upon alkali works; but there is no reason why no attempt should be made to grapple with the difficulty, but rather more reason for putting judicious but not vexatious pressure upon such manufacturers to try to make them improve their processes and appliances in the interest of the public. I think also, that it will be better to name certain gases than to take a wider definition—the gases when enumerated are something upon which the inspectors can definitely act. If a wider definition is attempted such as that proposed by Dr. Brown, viz., “any gas injurious to health or property,” the inspectors would have an almost insuperable practical difficulty before them: they or the Government for them, would have to decide from time to time, amidst conflicting testimony, what gas is, and what gas is not harmful, and then having decided that they would have to say what percentage of such gas is harmful. Is 0·2 per cent. of CO , prejudicial to health or 0·4 per cent.? Is 0·01 gr. of HCl or 0·001 of Cl in a cubic foot of the air of a neighbourhood prejudicial or otherwise? Now these questions would lead to endless delay in the practical working of any Act, and I submit that our Act should be so amended as to enumerate gases which are admitted to be harmful, which are known to be manufactured and which are liable to escape in sufficient quantity to be a serious annoyance to the public.

I would suggest that the Act be so drafted that the list of these gases can be amended by provisional order or otherwise if and when in the opinion of the central authority necessity arises.

The Act should provide that any works where these gases are manufactured shall be inspected by qualified inspectors appointed by the central authority, that when such works are under inspection it shall be competent for the central authority from time to time to define within what limits, if limits are practicable, escapes may be tolerated; in other words, a “best practicable means clause” of elastic construction should be provided.

By such a clause I do not mean that inspectors should have the power of saying to a manufacturer “You must use such and such means, you must use this or that apparatus or invention for the purpose.” Such power is obviously open to great abuse, but the inspector should have power when authorised by the central authority to say to a manufacturer, “It has been proved practicable to reduce these escapes to such and such a limit, you must now reduce them to this limit; adopt what means you please, put up what form of plant you like, only reduce your escapes to what is now known to be reasonably practicable. You shall have three months, six months, or whatever time is necessary to effect your alterations, but by such and such a date your escapes must be reduced to the required point, otherwise I shall be compelled to take action against you.”

The “best practicable means” should be therefore understood to be any means which will attain that result which is considered by the central authority to be the best practicable result for the time being.

Now it may be argued by those who do not wish to see any extension of legislation, that “British manufactures must not be handicapped by regulations which are not in force in foreign countries, for if they are so handicapped the foreign manufacturer will have an unfair advantage over us.”

I reply, if the proposed regulations are such that the British manufacturer is really at a disadvantage thereby, such regulations are not reasonable because they are not politic, and being unreasonable and impolitic they are not likely to be suggested by any responsible authority.

This part of the question appears to me to resolve itself into this: Can we trust the Government?

I venture to say we can, for I believe that no Government, be it Conservative or Radical, will ever have the desire, or even if it had the desire will ever be allowed, to hamper our manufacturers with unreasonable and impolitic restrictions.

I think that the experience of the last 30 years shows us that in noxious vapours legislation we have been careful of the manufacturer; it has been cautiously tentative, and, if you please, illogical; Englishmen often appear illogical; all practical men do.

Suppose for a moment that we had been what some persons may call strictly logical and had insisted upon having no anomalies, we should have been forced into one of two courses: on the one hand, we might have said, for example, all works that evolve sulphuric acid and hydrochloric acid must condense, therefore glass works shall do so as well as alkali works; or, on the other hand, we might have said because glass works cannot control their escapes therefore we won't ask alkali works to control theirs. The former alternative if vigorously carried out, would have injured or might have ruined the glass trade, the latter would have indefinitely delayed improvement in the alkali trade. No, thank goodness, we have not been “logical”; we have been practical and have done the easy work first; if we had not so acted we should possibly never have done any work of the kind at all, and in any case it would have been much delayed.

I submit the time has come when by the experience we have gained in doing the comparatively easy task of regulating alkali and some other manufactures, we should put our shoulders to the wheel again and see if we cannot take another step forward, and that next step seems to me to be the amendment of the present Act in the direction of scheduling certain gases and not certain works, and in the inspection of all works that deal with those gases.

This Government is preparing to amend the present Act, and will, we are informed, bring in a Bill this session with that object.* It is, I think, for this Society, the great representative society of the chemical manufacturers of the United Kingdom, to watch and to influence legislation in the interest, firstly, of chemical industry, but not forgetting that chemical industry has its duties as well as its rights. I have no doubt that the Parliamentary Committee of the Council are fully alive to this. But as the new Bill affects primarily a branch of our trade, the largest centre of which is in the neighbourhood of Liverpool, it seems highly desirable that this Section, having special knowledge of that part of the subject, should take action and confer with the Parliamentary Committee. I have, therefore, much pleasure in proposing the resolution, which reads as follows:—

“That a Committee (with power to add to their number) be appointed by this Section to confer with the Parliamentary Committee of the Council of the Society, to consider how the Alkali Works Regulation Act may be amended in the interest of the public and without injury to the manufacturer.”

Mr. J. C. GAMBLE, in seconding the resolution, said he quite agreed with Mr. Carey that gases should be scheduled and not processes. At the same time he had not such great faith in the Local Government Board as to at once leave it to them to say in all cases what were the best practicable means. He would prefer in the case of processes widely differing from those that have already been under inspection that at first they should simply be put under inspection, and when the inspectors had had sufficient time to become thoroughly acquainted with all the conditions under which they were carried out, they might then be put under the “best practicable means” clause.

* A Bill has since been brought in and was read for the first time in the House of Commons on Friday, April 8, 1892, and will be found printed *in extenso* on p. 382 of this issue.

Dr. HURTER, in supporting the resolution, drew attention to the Act as foreshadowed in Mr. Fletcher's paper.

He was sorry to find that the numerical standard limits of escape provided by the Alkali Acts of 1863, 1874, and 1881, were to be abandoned, and that the "best practicable means" clause was to take their place entirely. From Mr. Fletcher's paper he gathered that the new Act would read as follows: Noxious Gases Act: Every manufacturer must use what in the opinion of a judge and jury were the best practicable means of preventing the discharge into the atmosphere of any such gases evolved in his works, of which 10 neighbouring householders made *bona fide* complaints. If the Local Government Board were satisfied that the complaints were *bona fide*, their inspector would institute proceedings against the manufacturer. Such an Act would not work. A judge and jury would be the authorities who decide whether the best practicable means had been used. The noses of 10 neighbouring householders would take the place of anemometers, aspirators, &c., and it might well be asked, "Who is my neighbour?" Mr. Fletcher had no doubt the best intentions, and thought that such an Act was simple and not indefinite, but he (Dr. Hurter) was afraid that to the counsel of a defendant company, the Act might not read quite so definitely, and provided the means whereby any farmer or householder might harass the manufacturers.

He approved of the suggestion to schedule the gases rather than the works, but pointed out that the numerical standard limits of escape should be retained. These could not of course be applied at once to all the works. Escapes of sulphurous acid from glass and copper works were most difficult to deal with, and the question arose, supposing they succeeded in suppressing all the gases evolved in chemical works, would they derive any great benefit from it as regards the purity of the atmosphere? It was admitted on all sides that the largest pollution of the atmosphere was due to the combustion of fuel, the sulphur of which was by far the greatest source of sulphurous acid. He did not think that the loss which might be inflicted by unduly harassing the manufacturers would be compensated by the increase in agricultural profits, and he thought that while they were obliged to control the escape of these gases to such an extent that they would not be injurious to health, they must stop at that limit and not press for more than would insure that, considering that our population lived chiefly on other than agricultural pursuits.

Mr. TERRY did not approve of the proposal to schedule the gases. He thought it would cause serious inconvenience to many industries where gases were evolved to a small extent. He had in his mind such industries as used chloride of sulphur for the vulcanisation of india-rubber and other purposes. Where this substance was used on the large scale the neighbours might have cause for complaint, but it would be a difficult thing for those industries where the substance was used in but small quantity and intermittently to have to follow the larger works in putting up condensing plant. There would be an objection if the proposed Act was to be inoperative unless complaints were lodged, as a business in one locality might be seriously hampered to the advantage of a rival house where no legislative restrictions were in force.

Mr. RHODES thought the experience of the manure manufacturers answered Dr. Hurter's objection with regard to the best practicable means. No definite limit was fixed for those manufacturers who had their condensation to do in the best practicable manner. Had the limit been fixed early it would have been extremely difficult to conform to it. If it had been fixed at 0.2 grains per cubic foot total acidity in the mixer gases, some works would have conformed to it which were not condensing more than 60 or 70 per cent. of the gases from the mixer. Other works might be condensing 98 or 99 per cent. and yet have an escape with an acidity equal to 0.5 grain SO_3 per cubic foot. This was owing to the different construction of the plant, as when a fan was used to draw the gases from the mixers large quantities of air were sent through the condensers and diluted the gas, and went to reduce the total acidity per

cubic foot in the escaping gases. Where the chimney only was employed, this dilution of the gases was avoided. He (Mr. Rhodes) was also of opinion that gases should be scheduled instead of works, and maintained that even in the case of small industries such, for example, as the smelting of sulphate of lead from chamber bottoms, which caused a great nuisance, those who worked such processes should be compelled to condense their gases. Dwellers in Widnes sometimes experienced great nuisance from the smelting of these chamber bottoms. With regard to matters going before a judge and jury, a recent well-known case in which the defendants, who were supposed to have caused a great nuisance, were acquitted, demonstrated that under direction of a judge and before a jury everything would be thoroughly thrashed out.

Mr. FLETCHER remarked that as a judge and jury were the tribunal before whom cases in dispute must be brought for their decision, the facts, however technical, must be so marshalled and established as to be apprehended by them, convincing them even in the face of opposing evidence. It did not by any means follow, as had been suggested, that the aspirator and anemometer must be put on one side. These were required as means of bringing forward facts to convince the jury that the accusation or the defence was correct.

As to fixing a limit to air pollution, he would point out that the observance of the "best practicable methods" clause included the power of giving a definite limit. Numerical limits would grow in the hands of those who had to administer this clause.

It must be conceded that the best numerical standards that could practically be attained might vary under different circumstances, but experience and a continued effort to attain the best results would bring out a fixed limit clearly. Two figures had been mentioned as having been given provisionally, and they might still stand. They were, first, as to the amount of chlorine in a cubic foot of air issuing from a bleaching-powder chamber, that was given as five grains. Secondly, the amount of sulphuretted hydrogen that might be allowed to escape. This was fixed at 0. These figures came as the result of experience in the use of the best practical means for preventing the escape of these gases, and in this way from time to time other numerical standards would grow.

Prosecutions had been successfully carried through resting on this clause. The manufacturer was however, well sheltered from unwarranted attack. The difficulty was with the inspector, he had to marshal his facts and arguments in the face of opposition by witnesses on the other side so as to persuade the judge and jury that the best practical means had not been used. The manufacturers had the easier side of the argument to maintain; it was for the inspector to prove his case, and he was not likely to go into court unless he was quite certain of establishing it.

Cases that had recently been tried in Manchester might be cited as good instances of the protection afforded to manufacturers by the Government inspection. Nuisances were said to have arisen from certain factories which were under partial inspection, but the prosecution withdrew their claims against those portions which were thus under inspection, and rested it entirely on those portions which were not under Government inspection.

The difference between the inspection carried on under the Alkali Act and that of the sanitary officer, was that the Alkali Act empowered the inspector to see what was going wrong, so that he was often able to indicate means by which the source of complaint could be removed. Manufacturers were immensely shielded by the appointment of skilled inspectors who could investigate strictly into what was going on, and ascertain if the best practicable methods were employed for the suppression of nuisance.

As to the definition of sources of nuisance, Mr. Fletcher put it as an alternative; either that the gases which were to be subject of inspection should be named, or that all

manufacturing processes from which any noxious gas was liable to be discharged should come under the Act, a suitable definition of a noxious gas being given.

MR. NORMAN TATE said that it was undoubtedly desirable that further legislation should take place quickly. It was a great anomaly that one works should be debarred from turning out a certain gas whilst another works close to it could turn it out in quantity without interference. He was in favour of scheduling the gases instead of the works, and thought that, wherever possible, limits of escape should be distinctly mentioned; but he knew that it would be quite impossible in many cases to do this, and therefore a clause such as the "best practicable means" clause seemed absolutely called for. He decidedly objected to legal action being initiated by the representation of a certain number of neighbours or householders unless their complaints were most thoroughly sifted by competent inspection before legal action was taken. Any clause relating to such complaints from a number of householders or neighbours would require to be watched most closely and carefully framed, for it was very easy to get together the requisite number of complaints and put manufacturers to much inconvenience and expense.

MR. BUCHANAN and DR. CAMPBELL BROWN also supported the resolution which, on being put to the meeting, was carried unanimously, and a committee was appointed in accordance therewith.

EXHIBITION OF MODELS, &c.

DR. CAMPBELL BROWN exhibited several models of metallurgical furnaces which had recently been bought for the Chemical Department of University College from funds placed at its disposal by the City Council. These included models of an English lead furnace, a Belgian zinc furnace, a copper furnace, and a blast furnace, all of them being constructed so as to well illustrate the working of the several processes, and were of the same character as those supplied to the Mining Academy at Freiburg.

Manchester Section.

Chairman: Ivan Leviustein.

Vice-Chairman: Edw. Schanck.

Committee:

J. Angell.	J. Grossmann.
G. H. Bailey.	P. Hart.
K. F. Carpenter.	A. Liebmann.
G. E. Davis.	Sir H. E. Roscoe, M.P.
Harold B. Dixon.	C. Truby.
H. Grimshaw.	D. Watson.

Hon. Local Secretary:

J. Carter Bell.

Bank House, The Cliff, Higher Broughton, Manchester.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next:—Committee: F. H. Bowman, J. M. Irving, and E. Knecht.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Friday, April 8th, 1892.

MR. I. LEVINSTEIN IN THE CHAIR.

THE MANUFACTURE OF OXYGEN GAS.

BY FERDINAND FANTA.

As we know, atmospheric air is composed practically of four parts in volume of nitrogen to one part in volume of oxygen, and from this mixture the nitrogen alone cannot be removed because it has no inclination to combine directly or easily with any substance we know of, which does not also combine with oxygen.

Although mechanical means, such as forcing the air through porous material, india-rubber, metallic gauze, &c., have been experimented with, there does not seem to be any likelihood of such processes becoming practicable, in consequence of the great similarity of the two gases in respect of their physical properties, and of their density, which may be said to be approximately the same.

I now come to the method of separating oxygen from the atmospheric air by chemical means, and since, as I have just pointed out, no combination can take place with nitrogen, it becomes necessary to avail ourselves of the property of certain compounds of oxygen of absorbing certain determined quantities of oxygen which will be taken from the atmospheric air, and to again give up such oxygen under given circumstances, whereby the original lower oxide will remain as residue.

Two distinct processes, based on these reversible reactions, have been brought forward, one being based on the use of barium oxide which is due to Bunsen, the other based on the use of manganese oxides in combination with caustic soda, due to Tessié du Motay.

These are, so far as I know, the only two processes by which oxygen is obtained direct from atmospheric air without the intervention of any other chemical reaction, such as have been suggested for using oxides of lead, plumbates, &c.

The process of utilising barium oxide has been described at length in the Society's Journal (see L. T. Thorne, 1890, 246).

As you are no doubt aware, this forms the basis of the process known as "Brin's," and is, according to my belief, the only one which has till recently been applied on a somewhat large scale, and I am glad to take this opportunity of saying that some of the important applications to which oxygen, when produced on a large scale and a low cost, will be turned, may be to a certain extent attributed to the enterprise of the Brin Co., who, I understand, have of late years introduced a series of improvements, reducing, if not entirely removing, the inconveniences inherent to the process.

In reference to the second process, viz.: that of Tessié du Motay referred to above, Professor Mendeleëff expresses himself as follows:—

"As oxygen may become of considerable technical use from its capacity for giving high temperatures and intense light in the combustion of substances, its preparation directly from air by practical methods forms a problem whose solution many investigators continue to work at up to the present day. The most practical method is that of Tessié du Motay. It is based on the fact that a mass of equal weights of manganese peroxide and caustic soda, at an incipient red heat (about 300°) absorbs oxygen from air with the separation of water according to the equation $\text{MnO}_2 + 2\text{NaHO} + \text{O} = \text{Na}_2\text{MnO}_4 + \text{H}_2\text{O}$. If superheated steam at a temperature of about 450° be then passed through the mixture, the manganese peroxide and caustic soda originally taken are regenerated, and the oxygen held by them is evolved according to the reverse equation $\text{Na}_2\text{MnO}_4 + \text{H}_2\text{O} = \text{MnO}_2 + 2\text{NaHO} + \text{O}$. This mode of preparing oxygen

may be repeated for an indefinite number of times. The oxygen in combining separates out water, and steam acting on the resultant substance, evolves oxygen. Hence all that is required for the preparation of oxygen by this method is fuel and the alternate cutting off the supply of air and steam."

The only practical means of producing oxygen besides the "Brin" process are based on the Tessié du Motay process. Various attempts have been made in this respect, but seemingly with no effective result.

The difficulties which are met in this process, and which will be referred to more particularly in this paper, are of a complex nature, and it will be my endeavour not only to show the difficulties which have prevented the Tessié du Motay process hitherto becoming a commercial success, but also to indicate how these difficulties are being overcome in the process, of which I may claim some particular knowledge.

I now come to the different attempts to utilise the Tessié du Motay process. One patentee has suggested that, in order to render the material spongy and non-fusible, the sesquioxide of manganese should be fused, and then mixed with an admixture of caustic soda, also in a fused state. It was stated that the granular compound so formed would, if dusted over with black copper oxide, supply means of continuously producing oxygen by the alternate passage of air and steam.

Another patentee has advocated the use of permanganate admixed with kaolin, clay, &c., for the purpose of forming a kind of spongy brick, capable of yielding oxygen at different temperatures and pressures.

As to the first of these patents, I should say that, from experiments carried out with the greatest care, it is evident that the material is not rendered non-fusible, and that the addition of copper oxide is by no means to be commended in a process like this, since by doing so the fusing point of the compound is considerably lowered. From what I shall have an opportunity of putting before you later on, it is moreover, clear that it is a decided mistake to fuse the excess of caustic soda in order to get rid of the water contained therein.

As for the second patent, I may be allowed to say, while not doubting that oxygen may be produced by this process, and eventually even on a large scale, that there does not seem to be any reason why such an elaborate plant, necessitating, as it does, compressing and vacuum pumps, should be introduced for the purpose of utilising the remarkable properties of manganese oxides.

It has been my endeavour to study the causes of the non-success of the Tessié du Motay process (with the earliest stages of which I would here remark I was connected), and as a result of the researches to which I have been led, I find that the main points to be guarded against can fairly be said to be the following :—

It is all-important to render the material as granular as possible, and also to prevent it from fusing at a comparatively high temperature.

In the preparation of this material, I came to the conclusion that the most rational, and, I may say now, the *only* way of attaining this object, was to treat the material exactly in the same way as it would be dealt with during the process in the retorts. Accordingly, the material must, before being inserted in the retorts or utilised, not only be submitted to a temperature at least equal to that of the furnace in which it will be ultimately placed, but also that a sufficient quantity of moisture representing a similar amount to that to which the material will be exposed in the retorts, when steam is passed over it, should be introduced in the course of the preparation of the material. This, in other words, meant preparing the material according to a wet instead of a dry method, as had been suggested before.

Without going into the effects of such different preparations at the present, since I shall have to refer to them more fully in the course of the description of the process, I would simply say that, according to my views, manganate of soda

previously crushed by any ordinary mechanical means should be moistened with a small quantity of water, in which 5—10 per cent. of caustic soda has been dissolved, until a thick paste is obtained, and this mixing is best done by mechanical means, so as to ensure perfect homogeneity.

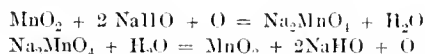
The paste is next submitted to slow heat, until complete evaporation has taken place. When the material is withdrawn from the shallow pan in which it has been evaporated, it is placed in a crucible where it is submitted to white heat. In this state the material is granular and spongy, and will not fuse, and it will readily be understood that, even if some amount of moisture were at any time brought into contact with this material, a simple evaporation will rid it again of the moisture, leaving it in its original state after preparation. This, however, is only one of the three difficulties to be overcome.

If air, charged as it always is, with a certain amount of moisture at a low temperature, be brought into contact with the heated material in the retorts, such moisture will cause spontaneous creation of steam, which, to say the least, would affect the oxidising power of the air by dilution and displacement. I say "the least" because, in my opinion, steam also acts as a de-oxidiser, and therefore the time requisite for the full oxidation of the material must be considerably increased, so much so, that after a series of reversed operations (oxidising and de-oxidising alternately) it will become necessary to oxidise the material by a prolonged passage of air in order to regenerate it.

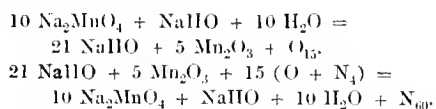
It is moreover essential that the steam used in the de-oxidising period of the process, be introduced into the retorts in as dry a state as possible, and, if anything, at a higher temperature than that of the material, although repeated experiments have proved that it is sufficient to use steam at the temperature at which the retorts are being worked. This has, moreover, the advantage of facilitating the dissociation of the elements composing steam.

The result of the foregoing remarks is, that in order to maintain the material in its original condition, it is necessary to render the material non-fusible by the wet process, and to use in connexion therewith, air previously deprived of its moisture and heated to the temperature of the material in the retorts, for oxidising purposes in combination with superheated steam for de-oxidising purposes, and in that manner condensation in the retorts, and production of steam during the oxidising process are avoided, whilst the de-oxidation is facilitated considerably by the dissociation of the steam, and excess of moisture is guarded against during this second part of the process.

The formula by which the reactions take place, according to the Tessié du Motay process are as follows :—



According to the process before you these formulæ would read as follows :—

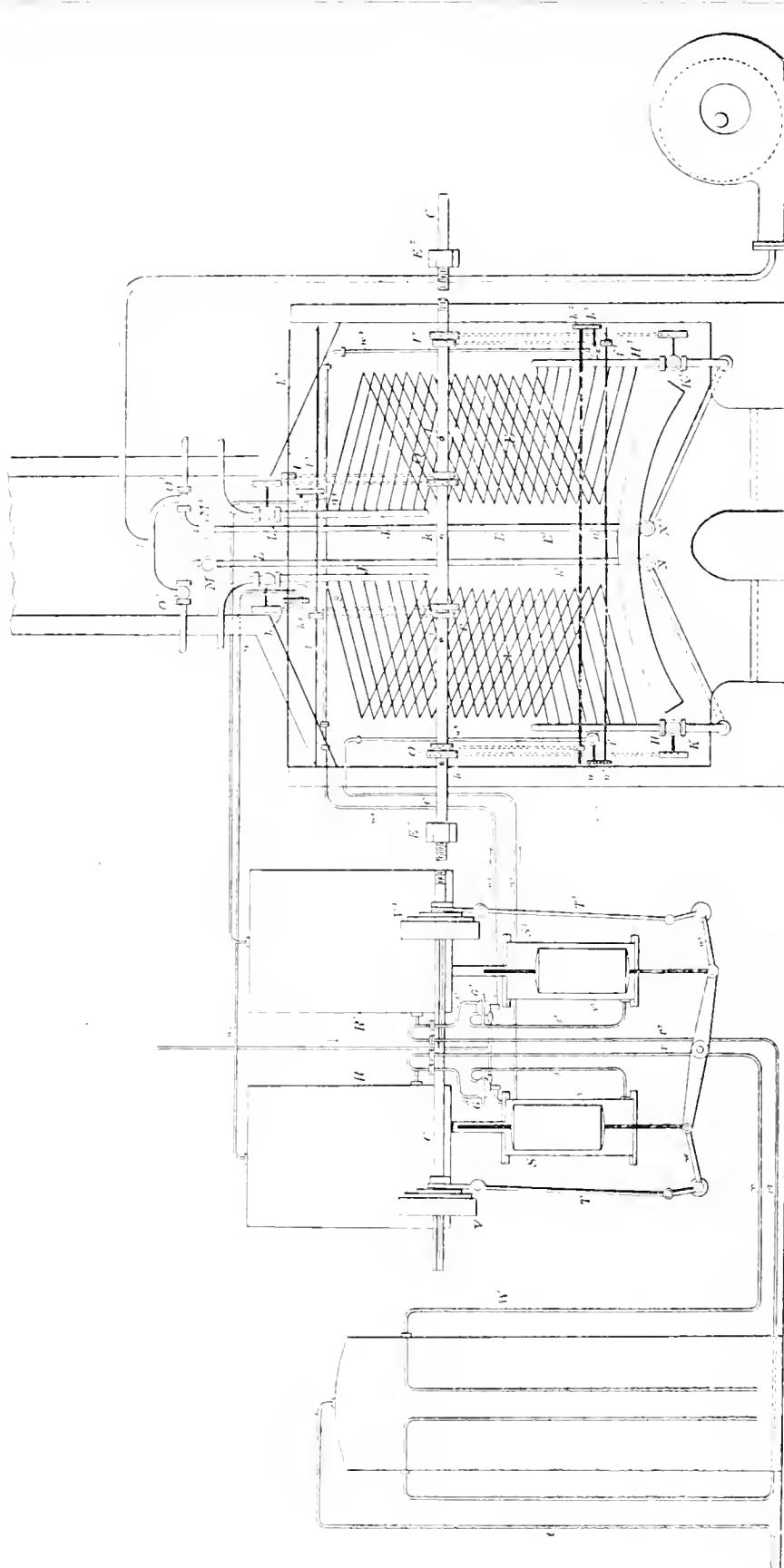


You will notice that the excess of caustic soda acts independently of the material itself, and, provided that only that amount of moisture be at any time allowed to enter the retorts, that can readily be absorbed, and can again be given up by such excess of caustic soda, the material will practically remain unaltered.

I had, perhaps, better at this stage explain the tracings which are before you, as it will enable me to more clearly convey to you the meaning of the series of operations which take place in connexion with the latter reaction.

I intend, after having given you a brief description of the apparatus, to enter into further details, if time permits, and

Fig. 2.



also to demonstrate on an experimental scale by means of the model before me, the mode in which oxygen is produced, which I trust will be interesting to you.

Description.

Fig. 2, is a general outline sketch diagrammatic of the whole arrangement illustrating the mode of operation.

Figs. 5 and 6 are longitudinal and cross sections of one of the dish-shaped retorts.

The same letters of reference indicate similar parts in the different figures.

As shown in Fig. 2, I construct an apparatus mainly composed of an outer rectangular or otherwise suitably shaped furnace, in which I place two or more series of retorts of suitable size and construction, but which I preferably construct as shown in Figs. 5 and 6. These are formed of a shallow rectangular tray or case made of cast iron, fireclay, or other suitable material, and are provided with a moveable cover or lid which can be hermetically fastened to the tray by means of bolts, screws, or other appropriate devices. The lower end of the tray is provided with a pipe *b*, running along the lower ledge of the tray, and the upper end of the tray is provided with a pipe *j*, communicating with the upper edge of the tray. Inside the trays are small wires *n* on which rests a perforated plate *o*, and on this perforated plate the manganoate (previously rendered non-fusible) is placed. The trays being filled with the material *p*, a second perforated plate *o'* is inserted, and the wires *n'* are fastened to same before enclosing the whole by screwing down the lid or cover *m*. Channels *x* and *y* are reserved in the moulding or casting of the trays by means of which the apertures *b* and *y*, are made to communicate with the free spaces left below and above the perforated plates *o* and *o'* respectively.

These retorts are placed at an incline of say 60°, and superposed on each other, allowing the heat of the furnace to circulate between them so as to equally and regularly heat the whole of the material with which they are filled.

Each of these retorts *a* and *a'* is provided with an inlet *b* at one end, and with an outlet *j* at its opposite end, and the connexions between the retorts are made in such a way that the inlet of the second retort is kept higher than the outlet of the first retort, so as to allow gases or steam, as the case may be, to ascend freely, owing to the difference of gravity consequent upon the heating of same as they pass through the retorts.

Fig. 2 shows two series A and B composed each of 24 such retorts, each of these series being formed of eight sets of three retorts, each of these eight sets being worked in parallel from one inlet collector H (and H' respectively) and each one of such sets of eight is also provided with an outlet collector I (and I' respectively).

I will now proceed to give full details of set A, it being understood that the second set B is in every way similar to set A.

The inlet collector H may be formed as shown in Fig. 2 of a cylindrical vessel, tube, or pipe, closed at one end, whilst at the other end (preferably the lower) it is provided with an air valve of sufficient internal section to provide the current of air necessary for eight retorts (in this case). The collector is moreover provided with eight small flanges, each of which is connected by means of a pipe to one retort. The eight pipes providing the necessary current of air to retorts Nos. 1 to 8 (in supposing the 24 retorts to be numbered in numerical order from 1 to 24, beginning with the lowest one) establish the communication between the collector and the lowest point of each of these retorts, whilst the highest point of each of these is put into communication with the lowest point of each of the next eight retorts by parallel junction pipes, and the highest point of this second lot of eight retorts is again put into communication with the lowest point of the third lot of eight retorts, whilst the highest point of these communicates with the outlet collector

I in every way similar to the inlet collector, with the exception that the air valve in this case is fixed on its upper end.

It will be understood from the above, and in referring to Fig. 2, that eight distinct series, each composed of three retorts, viz., 1, 9, 17; then 2, 10, 18, and finally 8, 16, 24 are formed; that these eight series are supplied simultaneously and that the passage of air through these 24 retorts is controlled by the two air valves K and L. The collector H is, moreover, provided with a small valve *f* for the inlet of steam, and the outlet collector I is provided with a valve *g* for the outlet of oxygen.

On the other hand the furnace contains two series of vertical pipes E and E' composed each of a suitable number of these, connected together at the upper end by horizontal pipes M and M', and at the lower end with similar connecting pipes N and N'. The latter are connected with the inlet valves K and K', whilst the upper pipes M and M' are connected together and supplied with air by means of a fan, blower, or similar appliance.

These two sets of pipes E and E' are filled with lime, chloride, or suitable material, for the purpose of absorbing the moisture of the atmospheric air which is forced through them, previous to its entering the retorts containing the material, and in this way such air is heated, and reaches the inlet collectors in a dry state, and at the same temperature, as that of the material in the retorts. These two points are essential to give the air its full oxidising power, as otherwise the moisture contained in same would create a spontaneous production of steam (thus tending to partly de-oxidise the material) on its coming into contact with the hot material in the retorts, and to this the unsuccessful attempts made up to the present time with the Tessié du Motay process may largely be ascribed.

As, however, the continuous passage of damp air over the same lime would speedily render some inactive, owing to its becoming saturated with moisture, each of the entrance pipes M and M' is provided with a two-way valve O' O², Fig. 2, by means of which each of the two sets E and E' can either be put into communication with the blower or can be thrown open allowing the moisture absorbed by the lime, whilst the damp air was passing over it, to evaporate, thus regenerating the lime, and rendering it serviceable during the next cycle.

It will be further understood that by means of these two double-way valves, one of the sets (E for instance) is traversed by air on its way to the valve K, such air being thereby dried and heated, whilst the other set E' throws off by evaporation the moisture which it had retained from the air passed through it on its way to the valve K' in a previous operation. The action of the two-way valves will be readily perceived, and the way they are operated upon by the mechanical device explained hereafter, is identical to that by which the air valves themselves are reversed.

In addition to the two sets of retorts containing the material to be oxidated and de-oxidated alternately, and to the two sets of air heating and drying pipes; the furnace also contains a continuous coil, serpentine, or similar series of pipes traversed by steam derived from any suitable boiler, the object of such coil, &c. being to superheat the steam necessary for the de-oxidating of the material in the retorts, and to thus decompose same into its constituent elements previous to the admission thereof to the steam valves *f* and *f'*.

The operation takes place as follows:—

The dish-shaped retorts having been filled with material specially prepared so as to render it non-fusible, in accordance with specification named before, and the furnace having been set to work until a regular temperature of between 400° and 450° has been attained throughout, air is forced by means of the blower through set A, this air passing through the horizontal pipe M into the series of vertical pipes E, where it rids itself of its moisture and becomes heated, enters the collecting pipe N, and its temperature is still further increased in passing in the fireplace until it reaches the inlet valve K. Entering the

inlet collector H it finds its way into the eight lower retorts, oxidates the material contained therein, and passes on to the next eight retorts by means of communicating pipes, and then again passes from these eight retorts to eight more, finally reaching the outlet collector I in the form of freed nitrogen, the oxygen having been retained by the material.

Whilst this operation has been going on, the valves *f* and *g* have remained closed.

In the meantime, and simultaneously with the passage of air through the retorts of the series A for the purpose of oxidating the material therein, the following has been taking place in the series B, viz:—

The double-way valve *O'*, Fig. 2, between the blower and the pipe *N'* being placed in such a position that communication is intercepted between the blower and the set *E'* of drying and heating pipes, and consequently so that the moisture contained in the lime of these pipes can freely evaporate passing into the open air, and the valves *K'* and *L'* being closed, the superheated steam has been allowed to enter by means of the valve *f'*, whence it enters the retorts 1 to 8 of the series B, de-oxidising the material contained therein, then passing from the highest point of these retorts to the lowest point of retorts 9 to 16, where it de-oxidates further material, and so on until the oxygen thus freed, in addition to that liberated from the last eight retorts, enters the outlets collector *I'*, and leaves same through the valve *g'*.

It is clear from the above that the inlet and outlet air-valves *K* and *L* of one series, and the steam inlet-valve *f''* and the oxygen outlet *g'* of the other series, will have to be kept open; whilst, on the contrary, the steam inlet-valve *f* and oxygen outlet *g* of the first series, and the inlet and outlet air-valves *K'* and *L'* will have to be kept closed, when, as is supposed in this case, the series A is being oxidised, the series B being simultaneously de-oxidised, and, further, that the position of each of these valves will

have to be reversed when the oxidation of the series A and the de-oxidation of the series B has been completed.

The reversing of these valves would naturally have for effect to allow the superheated steam to pass over the material of the series A which has just been oxidised, thus de-oxidising it again, whilst the dry-heated air passing over the material of retorts B, will re-oxidise the material, which, during the previous operation had given up its oxygen under the influence of steam.

It would seem, at first sight, that if by any mechanical arrangement the spindles of the eight valves (viz. four air and four steam oxygen valves) were to be connected, so that *K*, *L*, *f''*, *g'* are open, and *K'*, *L'*, *f*, *g* are closed, the reversing of one of the spindles, or of the shaft to which the eight spindles were geared, would produce the desired effect of alternating the flow of the fluids.

This is, however, not the case, and would, at all events, necessitate an interruption in the production of oxygen, whilst it would entail a considerable loss of the gas itself, in consequence of the de-oxidising steam entering the retorts before the air valves have been entirely closed; and in supposing even that the reversing of the valves takes place with sufficient rapidity to avoid waste of gas, then again the air in the retorts would become mixed up with the oxygen, thus considerably impairing its pureness.

What is needed, on the contrary, is that in the series which has been traversed by air, the inlet be closed separately, and that a certain interval be allowed for the air or nitrogen to find its way out into the atmosphere (this being facilitated by the difference of gravity of such air in the retorts and the outer atmosphere, and by the inclined position of the retorts and communicating pipes) before the outlet valve is closed, thus reducing the vitiating element to a minimum, whilst retaining in the retorts the full quantity of the oxygen which the material has been capable of absorbing.

On the other hand, it is essential that the valve permitting the outlet of the oxygen be opened before the valve

Fig. 5.

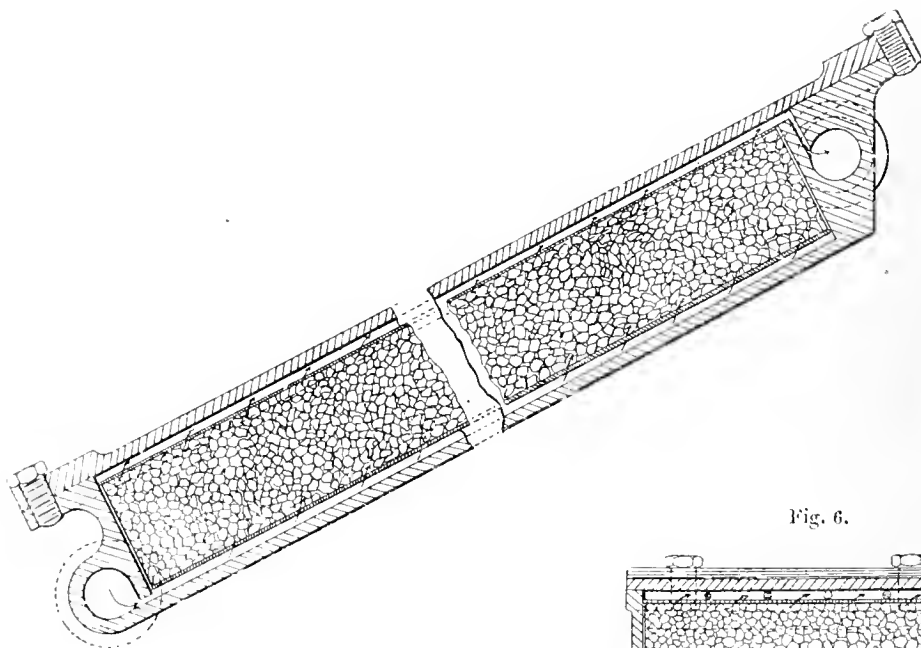
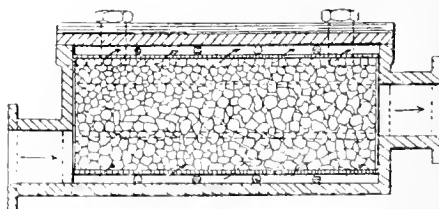


Fig. 6.



regulating the inlet of steam is opened, so as to facilitate the passage of the superheated steam over the material, and allow the same to traverse the retorts with the greatest possible rapidity, since the effect of hampering it in any way would be to unnecessarily condense the same, consequently moistening the material, which should be avoided.

The preceding remarks, which refer to the set which is being de-oxidised, also apply to the second set, the reversing of the valves of which has for its object to allow the oxidising air to pass over the material which has just been de-oxidised. Here it is important to close the inlet of steam, to allow an interval between the closing of the first valve and the closing of the outlet of oxygen, so as to fully exhaust the oxygen that can be freed, as otherwise the premature opening of the air valves, would amount to a waste of oxygen which would be carried away with such air; then only open the outlet of air, when any moisture retained in the retort will find its way out, and to finally open the inlet of dry hot air for oxidising purposes.

This latter point is rendered all the more important by the fact that the air introduced into the retorts for oxidising purposes would, if carrying moisture with it, have a de-oxidising power on the material instead of an oxidising power, as it would practically act like steam itself.

It is consequently necessary that the valves should be made to act in the following rotation:—

In series A-K closes; L closes; *g* opens, *f*' opens; whilst at the same time, in series B, *f*' closes, *g*' closes; L' opens, K' opens.

From this it will be seen that:—

K closes when *f*' closes,

L closes when *g*' closes,

L' opens when *g* opens,

K' opens when *f* opens,

and, *vice versa*,—

K' closes when *f*' closes,

L' closes when *g* closes,

L opens when *g*' opens, and

K opens when *f*' opens.

To obtain this object I devise a mechanical arrangement (Fig. 2), mainly composed of a horizontal shaft C, provided in its centre with a screwed part, the thread of which engages in a threaded plumber block E², and this shaft can be acted upon either by a straight belt or by a cross belt. When the cross belt is made to act, the shaft revolves from left to right, and is made to travel longitudinally from left to right also. On this shaft four loose double chain wheels, kept in position by lateral supports, are connected by means of chains with the spindles of the valves as follows:—

One of the wheels of the double chain wheel O acts, when same is thrown into gear, directly on the spindle of the valve K, thereby closing same, whilst the second wheel of the double chain wheel O acts on the small shaft *h*', the opposite extremity of which closes at the same time the inlet of steam *f*' by means of the gearing *h*² and *h*³.

The double chain wheel O which, as stated before, is loose on the shaft, is brought into action in consequence of the feather *h* of the shaft C becoming engaged in the key-way of the wheel, and acts upon this wheel until the shaft C has travelled sufficiently to the right, when the feather becomes disengaged, and the wheel becomes loose again. The thickness of the wheel and the pitch of the screw, as well as the respective diameters of the chain wheels, are so calculated that the valves are closed or open, as the case may be, when the feather has done its work. The shaft then continuing its course, occasions the feather *i* to engage in the next double chain wheel P, which is acted upon in the same way, closes the valve L and *g*', whilst the shaft still moving from left to right, brings the chain wheel Q into operation by means of the feather *k*, thereby opening the valves L' and *g*, and finally, and in the same way, the feather *l* acts on the double chain wheel V, which opens the valves K' and *f*'.

The shaft C is now at the end of its course, and is made to throw the cross belt out of gear, and is thus stopped.

When the reversing of the valves becomes necessary, the straight belt is made to act upon the shaft C, when same turning in the opposite direction, viz. from right to left, occasions the shaft to travel longitudinally in the opposite direction, thus coming back when the feather *l* acts on the double chain wheel V, then feather *k* on double chain wheel P, and, finally, feather *h* on double chain wheel O, thus reversing the respective valves in their proper rotation, as will be understood on referring to the drawing and to the table above. When the shaft C has again come to the end of its course on the return it throws the straight belt out of gear, whereby it is stopped, being thus once more in its original position.

The throwing into gear of either the cross belt or the straight belt is obtained by the physical state and condition of the fluid coming from the outlet valves *g* and *g*', as explained.

The oxygen, on leaving the valves *g* and *g*', is conveyed to two cooling appliances, R and R' (Fig. 2), the cooling apparatus R being connected with outlet valve *g*, and R' being connected with *g*'. At the lower extremity of the cooling apparatus, where the oxygen leaves same and is carried to the washing vessel W (Fig. 2), by means of the pipes *r* and *r*', two branch pipes *s* and *s*' are provided for, and these are made to communicate to the lower end of two cylinders S and S'. Each of these cylinders is provided with a float V, V', connected by means of a vertical guide-rod to a balance connecting the two rods. The two ends of this balance are, by means of a crank, chain, or otherwise, connected with the shipping fork of a friction clutch, which acts on a pulley, V, V', the boss of which is provided with a key, engaging in a groove of the shaft C, on which they are loose otherwise, so as to allow same to travel longitudinally. The gas having been passed through the washer, leaves same by means of the small pipe *t*, which conveys same to the gasholder for storage purposes.

Midway of the branch pipes *s* and *s*' are inserted two diaphragms (G, G' Fig. 2) valves constructed as follows:—

An outer casing 1, 1 (Fig. 7) is divided into two compartments by means of an elastic diaphragm or plate, so as to form two chambers. The upper chamber 7 is provided with an inlet 3, and an outlet 2. The diaphragm plate 6, forms a hermetic joint B with the flanges of the upper and the lower chambers. The lower chamber has an inlet 4, and outlet pipe 5, there being a valve seat and valve 9, between this inlet and outlet, and this valve is fastened to the centre of the diaphragm plate 6 by means of the valve spindle 10, which is counterbalanced and regulated by means of the adjustable spring 11, and the pressure can be set by means of the screw pin 12.

These valves are placed between the steam superheaters and the steam inlets *f* and *f*', of the two sets A and B, in the following manner:—

The steam coming from the superheater enters the pipe 4 of the lower chamber, and passing through the valve 9 leaves the chamber at 5 on its way to the retorts. The spring 11 is set so that the valve is slightly open when oxygen is evolved from the retorts.

The entrance pipe 3 of the upper chamber is connected with the upper part of the branch pipe *s*, coming from the cooler, and the outlet 2 of the same chamber 7 is connected with the vessel S containing the float *v*.

When, and as long as oxygen is evolved from the retorts, this oxygen finds its way to the washing vessel without entering chamber 7, but as soon as steam passes through the cooler, same becomes condensed and the water resulting therefrom, on reaching the diaphragm plate, causes same to contract, and the pressure thus acting on the valve 9, closes same and prevents any more steam from entering the retorts, whilst any steam which is still contained therein distills over to the cooler, and becoming condensed in its turn creates a vacuum in the cooler which causes the float *v* to be lowered owing to the water contained in the vessel S being taken up through suction pipe *s*, where it remains until the next cycle comes into operation.

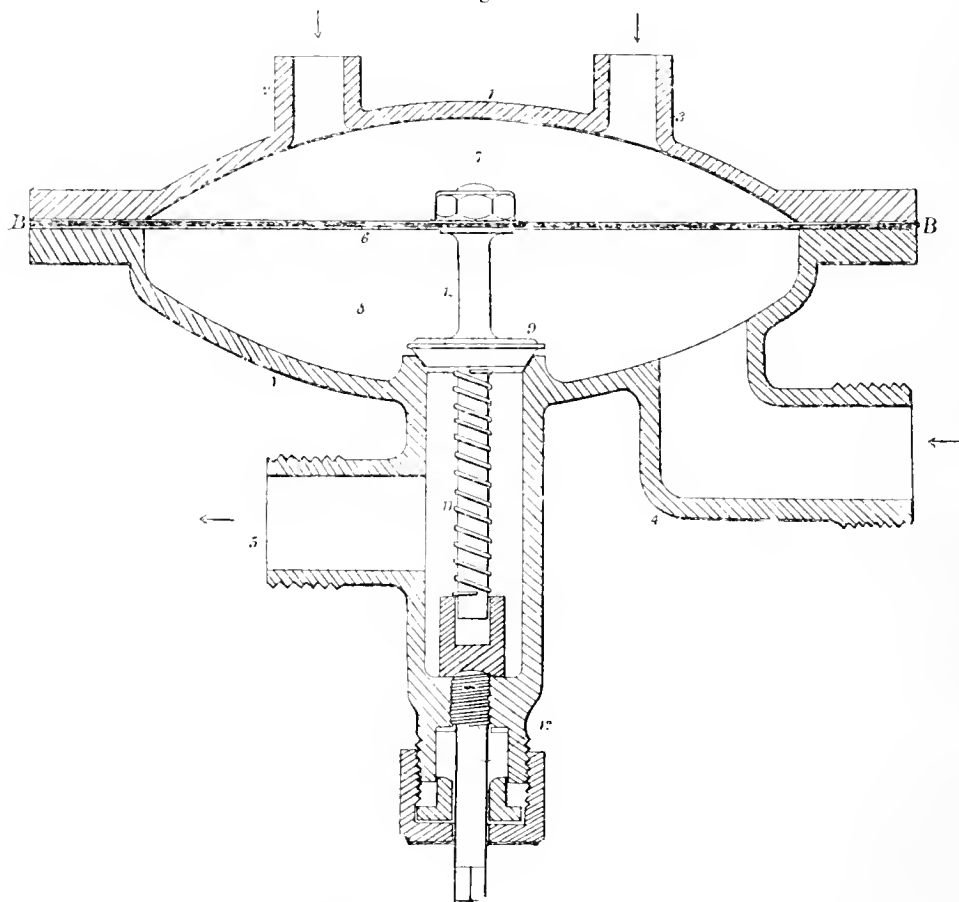
The two valves *b* and *b'* are identical in construction, and their respective connexions are similar in every respect.

The operation of the float and gear arrangement is as follows:—

As long as oxygen gas is liberated from one of the sets, say *A* of retorts, it finds its way to the cooling apparatus *R*,

through the pipe *r*, and the washer *W*, into the gasholder. As will be seen the floating arrangement has not in any way been brought into action so far. The liquid in both cylinders and the floats therefrom remaining at the same level, and in this position both shipping forks *T* and *T'* are in the vertical position, both pulleys being consequently out of gear, and the shaft *C* stationary.

Fig. 7.



When however the oxygen of the series *A* has been exhausted by the passage of the requisite quantity of steam, the fluid leaving the valve *g* is no longer oxygen only, but actual steam, which although superheated contains all the constituents of steam, and in fact is nothing but steam. Now, as soon as this steam enters the cooling apparatus *R*, this cooling apparatus begins (in consequence of the large available cooling surfaces) to act as a surface condenser of the steam, thereby creating a vacuum owing to the fact that the return of the gases from the gasometer is rendered impossible; on the one hand by means of check valves, whilst on the other hand the specially constructed diaphragm valves, *G*, *G'*, shown in Figs. 7 and 2, inserted on the pipe leading the steam from the steam superheater to the retorts containing the material automatically regulate or determine the entrance of steam into the retorts. This valve is acted upon and closed as soon as the condensation water coming from the inside of the refrigerator tubes is brought into contact with the upper surface of the diaphragm plate of this valve; and since the condensation water is led on to the diaphragm as soon as steam passes in the refrigerator instead of oxygen, the entrance of the steam into the retorts is stopped immediately.

In consequence, however, of the considerable difference of temperature between the steam remaining in the retorts and that contained in the pipes of the refrigerator, the

steam distils over to the refrigerator, where it becomes condensed, thus creating a vacuum, which is not only an advantage in respect of the retorts being freed of unnecessary moisture, but this vacuum is also utilised for acting on the floats, as it is made to draw away part of the water contained in the vessel *S* by means of the pipe *s*, and in this way float *v* is lowered, made to act on the crank *w*, and thus on the shipping fork *T*, which engages the pulley *V*, provided with a cross belt, by means of which arrangement the shaft *C* is made to travel from left to right, reversing the position of the valves as explained before. When the shaft is at the end of its course, the friction clutch of the pulley *v* is thrown out of gear by the shaft itself, thus stopping same, and the float is again rendered independent.

The series *B* is thereby brought under the influence of steam, in the stead of the series *A*, and as long as oxygen is being liberated the floods remain inactive, and the shaft *C* stationary. As soon, however, as the oxygen becomes exhausted, the same action as that explained before with reference to the float arrangement in connexion with the cooling apparatus *R* takes place in the float arrangement *S'*, and thus operates on the shipping fork *T'*, and on the pulley *V'*, which is acted upon by the straight belt, thus making the shaft *C* come back to its original position, reversing the valves on its backward course.

The change of cycles is thus produced automatically, and regulated by the nature of the fluid leaving the retorts. The main object and result obtained thereby is not only a saving of labour, but is principally to avoid an excessive strain on the producing power of the retorts, and thus the material does not become loaded by any unnecessary moisture, whilst perfect regularity of the working of cycles is secured.

DISCUSSION.

Dr. BOWMAN said that a most important point in the process was, that the air and steam came in contact with the materials at the same temperature, whereas in the old processes the air and steam were at different temperatures. In this case, however, it might, without injury, vary in the furnace or retort, since the pipes travelled side by side. The reaction thus took place with greater certainty, and the materials, instead of deteriorating, retained their properties however long they were in use. The process was automatic, and a temperature of about 600° which could be obtained as waste heat, was quite sufficient to evolve oxygen and keep the material in a fit state for the process. When the steam had done its work it ceased to be decomposed, and passed through the pipes towards the cooler. The materials used were very cheap; and when once charged the operation went on night and day. The gas contained about 95 per cent. of pure oxygen as it issued from the machine.

Mr. WATSON SMITH said he had seen Mr. Fanta's model plant at work, and was astonished at the rapidity with which the gas was evolved. He had asked Mr. Fanta to let him see the experiment carried out in his own laboratory, in an ordinary glass tube placed in a combustion furnace, so that he might prepare the materials with his own hands according to the prescription. The success of such an attempt, he had found, depended to some extent on the mass of the material, and as a glass tube continually cracked, a copper tube like that before them was substituted. Complete success had followed the trial. He thought it plucky of Mr. Fanta to dare to attempt to make oxygen gas in this laboratory model before his audience, by a reaction in which the question of mass was certainly concerned to some extent, and in which the process was also a reversible one. Mr. Fanta had done this, however, at his urgent suggestion, and he could vouch for the material, for he (the speaker) had prepared it with his own hands. The part of the process which had at first excited his incredulity, was that in which it had been alleged that the material was rendered *more infusible*, by first intimately mixing it with some caustic soda. He had a lively recollection of the fate of caustic soda ash in the soda-ash furnaces, when the material contained say 13 or 14 per cent. NaOH. He was once connected with the old Prestolee Alkali where a very white caustic ash, which contained as much as 16 to 17 per cent. NaOH, was skilfully made for rag bleaching in paper works; and he well remembered the difficulty of furnacing the material owing to the greatly increased fusibility due to such a high percentage of caustic soda. Here then was a very unexpected physical condition, superinduced by the addition of a substance from which the opposite result would have been expected.

The CHAIRMAN said in his opinion the demonstration which Mr. Fanta had brought before them was another forcible illustration that chemical industries depended not only on chemical knowledge, but largely on chemical engineering. As a chemical invention there was nothing new in the process described, and all that Mr. Fanta had done was to resolve the mechanical difficulties which stood in the way.

Mr. FANTA said he started with caustic soda and finished with an excess of it. It had been suggested that the caustic soda should be fused and then put into the retort. If that was done, after a time the material became absolutely unfit for use. In this process the caustic soda, added in the solution was evaporated with the manganate, and then submitted to heat. In that condition the material did not

fuse again, but would stand white heat without fusing. The theory of this was verified by the reaction which he had put down, and this was again verified in the process itself. There was one important point, and that was, if the manganate in the retorts were wholly deoxidised, the re-oxidation did not take place freely—in fact, in some cases it would not take place at all. He found that the proportion of manganate in the retorts did not exceed 40 per cent., and this was entirely different to what really happened in other processes. The proportion of the materials was one of the essential points.

Dr. GROSSMANN said he had been closely connected with the oxygen industry nearly all his life. If there were any fault which he could find with the apparatus it was that it was too ingenious, but, as Dr. Bowman had stated that it did not get out of order, this was all the more creditable. He should like to ask Dr. Bowman if the temperature he gave were Fahrenheit or Centigrade?

Dr. BOWMAN: Between 600° and 800° F. This low temperature was one of the advantages of the process, because it enabled them to use iron pipes without fear of deterioration.

ON SOME OF THE RISKS ATTENDING THE USE OF HIGH-PRESSURE GASES.

BY C. F. RUDENBERG, B.S.C., AND W. E. HEYS.

THE newspapers have made us familiar with several cases of explosions attended with most regrettable consequences, which have occurred in the use of high-pressure gases. An investigation of the causes which have led up to these explosions reveals nothing which might not have been predicted, but much which was not expected.

We will ignore such explosions as have their origin in the use of defective material and workmanship, and in insufficient strength, since these causes are purely mechanical and can be avoided by ordinary prudence. But we may remark that calculations for strengths based on the static pressure of the gas to be employed, will be hereinafter shown to be greatly misleading and to give far too low values. The example of exploded apparatus on the table will demonstrate to you the almost criminal negligence which sometimes occurs in the manufacture of fittings for high pressures, and the fatal folly of users who, regardless of risks, prefer what is cheap to what is good.

In the use of high-pressure gases, they are generally contained in steel flasks, fitted with a valve at the nozzle. To this nozzle the service pipe is secured, which is usually fitted with a regulator valve and a pressure gauge. We may usefully limit our observations to such an arrangement, as it will teach us all that is necessary.

Our first observation is that immediately on the opening of the valve, no matter how carefully and gradually this may be effected, the needle of the pressure-gauge flashes suddenly to the point on the dial indicating the pressure in the flask. The same result occurs even if the gas is withdrawn by being caused to pass through the finest hole which can possibly be drilled, say less than the tenth of a millimetre in diameter.

Secondly, we observe that the service pipe, pressure-gauge, and regulator valve, enclose a rather considerable air space to which the compressed gas has access.

From these conditions we deduce—

(a.) That ordinary time values must not be regarded, the phenomena being instantaneous.

(b.) That owing to the enormous velocity of the issuing gas, great friction must arise and increase the temperature of the gas.

(c.) That the air enclosed in the fittings must be instantaneously compressed to at least the same pressure as the gas in the flask.

(d.) That this instantaneous compression of the air must result in an increased temperature.

(e.) That owing to the heat of friction and of compression, the mixed gas and air must, instantaneously, have a highly exalted temperature.

(f.) That this increase of temperature is sufficient, at less than 100 atmospheres pressure, to dissociate the elements of hydrocarbons. We will illustrate this experimentally with atmospheric air at about 80 atmospheres pressure, which you will see is quite sufficient to reduce chips of wood to ashes.

(g.) That in the event of the compressed gas being oxygen, this gas will instantaneously combine explosively with the dissociated elements, forming water and carbon dioxide. The increase of pressure (e) by heat and (g) by explosion, are additive.

It will, from the foregoing, be obvious that even in the case of an inert gas like nitrogen or CO_2 the actual pressure to be instantaneously borne by the fittings is very far indeed in excess of the pressure in the flask.

It is very possible and easy to adopt precautions of an elementary character which will eliminate all possible risks of danger from explosion.

These precautions are briefly:—

(1.) Careful avoidance of even a trace of oil, or of any hydrocarbon in any of the fittings, or anywhere whence it may leak, penetrate, or be conveyed to the fittings.

(2.) Closing the orifice through which the gas must pass from the flask, by means of a compact porous septum, so as to prevent any outrush of gas.

(3.) Sufficient strength of material and first class workmanship.

(4.) The avoidance of a closed casing for any part of the fittings, since a minute leak into the casing may induce an explosion; sufficient pressure and heat being accumulated before even a weak casing can give way. In the case of a casing for a pressure-gauge, light flaps are employed, to close suitable openings formed in it. This may be combined with a second porous septum completely filling the inlet to the gauge.

It is very usual with some makers to test their gauges by means of an oil pump; such makers' gauges should be avoided for high-pressure gases.

An additional precaution may be found in making all the air spaces in the fittings as small as possible, since the quantity of the air compressed is one measure of the amount of heat developed in the act of compression.

We desire particularly to call attention to two remarkable characteristics of explosions which have been observed as arising from the presence of oil. These are, their intensity and their limited localisation. An explosion of mixed hydrogen and oxygen in well made fittings is comparatively innocent, and may take place without any serious damage at all pressures. In the case, however, of an explosion owing to the decomposition of oil, such as we have before spoken of, the explosion is of the most intense character and attended by a temperature sufficient to fuse a considerable mass of steel or brass: whilst it is limited in its effects to a very small portion of the space in which it may occur. Thus, when the explosion has taken place in a tube with a quarter-inch bore, the explosion has been limited to some three or four inches in length, where the walls of the tube have been so fused as to increase the bore to about half an inch, and the tube itself has been completely ruptured. At the same time a pressure-gauge attached to the tube at a short distance has not been damaged. Probably some members of the Society may be tempted to investigate this part of the subject more fully. It may be new to some of them that ordinary oil may under such simple conditions become an explosive of extraordinary power.

THE ANALYSIS OF SNOW FROM THE NEIGHBOURHOOD OF CHEMICAL WORKS AND VARIOUS OTHER PLACES.

BY J. CARTER BELL, A.R.S.M., F.I.C. ETC.

THE Corporation of Manchester, in consequence of complaints from people in the neighbourhood of Mr. Levinstein's works, brought an action against him at the last Manchester Assizes for emitting noxious acid and other vapours from his works, thus polluting the atmosphere. As the ground all round the works was covered with snow, I thought it a good opportunity to collect some, and compare it with the snow which I collected from other places far removed from chemical works.

Place.	Parts per Million.		Chlorine as Chlorides.	Sulphuric Acid as Sulphates.
	Free Ammonia.	Fixed Ammonia.		
1. Corporation St....	0.85	1.00	76.0	3.40
2. Exchange Station.	1.50	0.75	108.0	2.70
3. Broughton Bridge	2.60	1.25	95.0	3.60
4. Broughton Park...	0.200	1.00	7.0	2.90
5. Sewage Works....	0.50	1.50	8.0	4.90
6. Garden on Cliff...	0.60	1.00	7.0	3.30
7. Kersal Moor.....	0.30	1.00	5.0	2.90
8. Owens College....	2.00	1.40	17.0	4.70
9. Outside Mr. Levinstein's Works.	1.00	0.50	8.0	1.80
10. Bank opposite chimney.	0.370	1.00	6.0	3.20

None of the samples contained any free acid, but the chlorine in Nos. 1, 2, and 3, is excessively high. I can only account for this by assuming salt to have been thrown upon the streets as is the custom in Manchester. All the other samples were collected from the upper surface of undisturbed snow. These analyses with other evidence actually proved that the air in the neighbourhood of the chemical works was purer than that found in the Manchester streets.

NOTE ON THE ACTION OF FROST UPON COTTON.

BY C. F. SEYMOUR ROTHWELL, F.C.S.

FROM the literature published on this subject one obtains the idea that cotton is tendered by frost. Hummel, in his "Drying of Textile Fabrics," says, "that although the evidence on this point is quite conflicting, it is quite conceivable that the crystallisation might act injuriously in a mechanical way, and that the atmospheric ozone might also exercise some slight destructive influence." This uncertainty is no doubt due to the fact that until recently no reliable machine for testing the strength of the cloth was available.

The following experiments were made to decide this question:—Two pieces of "madder-bleached" cloth, one of good quality and the other of very poor quality, were placed in water for 10 minutes, withdrawn, and, without squeezing, hung up, full width, the thermometer registering four degrees below zero Centigrade. The cloth was quite stiff in three minutes, and although the temperature never rose higher than -3°C ., in three hours the ice had completely evaporated leaving the cloth quite dry. The strength of the cloth which had been frozen was then tested with Goodbrand's "Dead Weight Cloth Testing Machine," against some of the same cloth in its original condition, when the breaking weight was found to be identical in both cases.

When carefully used the machine is accurate to within \pm per cent.

The above trials were repeated, but when the ice had evaporated—which generally took three to four hours at -3°C. to -4°C. , the cloth was dipped in water and hung out again, this being repeated four times, making the total time the cloth was frozen about 16 hours. The strength of both qualities of cloth was also found in this case to be equal to the original cloth.

From these trials it is evident that cotton is not "tendered" by the freezing of water within it, at any rate not when in the open width.

If the fibres were bound or held in position to a greater or lesser extent, such as obtains in the case of the pieces near the bottom of a waggon-load of cloth when frozen, probably the cloth might be weakened mechanically by the crystallisation of the water, but, although I have only made a few trials in this direction still they indicate that the cloth is practically uninjured.

The prevailing opinion that cloth is weakened when it is frozen has no doubt arisen from the fact that when the fibres are frozen stiff they are easily snapped; but any stiffening body, such as gum, &c., will have the same effect, and this has obviously nothing whatever to do with the actual strength of the fibre.

Meeting held Friday, February 5th, 1892.

MR. IVAN LEVINSTEIN IN THE CHAIR.

ON THE ALUMINO-FERRIC PROCESS OF SEWAGE TREATMENT.

BY G. Sisson, JUN.

SEVERAL important omissions in the papers of Messrs. Grimshaw and Barrow, in the January number of the Journal, appear to have passed unnoticed. For example, on page 4 there is the following:—"For the purpose of comparing the action of clarine with that of other precipitants and processes, I have been able to obtain figures ready to hand in relation to the International, Electrical, and Lime processes. These are the only processes which can be said to be in the field for the purification of sewage."

This last sentence shows a remarkable oversight on the part of the writer, as over 30 towns and villages are now using a process not mentioned in the above, viz., the "Alumino-ferric," which is treating at least 20 million gallons of sewage daily.

On page 5, sulphate of alumina is confused with "alumino-ferric." Although the latter contains the former it also contains, as its name indicates, an iron salt, the proportion being sufficient to take up any traces of sulphuretted hydrogen present in ordinary town sewage.

Mr. Grimshaw (page 11) claims that persalts of iron act as carriers of oxygen to oxidise the organic matter of the sewage, by a so-called catalytic action, that is to say, ferric oxide (of course hydrated) becomes ferrous oxide, having given up oxygen to the organic matters; then it re-oxidises to ferric oxide and so on.

No evidence whatever has been brought forward to support this view. No experiments are cited to prove such a reaction, and supposing the whole of the surplus oxygen of ferric hydrate to be available, the amount is quite insufficient to deal with the organic matter present in the sewage. For example, in the addition of 5 grains of Fe_2O_3 per gallon of sewage only 0.5 grains of oxygen are available for this purpose, while sewage such as that of Salford will absorb 5 grains of oxygen per gallon, viz., 10 times as much. Moreover, when a reagent is added to sewage the precipitate formed is soon carried down to the bottom of the settling tank, and is thus removed out of the field of action.

With reference to the cost of different processes, the statements on pages 6 and 7 of the Journal are very confusing; e.g., on page 6 the cost of the alumino-ferric

process is stated to be 67s. per million gallons, while on page 7 it is put down at 75s.—apparently a mistake. The calculations must be based on erroneous data; at all events neither of the figures given is correct. On the same page, after the table of comparison, it is stated that all except the first and last processes propose to filter, thus including the "alumino-ferric" as a process where filtration is required. As a matter of fact filtration is not required, and is indeed unnecessary.

With reference to sludge, the weights given on page 7 also appear to be incorrect. No actual measurements of sludge were taken during the Salford trial with "alumino-ferric," and the figures given must therefore have been obtained by some method of calculation not stated. The lime process, which, it is generally admitted, gives a maximum amount of sludge, is actually credited with a less quantity than that produced by alumino-ferric, thus showing the incorrectness of the figures.

Newcastle Section.

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Vice-Chairman: T. W. Stuart.

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W. W. Proctor.

W. L. Remoldson.

J. E. Stead.

John Watson.

Hon. Local Secretary and Treasurer:

Dr. J. T. Dunn, The School, Gateshead.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next: Chairman: A. Allhusen, Vice-Chairman: John Pattinson. Committee: John Morrison, W. A. Rowell, and T. W. Stuart.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held in the Durham College of Science,
Newcastle, on Thursday, April 7th, 1892.

MR. JOHN PATTINSON IN THE CHAIR.

NOTE ON THE PREPARATION OF SAMPLES OF RICH ARGENTIFEROUS LEAD FOR ASSAY.

BY JOHN PATTINSON, F.I.C., AND H. S. PATTINSON,
PH.D., F.I.C.

It has been found that the most satisfactory method of obtaining an average sample of pigs of rich argentiferous lead—containing from 100 to about 1,000 oz. of silver per ton of lead—is to saw each pig through with a circular saw. The fine particles produced by the saw, termed "sawings," are collected, and from them the samples are drawn to be sent to the assayer.

Assays of rich argentiferous lead are best made upon from 200 grains to half an ounce of lead, but such a small quantity of the sawings as this cannot be relied upon to represent the whole bulk of the sample, because of the large size of some of the particles. This difficulty, however, is easily overcome by melting up either the whole of the sample or such a quantity of it as can be relied upon to represent the composition of the whole, and casting the lead into small cakes or "buttons" from which portions weighing from 200 grains to half an ounce can then be cut for assaying. We find that from a sample of sawings of the usual size a button or small bar fairly representing the sample can be cast from about 2,000 grains of the sawings.

When the sawings are melted the button of lead obtained invariably weighs less than the weight of sawings taken,

This loss of weight is partly due to the oxidation of the impurities contained in the lead, which separate as dross or are volatilised during the process of melting. The remaining lead is consequently enriched in silver by the removal of these impurities and the assay obtained from this lead is higher than the true assay of the parcel of bars from which the sawings were taken. A correction must therefore be made upon the assay for this enrichment in order to arrive at the true assay of the sample.

The total loss of weight on melting the sawings is, however, not wholly due to oxidation and volatilisation of the impurities, but is partially due to the combustion of the oil that is upon the surface of the sawings, which has been introduced into the sample by the necessity of using oil to lubricate the circular saw. To correct the assay of the melted lead by an amount corresponding to the total loss of weight on melting the sawings, would therefore be obviously wrong, since a portion of this loss is due to oil in the sample which was no part of the original bars of lead. The percentage of oil in the sawings must therefore be ascertained and deducted from the total percentage loss on melting the sawings.

We determine the oil in the sawings by washing 1,000 grains of them with ether, filtering into a tared flask, evaporating the ether, and weighing the oily residue remaining in the flask.

With some classes of lead the loss of weight, due to oxidation and volatilisation of the impurities, when the sawings are melted alone, is very considerable. We find that a very convenient way of diminishing this loss is to add a little potassium cyanide to the sawings when they are being melted. We use for this purpose about half an ounce of ordinary commercial potassium cyanide to 2,000 grains of the sawings and the melting is made in a fireclay crucible.

As an example of how the loss is diminished, the following instance may be cited:—

4,000 grains of sawings melted alone lost in weight
60 grains = 1·5 per cent.
2,000 grains of the same sawings melted with KCN lost
16 grains = 0·8 per cent.

The percentage of oil in these sawings was determined and found to be 0·52 per cent. Deducting this amount from each of the above total losses we find that the loss due to oxidation and volatilisation is—

When the sawings are melted alone, 0·98 per cent.

When the sawings are melted with KCN, 0·28 per cent.

In this instance, therefore, the loss due to oxidation and volatilisation was $3\frac{1}{2}$ times greater when the sawings were melted alone than when they were melted with potassium cyanide.

The following table gives some examples of the results obtained with several samples of sawings when potassium cyanide was used in melting them:—

	Total Percentage Loss, including Oil.	Percentage Loss due to Oil.	Percentage Loss exclusive of Oil.
1. First trial	0·78	0·52	0·26
Second trial	0·80	0·52	0·28
2. First trial	0·35	0·11	0·24
Second trial	0·35	0·11	0·24
3. First trial	0·50	0·32	0·18
Second trial	0·51	0·32	0·19
4.	0·30	0·15	0·15
5.	0·30	0·13	0·17
6.	0·31	0·12	0·19
7.	0·38	0·15	0·23
8.	0·25	0·10	0·15
9.	0·33	0·14	0·19

It will be seen, from the tests of the first three samples, which were made in duplicate, that very concordant results are found by this process, and also that, in all the samples, the loss of weight due to the oil is very considerable as compared with the loss from other causes. In some instances this loss due to oil is about twice as much as the loss from oxidation and volatilisation.

The amount of loss from oxidation and volatilisation in all these samples is but small, varying from 0·15 to 0·28 per cent., and it may seem at first sight to be of little importance, but, actually, the correction of the assay corresponding to these small losses makes a difference on a lead containing, say, 500 oz. of silver per ton, of $\frac{3}{4}$ oz. of silver per ton in the first case, and 1 oz. 8 dwt. per ton in the latter case; and these amounts when deducted from the assays of the cakes of lead give the true contents of silver in the original lead. With richer leads the correction is, of course, proportionately greater.

It is obvious that in the above cases, if the correction for loss on melting the sawings were to include also the loss due to the oil, an error would be made which would lead to an *excessive deduction* varying from $\frac{1}{2}$ oz. to 2 oz. 12 dwt. of silver per ton, supposing the lead to contain 500 oz. of silver per ton by assay of the cake of melted sawings.

DISCUSSION.

Mr. SHAW suggested that liquation and separation of constituents might take place in the small ingot, but Mr. PATTINSON considered that it was too small and cooled too quickly for that to occur to any measurable extent.

Mr. RENNOLDSON thought that if the oil were first removed, its amount need not be determined; he also suggested the use of water as a lubricant in place of oil.

THE VARIATION IN THE COMPOSITION OF CAUSTIC SODA WITHIN THE SAME DRUM.

BY JOHN WATSON, F.I.C.

So far as I am aware, very few results have been published with a view to elucidate this important question.

At the suggestion of our worthy Chairman, I have pleasure in submitting the tests of several samples, taken from different parts of drums which we have opened, at various times, during the past four years.

First, it may be interesting to consider, briefly, what has already been published on this subject.

In the Chemical News, for 25th April 1873, a paper by Messrs. Glendinning and Edger, of this town, is to be found, "On the separation of caustic soda into portions of different strengths on passing from the fused to the solid condition."

These gentlemen state that when caustic soda, containing water in excess of that combined as hydrate, passes from the fused to the solid state, it separates into portions of different strengths. In such a case, a sample taken from the drum after cooling may, according to circumstances, they say, differ from that taken ex pot during the packing operation by several per cents.

A drum of caustic soda, containing 66·8 per cent. soda (Na_2O) and about 6 per cent. water, in excess of the water of hydration, was cut through its centre, transversely to its longitudinal axis, and samples were taken:—A, from the outside, not extending more than 1 in. towards the centre; B, from a part about 5 in. nearer the centre; and C, from

the centre itself. The radius of the drum was 11 in. The results were:—

	A.	B.	C.
Soda (Na_2O).....	66.9	69.7	Per Cent. 61.6

The outside, or A sample, invariably agrees closely with the packing sample, according to Messrs. Glendinning and Edger. Analyses of the above samples showed that the differences were chiefly due to water; but in some measure to chlorides and sulphates, these impurities occurring in largest quantities in the centre.

The differences in strength, due to separation, will be influenced by circumstances, say these authors, such as the quantity of water present, the temperature at the time of packing, and the size of the drum.

Finally, Messrs. Glendinning and Edger explained the higher percentage of water in the centre by a theory, of the greater affinity for water possessed by the fluid than by the solid caustic, which, as Dr. Lunge, has remarked ("Treatise on Sulphuric Acid and Alkali, Vol. II., p. 622), is very questionable.

Mr. John Morrison, according to Dr. Lunge (*loc. cit.* p. 622), entirely denies the difference of quality within the same drum; the former never found more than 0.2 per cent. difference in testing any portion of a block.

First, I wish to make it clear that the tests I am about to submit to you are those of caustic soda containing no water (except that combined as sodium hydrate), whereas the drum examined by the gentlemen first referred to contained about 6 per cent.

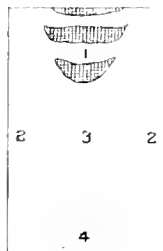
With regard to the difference between samples ex pot and those taken ex drum. For nearly three years at Allhusen's works we took samples both ways, and found the tests to be almost identical. Thus, in the average of one month's work which I have by me, there was only a difference of 0.06 per cent. between the tests of the two sets of samples, those ex drum being the higher.

This difference during the month may be considered to represent our experience over the three years, and now we only take pot samples in cases where we have to make lower strengths of caustic—70 per cent., &c.

In taking the samples, the tests of which are given below, the drums were laid on their sides, opened, and the block of caustic split across lengthwise. Pieces were then cut out as follows:—

- (1.) From near the top, out of the second crust.
- (2.) From the sides of the drum.
- (3.) From the centre.
- (4.) From the bottom.

The annexed rough sketch shows the regions from which the samples were taken.



In high-strength caustic soda, 76 or 77 per cent., a cone of discoloured caustic is almost always found at the bottom of the cylindrical mass.

In 70 per cent. caustic, so far as I have seen, the discoloured particles are generally to be found in a spherical, or lenticular patch, near the centre of the drum.

77 PER CENT. CAUSTIC SODA.

Samples taken from various parts of two drums of Allhusen's 77 per cent. caustic:—

	E 21.	L 66.	Mean of two Drums.
Top of drum (second crust).....	76.85	77.18	Per Cent. 77.01
Sides of drum.....	76.95	77.08	77.01
Centre.....	76.55	76.61	76.58
Bottom (discoloured cone).....	76.90	76.97	76.93
Average of the four samples	76.81	76.96	76.88
Greatest difference between two portions.....	0.40	0.57	0.43

It will be seen, from the above tests, that in the first drum, marked E 21, the highest test, 76.95 per cent., was obtained with pieces chipped from the sides of the drum, whereas the caustic chipped from the centre of the drum tested lowest, viz. 76.55 per cent. The greatest difference in this drum, therefore, was 0.40 per cent. soda. The second drum, L 66, tested highest at the top (second crust), viz. 77.18 per cent. soda, and again, the lowest test was from the centre pieces, viz., 76.61 per cent. soda; in this case the greatest difference between the various portions of the drum was 0.57 per cent. I shall refer to the tests of this drum again, later on. Taking the mean of the tests from both drums, it will be seen that the caustic was strongest at the top and sides, viz., 77.01 per cent., and weakest at the centre, viz., 76.58 per cent.

With a view to finding out the cause of the difference in strength within the same drum, I weighed off a considerable quantity (40 grms.), of the sample from centre of the L 66 drum, also a similar quantity from the top of the drum; the two chief impurities were determined with the following results:—

	Centre.	Top (2nd Crust).
Sodium chloride.....	0.54	Per Cent. 0.55
Sodium sulphate.....	1.42	0.87
Available soda.....	76.61	77.18

The difference in the percentage of sulphate, 0.55, is equivalent to 0.40 per cent. Na_2O .

70 PER CENT. CAUSTIC SODA.

Samples taken from various parts of two drums of Allhusen's 70 per cent. caustic soda:—

	L 78.	L 83.	Mean of two Drums.
Top of drum (second crust)	70.54	70.05	70.29
Sides	70.25	69.53	69.89
Centre	70.91	70.23*	70.57
Bottom.....	70.38	69.49*	69.93
Average of the four samples ...	70.52	69.82	70.17
Greatest difference between two portions.....	0.66	0.74	0.68

* In the case of these two portions the solution was slightly milky in appearance, owing, doubtless, to a trace of lime, which was filtered off and washed before titration.

From the mean of the above results it will be seen that the samples from the sides of the drum are the lowest in strength, those from the centre being the highest.

In a third drum of 70 per cent. which I had opened, I found, on testing, the same order, viz., the portions from the sides of the drum were weakest, those from the centre strongest, and in this case I had also taken the precaution of filtering off a trace of lime which was present in the sample from the centre.

The results given above show that in L 78 the centre was the strongest sample, testing 70.91, the portions taken from the sides were weakest, testing only 70.25, the greatest difference being 0.66 per cent. soda. In L 83, again, the centre sample was the strongest, 70.23; the sample from the bottom was in this case slightly weaker than that from the sides, testing 69.49, the greatest difference being 0.74 per cent. soda.

Analyses of the samples from the centre and bottom of L 83 gave the following results:—

	Centre.	Bottom.
		Per Cent.
Sodium chloride	9.54	9.26
Sodium sulphate	0.65	1.39
Available soda	70.23	69.49

Again it will be seen that the sulphate is very much higher in the weaker portion. The difference in the percentage of sulphate, 0.94 is equal to 0.73 soda per cent., whereas the difference in the soda was shown to be 0.74 per cent.

In the case of the 77 per cent. drum, marked L 66, and that of the 70 per cent. drum, marked L 78, I tested at least two portions from each part of the drum, and with a view to prevent hasty conclusions or dogmatic statements, I give the individual tests, which it will be seen show that there may be considerable variation within the same region of the same drum, e.g., in the centre of L 66, one portion tested 76.29, whereas other two portions tested 76.71 and 76.83 per cent.; again, at the sides of L 78, the first portion tested gave 70.50, but the second only 70.01 per cent.

Individual tests from various parts of a 77 per cent. and of a 70 per cent. drum:—

	L 66.	L 78.
		Per Cent.
Top (second crust) I.	77.22	70.56
II.	77.14	70.52
Mean	77.18	70.54
Sides I.	76.98	70.50
II.	77.19	70.01
Mean	77.08	70.25
Centre I.	76.71	70.86
II.	76.29	70.97
III.	76.83	..
Average	76.61	70.91
Bottom I.	77.00	70.44
II.	76.95	70.33
III.	76.97	70.38

To sum up, in conclusion, my experience, based on the examination of samples from various parts of seven drums, from different batches of caustic soda, goes to show that

the variation in strength is nothing like so great as was found in the isolated case reported by Messrs. Glendinning and Edger; but the different conditions as to moisture must be borne in mind. On the other hand, the greatest differences in strength between portions from the same drum, are, as a rule, according to my experience, greater than stated by our friend Mr. John Morrison. In the seven drums which I have examined, in only one case did I find the greatest difference as low as 0.20 per cent., in another case I found it as high as 1.34 per cent.; but the average of the seven drums gave 0.71 per cent. difference between the highest and the lowest tests. It is only fair to my employers to say that these seven drums of caustic included one not made at Gateshead.

It is notable that the lower the strength of caustic, or in other words, the greater the proportion of salt present, as a rule, the greater is the variation of strength.

THE USE OF FULLER'S SPIRAL SLIDE-RULE FOR CHEMICAL CALCULATIONS.

BY JOHN WATSON, F.I.C.

THE use of the slide-rule to facilitate calculations has been long known to chemists and engineers. In the transactions of the Newcastle Chemical Society, the Society which most of us regard as the parent of this Section, an interesting paper, by Mr. H. R. Procter, is to be found (Vol. IV. p. 330) on the use of the slide-rule for chemical calculations.

The ordinary slide-rule answers well enough for certain purposes, but to give a result of even three figures, where the third figure shall be strictly accurate, a rule is required of such length that its working becomes unhandy.

When we are reminded that this spiral slide-rule, which can be handled with ease, is equivalent to a straight slide-rule 83 ft. 4 in. long, or a circular rule 13 ft. 3 in. in diameter, we realise the advantage of this form which has been patented by Professor Fuller. Since 1879 this slide-rule has been obtainable from Mr. W. F. Stanley, the well-known instrument maker in Holborn.

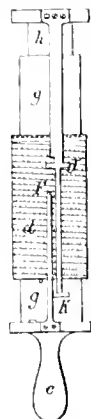
In the preface to the first edition of "The Alkali Makers' Pocket-Book," by Drs. Lunge and Hurter, reference is made to the fact that the latter-named gentleman, in re-calculating the tables for English weights and measures, used Fuller's calculator and Thomas's arithmometer, to avoid errors of computation as much as possible. The use of this spiral slide-rule for chemical calculations, therefore, is not new, as the book referred to was published in 1884; but I venture to believe that there are many chemists in this district who have never seen a Fuller's calculator, and that is my excuse for taking up a little of your time in bringing so useful an instrument before your notice this evening.

It is due to my old friend, Mr. Walton Brown, of the Coal Trade Office, to say that he first showed me an instrument, similar to this, which he had used for some time.

Seeing that the calculator was likely to save much time, paper, and pencil, to say nothing of brain work, I obtained this instrument through Mr. Winter, in Grey Street, and we have had it in daily use for the last 18 months. During this period it has not required any repairs or re-adjustment, and is still as good as new. The price of an instrument such as this, in mahogany case, is 3*l*. A smaller rule, with a scale 200 in. long, giving an approximation of $\frac{3000}{30000}$ th, was made for some time and sold at 20*s*., but in November 1890 I heard from Mr. Stanley that the shorter rule was very unsatisfactory, and he had ceased making them. A pamphlet of 11 pages, giving instructions for the use of the rule, is presented with each instrument; it is therefore needless for me to give more than a brief description (partly taken from the pamphlet) of the mode of working.

The rule consists of a cylinder or muff, *d*, which can be moved up and down upon and turned round the axis *g*; the latter is held by the handle *e*. Upon the cylinder *d* a single logarithmic scale is wound in a spiral, the numbered

graduations being from 100 to 1,000. Each of the primary divisions up to 650 is divided into 10 parts, and from thence to 1,000 into five parts. It follows, therefore, that each number of four figures has either a mark upon the scale, or



(if above 650) is midway between two marks. Fixed to the handle is an index or pointer F, and fixed to the innermost cylinder *h*, which telescopes into *g*, are two indices, the upper J and lower K, whose distance apart is the axial length of the complete spiral. These moveable indices may be placed in any position relative to the muff *d*.

In using the slide-rule it will be found most convenient to hold the handle in the left hand, leaving the right hand to move the cylinder *h* by the top, and to note down with pen or pencil the results obtained. On the axial cylinder *g* several useful tables are printed; among others, one giving inches and vulgar fractions of inches as decimals of a foot, one for pounds and quarters as fractions of a hundred-weight, &c.

For a *simple multiplication* of, say, a number of four figures by another number of three or four figures—

Bring 100 to F (by use of catch).

Set K to the higher number.

Bring the lower number to F.

Read product at J or K.

For working such a case as—

$$\frac{a \times b \times c}{d \times e}$$

Professor Fuller informs me that he finds it more convenient to do without the stops; they can be easily removed if not required.

In the case of *division* of a number of two to five figures by a divisor of two to five figures—

Bring the divisor to F.

Set J or K to the number to be divided.

Bring 100 to F by use of the catch.

Read quotient at J or K.

Proportion, or "rule of three," is a combination of multiplication and division, and questions in this rule can be easily solved by use of the calculator. The instrument has other applications, for particulars of which I must refer those interested to the pamphlet to be had at Mr. Stanley's address.

As examples, I will give a few specimens of the kinds of calculation which a chemist would find this slide-rule useful for:—

Multiplication.—A precipitate of barium sulphate has been found to weigh 0.178 grm.; the factor for sodium sulphate is 0.6094, the product is obtained by the calculator in a very short time, strictly accurate to the *fourth* decimal figure; indeed, where required, a very close approximation can, in this case, be obtained of the fifth decimal figure. Working this example by pencil and paper, in the old way, in addition to the two factors, 14 figures would be written down before the product could be got by addition; but the time and trouble of writing these 14 figures is entirely dispensed with by using the calculator.

Division.—A sample lump of caustic soda weighing 5.565 grms. is dissolved in water and titrated by standard acid (1 cc. = 0.100 grm.), 42.85 cc. being required:— $42.85 \div 5.565$ gives the percentage of soda in the sample. The quotient, to the second decimal place, can be obtained in a very much shorter time by the calculator than by working out on paper, and, by use of the instrument, the writing down of some 29 figures is obviated.

Proportion.—Numerous examples might be given; but, if time is saved by the use of the calculator in multiplication, and also in division, *a fortiori*, in the combination of the two, time is also saved.

One case where the calculator will be found to save much time, is in that class of analyses where the constituents have been determined, say, in the wet state, and are to be calculated to the dry state. In an actual case a sample had the following constituents:—

In Original State.	Calculated to Dry State.
48.81	55.86
25.25	28.90
7.55	8.64
0.77	0.88
0.74	0.85
4.10	4.69
Moisture 12.60	..
99.82	99.82

In calculating the first item in the above analysis to the dry state, the proportion would be stated—

$$87.22 : 99.82 :: 48.81 : x$$

We find by the calculator the quotient got by dividing the first term into the second, viz., 1.1445, and leave the moveable pointer K at that quotient. Now bring round the muff or cylinder *d* till the third term of the proportion is opposite the fixed pointer F. The answer is read at the moveable pointer. To get the second item, in the dry state, simply move the muff till the graduation, 25.25, is opposite the fixed pointer and again read the answer at the moveable pointer; and so on through the analysis, it being only necessary to move the muff to bring the graduation of each fresh number opposite the fixed pointer.

I need scarcely say the description of the method of working takes up a much longer time than the actual working of the instrument itself does.

Another instance, which should come under the heading of multiplication, may be given:—Some 18 months ago, we had to determine the areas of a large number of liquor tanks and settlers; having measured the length and width, we found the calculator (with its table giving decimals of a foot) very useful for working out the areas.

Some may possibly say "You are comparing the instrument with old-fashioned methods of working chemical calculations. Why not use logarithms?" I must confess, frankly, that I was never enamoured with the use of logarithms; but, as I have tried them at two or three different periods, I am not biassed against their use. Recently, I worked a set of calculations with this calculator, against a chemist who regularly uses logarithms, he using his "logs." The result of the contest was decidedly in favour of Professor Fuller, both as to speed and accuracy.

Mr. HUGH BARCLAY made a verbal communication on a process for the ready and accurate determination of the loss of coal in coal-washing operations. He also gave a demonstration of the process, which depends on the separation of constituents of different densities by a liquid of intermediate density.

Nottingham Section.

UNIVERSITY COLLEGE, NOTTINGHAM.

Chairman: L. Archbutt.

Committee:

<i>F. Clowes.</i>	<i>E. W. Snall.</i>
J. B. Coleman.	H. J. Staples.
C. H. Field.	C. Taylor.
H. Forth.	Sir John Turney.
<i>E. Francis.</i>	J. T. Wood.
S. J. Pentecost.	

Treasurer: J. M. C. Paton.

Hon. Local Secretary:

R. L. Whitley, University College, Nottingham.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies, and will take office in July next:—*Vice-Chairman*: F. Clowes. *Committee*: F. J. R. Canulla, F. D. Mordle, and G. J. Ward.

SESSION 1892.

1892:—

May.—Mr. C. Spackman, "Notes on the Manufacture of Portland Cement from Lime Mud after Treatment by the Chance Sulphur Recovery Process."

Meeting held Thursday, February 10th, 1892.

MR. L. ARCHBUTT IN THE CHAIR.

ON AN IMPROVED FORM OF PIPECLAY TRIANGLE.

BY J. B. COLEMAN, A.R.C.S.C., F.I.C.

In the various supports used for holding crucibles and like vessels during heating, the following disadvantages are present:—

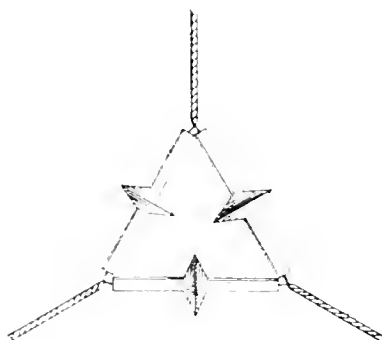
1. Platinum triangles on heating to a high temperature expand and soften, inducing "sagging." If platinum vessels are heated, partial fusion between the wire and vessel may occur. The expense also is considerable, and effectually precludes its use by all but advanced students.

2. The ordinary pipeclay triangle prevents contact of the flame, except at the three angles, particularly if the vessel to be heated is small, such as crucibles, &c.

3. Triangles made entirely of porcelain and fireclay are fragile and expensive.

The modification in the improved form of triangle shown in Fig. 1 consists simply in making a flange in the middle

Fig. 1.



portion of each of the three pieces of pipeclay forming the triangle. In this way contact takes place in three points

only, and thus leaves ample space for the flame to play upon the surface exposed. The result is that thorough contact between the flame and the vessel to be heated is secured. The effect of this improvement is to lessen the time of heating, and also to increase the temperature attainable from a given flame.

The following experiments show the advantages of the triangles. The flame used in these experiments was that from a Bunsen burner, the gas supply of which was regulated by means of a Stott's governor.

1. A platinum crucible was used and 10 cc. of water were gently heated to boiling, first in the improved and then on the ordinary form of triangle; the time required was carefully noted. Results:—

	Temp. of water, 21° 3' C.	Temp. of air (constant), 13° C.	Seconds.
Improved triangle.	Time required for 10 cc. of water.		45
Ordinary " "	" " " "		60
Difference in favour of improved triangle			15

2. (a.) A platinum dish was employed, 50 cc. of water were heated to boiling on both forms of triangle, and the time required noted. Results:—

Seconds.	
Improved triangle with 100 cc. water	65
Ordinary " " "	85
<hr/>	
Difference in favour of improved triangle.....	20

(b.) Into a porcelain dish 2½ in. diameter, 103 grms. of an alloy of lead and tin were introduced. The dish was heated until the alloy was thoroughly melted and the time required noted:—

	Min. Secs.
With improved triangle	2 20
„ ordinary „	2 50
<hr/>	
Difference in favour of improved triangle.....	30

Hence the gain in time was from 20 to 25 per cent.

3. In flat-bottomed vessels the results were not so good, but were slightly in favour of the improved form of triangle.

4. Experiments were also made in burning off organic matter. In some cases the time occupied was less than half that required when the ordinary form of triangle was employed.

To sum up, the triangle is cheap since it can be made in long lengths and cut up into suitable portions by means of a file, which are then threaded and bound together by iron wire in the ordinary way. It is strong, since the flange is made at the weakest point, that is, at the middle. It is economical, since a higher temperature and more rapid heating is obtained from a given flame.

In the experiments recorded above, ordinary pipeclay was used. The mould was made of hard wood, a smooth iron wire being used for the core. After the clay was moulded into shape the wire was withdrawn, and the clay dried in the steam oven, and finally heated for several hours in a muffle furnace and allowed to cool slowly. For use on a large scale polished steel moulds will be found suitable so as to admit of a greater length of pipeclay being made at once, which may after annealing be cut up into the required lengths.

DISCUSSION.

The CHAIRMAN exhibited a welded platinum triangle which he had used for many years. He found it an advantage to be able to alter the shape of the triangle to suit different sized crucibles. There was always a slight adhesion between the triangle and the crucible at a red heat, but even after heating in the blowpipe flame no transference of metal took place. It was, however, advisable to allow the triangle and crucible to cool down below redness before separating them; a slight touch was then sufficient. Mr. Coleman's triangle was a great improvement on the ordinary clay triangle.

A CONVENIENT FORM OF DISTILLATION FLASK FOR THE ESTIMATION OF AMMONIA IN WATERS, AND FOR OBTAINING WATER FREE FROM ORGANIC MATTER.

BY J. B. COLEMAN, A.R.C.S.C., F.I.C.

IN the estimation of "free" and "albuminoid" ammonia in water considerable difficulty in freeing the apparatus from ammonia gas is experienced. This is not so great if a retort be used as the distillator. But even in this case, in the adaptation of the neck of the retort it is necessary that the steam comes into contact with rubber-joints, unless the retort is small; since, if large retorts are used, it is necessary to draw out the neck so as to fit into the inner condenser tube, or a specially large condenser tube must be used. The apparatus then is somewhat cumbersome.

If a corked flask be used in place of a retort, the steam comes into direct contact with the cork, and with the majority of corks the supply of ammonia appear exhaustless. Analysts well know the value of a cork which is not a source of ammonia in the above operations.

By employing a distillation flask into the neck of which is fused a side tube fitted with a light, hollow, glass stopper, all the above objections are done away with. The stopper, when wetted, is perfectly steam-proof, even if the grinding is indifferent. The side tube passes several inches down the inner condenser tube, which is of just sufficient diameter to admit it, and so the rubber-joint is obviated, perfect condensation occurring without escape of steam.

The water or reagent may be added without disturbing the apparatus by simply taking out and replacing the stopper.

It will be seen that by employing large flasks, water free from organic matter can be conveniently prepared in this apparatus.

A SIMPLE METHOD OF CALIBRATING A DELIVERING PIPETTE.

BY PROFESSOR FRANK CLOWES, D.S.C., F.I.C.

The following will be found to be a simple and accurate way of estimating the capacity of a pipette, no stop cocks or other additional apparatus being needed.

The clean and dry pipette is first provided with an arrangement for closing the delivering end so that it may be weighed while it contains water.

This arrangement is effected by slipping a strip of rubber 4 in. long and $\frac{1}{2}$ in. wide over the lower end of the pipette, then drawing up the free ends on opposite sides under slight tension and binding them tightly with copper wire. The rubber now forms an elastic loop, with which the end of the pipette may be closed at pleasure. An india-rubber ring cut across answers admirably for this strip.

In the process of calibration the rubber loop is drawn aside and the pipette filled by suction. The pipette is allowed to empty and drain for half a minute, and the end being at once closed by the rubber band, is weighed at once. Distilled water at 15.5° C. is now introduced into the upper end of the pipette by means of a fine wash-bottle jet, until the graduation is reached. The pipette is now weighed again. The increase in weight should be equal to the weight of the registered number of cc. at 15.5° C. Should this not be so, a little water may be added or taken away by means of a piece of glass tube drawn out into a slender capillary.

Having adjusted the weight of water so as to correspond with the registered volume, the graduation is then made in the usual manner.

Professor Clowes also showed and described his apparatus for testing the sensitiveness of different forms of miners' safety-lamps when employed for detecting low percentages of inflammable gases in the air.

Meeting held Thursday, March 31st, 1892.

ON DUMAS' METHOD OF ESTIMATING NITROGEN IN ORGANIC BODIES.

BY JAMES O'SULLIVAN, F.I.C., F.C.S.

OF the methods employed to determine the quantity of nitrogen in organic compounds there is not one more favoured, and justly, than that of the absolute method of Dumas. This process entails more labour, and takes more time than any other, but this is compensated for by the faith which can be placed in the results obtained by it.

Dr. Frankland (Phil. Trans. vol. cxlvii. p. 59) in his classical researches "On the Substitution of Nitrogen for Carbon in Organic Compounds," experienced considerable difficulty in estimating the nitrogen in the substitution products. He employed Simpson's modification of Dumas' method and found it impossible to obtain the resulting gas free from considerable quantities of nitric oxide, although the gas was made to stream over 12 inches of copper. To obtain the absolute volumes of nitrogen and nitric oxide, a gas analysis apparatus had to be employed.

My experience with the absolute method proves that the gas obtained invariably contains an appreciable quantity of nitric oxide, and that the amount is not much influenced by the presence of the usual copper in the combustion tube.

The estimations of nitrogen in the undermentioned substances, except where it is otherwise stated, were not made to prove this, but were simply parts of an analytical process.

The combustion tube was filled as in Dumas' method; however, the bicarbonate of soda was dispensed with, as a Sprengel pump was in all cases employed to obtain a vacuum and to collect the resulting gases when the combustion was completed.

The copper oxide employed was prepared from copper wire cut in lengths of about 5 mm., and the copper was a roll of copper gauze 3 in. long, enclosed in a piece of sheet copper; this was oxidised and reduced by hydrogen prior to use.

The time taken to burn the extracts mentioned was in no case less than three hours, and the remaining bodies tabulated, being more difficult to burn, took about four hours. Arsenious acid mixed with the copper oxide, as advised by Strecker, did not have any influence in accelerating the combustion. A gas-analysis apparatus was employed in all cases to determine the absolute volumes of nitrogen and nitric oxide in the resulting gas which was collected over potash. The total volume of gas was first determined, and after the addition of an excess of oxygen in the presence of potash, the excess of oxygen was removed by a few drops of pyrogallin. The residual gas, being nitrogen, was then determined, and the difference between this quantity and that of the original gas gave the nitric oxide present, which was absorbed as nitric peroxide by the potash.

In Table I. is shown the maximum, minimum, and average percentages of nitric oxide in the resulting gas when copper was used in the combustion tube:—

TABLE I.

Number of Determinations.	Substance.	Percentage of Nitric Oxide on Total Gas.		
		Maximum.	Minimum.	Average.
6	Barley.....	9.81	3.56	7.38
3	Malt.....	11.70	4.37	8.20
2	Alcoholic extract of barley	8.00	2.73	5.11
5	Alcoholic extract of malt...	5.72	2.81	4.38
4	Insoluble residue of barley (grains).	4.20	2.62	3.06
5	Insoluble residue of malt (grains).	9.96	3.06	6.42

These numbers, to which many more obtained from similar bodies could be added, show that with all the substances burned, even though there was copper in the combustion tube, nitric oxide was present in the gas.

I have had considerable experience with Dr. Frankland's method of determining organic carbon and nitrogen in water residues and have never obtained a gas that did not contain nitric oxide although copper was always used.

It occurred to me, as my experience proved the invariable presence of nitric oxide in the gas, which had to be estimated, in all cases, that the copper might be discarded and a plug of asbestos substituted. This does away with the tedious process of preparing, by reducing with hydrogen, the oxidised copper, and it will be seen from Table II. that not much more nitric oxide is found in the gas thus obtained.

TABLE II.

Number of Determinations.	Substances.	Percentage of Nitric Oxide on Total Gas.		
		Maxi- mum.	Mini- mum.	Aver- age.
12	Beer.....	7.12	3.00	5.38
6	Barley.....	10.08	7.83	8.85
8	Malt.....	13.70	5.82	8.72
5	Alcoholic extract of barley.	14.90	7.00	9.95
10	Alcoholic extract of malt...	8.37	3.64	5.84
1	Insoluble residue of barley (grains).	4.20	2.62	3.06
8	Insoluble residue of malt (grains).	12.00	3.00	9.30

In order to show that the nitric oxide was not due to the substances being burned under a reduced pressure, as is the case when a Sprengel pump was used, I made a few determinations by breaking the vacuum before proceeding with the combustion of the substance. A longer combustion tube than usual was employed. About 0.3 grm. of cane sugar was placed at the closed end of the tube, which was then filled with the copper oxide and the substance, after which a much larger quantity of copper oxide was placed than usual. When the vacuum was formed, three to four inches of the front of the tube were heated to redness and then the end containing the cane sugar. As soon as the vacuum was broken by the carbonic anhydride the combustion was proceeded with in the usual manner. Four determinations of nitrogen in malt were made in this way, two without copper in the tube, one with copper, and one with a coil of silver foil instead of copper. The resulting gases contained the following percentages of nitric oxide on the total gas measured:—

	Per Cent.
No. 1, without copper.....	8.14
No. 2, ".....	9.55
No. 3, with copper.....	9.00
No. 4, with silver.....	8.49

Two determinations of nitrogen in uric acid were made without employing copper; in one the vacuum was broken by cane sugar and the following are the numbers obtained:—

	N.O. ₂ on Total Gas.	Nitrogen.	Theory.
	Per Cent.	Per Cent.	Per Cent.
No. 1, vacuum broken.....	5.15	Found 33.8	33.3
No. 2, " unbroken..	4.80	" 33.4	

I have observed that in the determinations of carbon and hydrogen in bodies containing nitrogen, especially when the substances were burned in oxygen, that the water in the

chloride of calcium tube tasted acid and had an acid reaction whether copper or silver was used in the combustion tube. This shows the presence of nitric peroxide in the gas which must be absorbed by the potash bulbs, and consequently increases the carbon number. Dr. Frankland, in the work already mentioned, observed that his carbon results were high, and ascribed this to the formation of potassic nitrite. (Frankland's Experimental Researches, 232.)

The quantities of the substances burned are not given here, nor the amounts of the gases obtained; however, the total gas measured in any case was not more than 0.04 grm., and not less than 0.008 grm.

In conclusion, my experience of the determination of nitrogen by this process shows that copper can be dispensed with, and as there is always nitric oxide in the gas the most accurate results are obtained by measuring the quantity of nitric oxide and nitrogen in the gas by means of a gas-analysis apparatus.

THE VOLUMETRIC DETERMINATION OF CALCIUM PHOSPHATE BY MEANS OF URANIUM SOLUTION.

BY J. B. COLEMAN, A.R.C.S.C., F.I.C., AND J. D. GRANGER.

In the volumetric estimation of calcium phosphate by means of uranium solution, it is stated by some authorities that to obtain correct results calcium phosphate in place of sodium phosphate must be used for standardisation.

To ascertain the relative accuracy of the two methods the same uranium solution was standardised, firstly, by means of sodium hydrogen phosphate solution, and secondly by means of calcium phosphate solution.

The method employed in all the determinations was the following: A solution of uranium nitrate, previously mixed with sodium acetate, was run into an acetic acid solution of the phosphate, also previously mixed with sodium acetate. The titration was performed at 80° C.

The end of the process was indicated when a drop of the liquid gave a faint brown colouration with a drop of potassium ferrocyanide.

It should be noted that an appreciable quantity of free acetic acid retards the formation of the colour considerably, therefore as little free acid as possible was used.

The sodium phosphate, $\text{Na}_2\text{HPO}_4 \cdot 12 \text{H}_2\text{O}$, used was twice crystallised and dried between filter-paper. It was analysed and found to contain 19.60 per cent. of P_2O_5 against 19.83 per cent. by theory, this difference being probably due to the presence of a little moisture.

The pure calcium phosphate was prepared by the addition of a solution of Na_2HPO_4 to an alkaline solution of CaCl_2 , the latter being kept in excess. The precipitate was washed and finally dried in the steam oven. It is stated that this precipitate varies in composition. Three samples were prepared by the above method. The P_2O_5 precipitated with ammonium molybdate and the precipitate dissolved in ammonia, and re-precipitated by means of magnesia mixture and weighed as $\text{Mg}_2\text{P}_2\text{O}_7$.

The percentage of P_2O_5 in the specimens were 46.93, 48.86, 49.59, whereas $\text{Ca}_3(\text{PO}_4)_2$ contains 45.82.

Since these numbers varied greatly, another sample of calcium phosphate was prepared by adding an alkaline solution of Na_2HPO_4 to a solution of CaCl_2 . This sample was analysed by the method mentioned above and found to contain 45.18 per cent. P_2O_5 .

A standard solution of calcium phosphate was next prepared, containing 2 grms. of P_2O_5 per litre, i.e. 50 cc. = 0.1 grm. P_2O_5 .

For this purpose 2.0164 grms. of calcium phosphate containing 49.59 per cent. of P_2O_5 were dissolved in a little nitric acid; the acid was then neutralised by ammonium hydrate and a slight excess of acetic acid added. The solution was then made up to 500 cc.

The standard solution of $Na_2HPO_4 \cdot 12 H_2O$ was made up by dissolving 10.203 grms. of the sodium phosphate containing 19.60 per cent. of P_2O_5 in water and making up to a litre; this solution therefore contained 2 grms. P_2O_5 per litre, and was therefore the same strength as the calcium phosphate solution.

A solution of uranium nitrate containing 35 grms. per litre was prepared and run from a burette into separate 50 cc. of the above solutions, in the manner described, with the following results:—

50 cc. of the calcium phosphate solution required 19.80 cc. of uranium solution.

50 cc. of the sodium phosphate solution required 20.85 cc. of uranium solution.

Thus the uranium solution, if standardised by sodium phosphate, would give too low results when used for estimating calcium phosphates.

Thus if the calcium phosphate contained—

50 per cent. of P_2O_5 the error would be 2.51 per cent.

10 per cent. of P_2O_5 the error would be 0.50 per cent.

The uranium solution (standardised by means of calcium phosphate) was then contrasted against the gravimetric process for estimating phosphates. For this purpose analyses were made with samples of calcium phosphate, first by precipitating by ammonium molybdate, and finally estimating as $Mg_2P_2O_7$ and also by titration with uranium solution.

The following results were obtained with two samples of calcium phosphate:—

Percentage of P_2O_5 found.	Calcium Phosphate (1).	Calcium Phosphate (2).
Uranium method	47.16	45.16
Gravimetric estimation	46.93	45.18
Difference	0.23	0.02

The above results show that to obtain correct results in volumetric determination of calcium phosphate, by means of uranium solution, (1) the uranium solution must be standardised by means of calcium phosphate; (2) the percentage of P_2O_5 in the calcium phosphate used for standardisation must be estimated gravimetrically.

Also, sodium phosphate cannot be used for standardisation as the results will be low, especially if the proportion of calcium phosphate is considerable.

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Hon. Local Secretary:

H. R. Procter, Yorkshire College, Leeds.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next: Committee: J. B. Cohen, F. W. Richardson, G. W. Slatter, and J. B. Wilkinson.

Notices of Papers and Communications should be addressed to the Hon. Local Secretary.

Meeting held Monday, April 4th, 1892.

MR. GEORGE WARD IN THE CHAIR.

NOTE ON THE TECHNICAL ANALYSIS OF GAMBIER, &c.—No. 2.

BY H. R. PROCTER, F.R.C.

Lecturer on Leather Industries, Yorkshire College, Leeds.

At the time of writing the Preliminary Note on the Analysis of Gambier, which appeared in the Journal of Aug. 1891 (681), it was anticipated that at an early date a report might be made recommending a method for general adoption. This has not proved possible for various reasons. In the first place, a communication has been received from Director Eitner, of the Vienna *Versuchsstation für Lederindustrie*, in which he declines for the present to take part in the establishment of any standard method, on the ground that he is dissatisfied with all those at present in use, and that he hopes before the close of the year to complete investigations which will give a new basis for such estimations. Having regard to the previous contributions of the Vienna Station to the technology of leather manufacture, and to its wide influence among leather chemists, it is clear that it is of no use to attempt to anticipate the publication of Director Eitner's results by any convention based on present methods. Another reason for delay is that lack of time, and the complications of the problems involved, has prevented the writer from giving the investigation which they demand to several points named in his previous communication. Some progress has, however, been made, and it seems worth while briefly to describe the methods now in use at the Yorkshire College, not as final or perfect, but as giving constant and reliable results without unreasonable expenditure of time.

The question of the estimation of catechin in gambier as apart from catechutannic acid, is reserved for further investigation; together with the equally important one whether it must be regarded by the tanner as a valuable or injurious constituent. It is undoubtedly the cause of a troublesome "disease" of leather known as "the whites." When gambier is dissolved hot, and added in large quantities to cold liquors, a portion of the dissolved catechin is generally precipitated in an amorphous form, as has been pointed out to me by Mr. Bertram Hunt; but under some imperfectly understood conditions, of which gradual cooling of the liquor in cold weather is possibly one, the supersaturated

solution deposits crystalline catechin, either in the interior, or on the surface of the hides, forming unsightly white blotches, which are only removed with some difficulty by handling in warm liquors. The nature of the defect has been recently investigated in the Leather Industries Laboratory of this College, and it has been found that the appearance of the white matter is distinctly crystalline under the microscope, and that when portions are scraped off and dissolved in hot water, and allowed to crystallise on a micro-scope slide, the crystals formed are identical in their appearance and reactions with those obtained direct from gambier. Some gambiers are much more apt to produce this defect than others, probably from their higher percentage of catechin, and as this substance is easily converted into uncrystallisable gambier-tannin by exposure to heat, it becomes a question of importance whether gambier would not be improved for use in tanning by such treatment. Cube-gambier, which contains the highest percentage of catechin, and which is hence most apt to cause "whites," would have its catechin converted completely into tannin by drying at a temperature of 120° C., say on the top of a steam boiler.

The following are the details of the method at present employed.

Sampling.—With regard to block-gambier, it has been found practicable to sample satisfactorily, either by cutting slices through the blocks, or by the use of a tubular sampling tool like a large cork borer, fitted with a wooden plug or plunger to force out the cylinders of gambier. It is desirable that this tool should be long enough to pass completely through the block, or in withdrawing it, a good part of the cylinder which is cut is apt to be expelled by the pressure of the air, which cannot find its way down the sides of the tool. Probably a common tin pea-shooter might be used successfully as a makeshift. In any case, the whole sample drawn from several blocks must be at once thoroughly kneaded up into a single homogeneous mass, and enclosed in a bottle or tight tin, to prevent loss of moisture. Such samples soon become mouldy on the outside, which might possibly be prevented by the use of a few drops of turpentine, or some other volatile germicide in the bottle, but the interior of the sample is only very slowly affected. The sampling of other tanning materials calls for no special remark, except that in preparing various hard fruits, such as valonia and myrabolams for grinding in small mills, the use of a heavy short-handled hammer, on a thick metal plate, surrounded on three sides with raised ledges to stop flying fragments, as proposed by Mr. A. Neubald Palmer, is very convenient.

Quantity of Material employed.—It was mentioned in the previous note that while at the Vienna Versuchsstation such a quantity of tanning material was employed as to give a solution containing 1.0–1.2 per cent. of dry extract, Professor von Schroeder and Dr. Koch used solutions containing only from 0.2–0.5 gm. per 100 cc.; and other chemists solutions of intermediate strength. At the Yorkshire College, solutions of 0.6–0.8 gm. of dry extract per 100 cc. are used. This medium strength has been chosen, not only as giving results not very divergent from either of the extremes, but as being practically more convenient than either, lessening, on the one hand, the objectionable evaporation required with many materials, to obtain the necessary concentration for the Vienna method, and the amount of hide-powder used, and on the other, the serious errors introduced by solubility of hide-powder, and small inaccuracies of weighing, in working with extremely small quantities of substance. It is argued by the advocates of stronger infusions that only liquors of such strength as can be practically employed in tanning should be used; the strength of 0.6–0.8 per cent. can scarcely be objected to on this ground, since in 256, 100, of the *Gerber*, the organ of the Vienna Versuchsstation, the strengths of 18 Austrian handler-liquors are given which all range below 0.6 per cent., and equally weak liquors are used for certain purposes in this country. Conversely, it is pointed out by Von Schroeder, that certain tanning colouring matters are only soluble in much water, and that chemists should endeavour to estimate the whole tanning substance present.

To this it may be replied, that with many materials no practical amount of water will keep the whole of these bodies in solution; and that there is no need to estimate more than will dissolve in liquors of practical strength, as a large percentage is generally rather injurious than beneficial to the tanner on account of their dark colour.

In order to obtain infusions of the strength named, approximate quantities for the following materials are given below:—

	Per litre.
Cutch, cube, gambier, and dry extracts, algarobilla, galls.....	8 grms.
Block gambier, divi-divi, valonia, myrabolams, mimosa.....	10 "
Sumach, canaigre, liquid extracts, mangrove bark.....	15 "
Angica bark, Persa bark, "Gambia" pods.....	20 "
Babool bark, quebracho wood, cork bark.....	30 "
Oak, hemlock, and larch bark.....	40–50 "

Preparation of Infusion.—**Extracts.**—The weighed quantity is dissolved in nearly boiling water, made up to about 1 litre, and cooled rapidly under the tap, the neck of the flask being covered with a small beaker, as the stopper is apt to stick. When cooled to 15° C. it is made up exactly to the mark and at once filtered. At the suggestion of Dr. Robert Hellon, Schleicher and Schull's pleated hardened filters No. 588 of 1½ cm. diameter are used for this purpose, and generally give at once a clear filtrate. If not, the first portions must be rejected. As some chemists have stated that tannin is absorbed by paper, the first 100 cc. filtered is used for the hide filter. Gambier is treated in the same way, with the exception that water of about 80° C. is preferable to boiling, as it dissolves the tannin just as completely, but gives an infusion which filters more readily. The gambier is dissolved in a beaker with successive quantities of the water, settling and pouring off the solution from the undissolved part till it is practically colourless. Dr. Hellon uses a von Schroeder's extractor, which is very convenient if at hand, as the coarser particles cannot pass through the muslin on the piston until dissolved or reduced to a fine state of division, and the insoluble matters are left behind in a state very suitable for examination. The same end would be attained by filtration through muslin.

Solid materials such as barks, valonia, &c. are best exhausted in the extractor devised by Dr. Koch of Leipzig, or in the somewhat simpler modification used by the writer. In its original form this apparatus consists of a flask fitted with an india-rubber cork with two perforations. One of these carry a short glass tube which does not project into the flask, and which can be connected by means of rubber tube, with a supply of distilled water on a shelf 4 or 5 feet above it. Through the second hole passes a tube, long enough to reach the bottom of the flask, and slightly widened at the lower end, and covered with a piece of silk gauze such as is used for dressing flour. The upper end of the tube is connected with a short piece of rubber tube provided with a screw pinch-cock (the food regulators supplied by druggists for use on babies' bottles answer very well). In use, a layer of dry sand purified by hydrochloric acid of $\frac{3}{4}$ in. deep is put in the bottom of the flask, and the material to be extracted is introduced by means of a wide funnel; the filter tube is passed down through it into the sand, while at the same time water is drawn into the flask, by immersing the short rubber tube in a beaker, and sucking at the longer one, which is afterwards connected with the raised water-bottle while the infusion is allowed to drop slowly into an empty flask from the shorter tube. The cork is secured with string or a special clamp. The apparatus forms, in fact, a simplified Real's press, with the advantage that it can readily be placed in the water-bath for hot extraction. Its most serious disadvantage is that, the filtering area of the gauze being small, it is easily choked by finely-powdered materials, and is extremely difficult to clear without taking the apparatus to pieces. It is also a little troublesome to fill.

To avoid these difficulties the following modification has been devised by the writer, with very satisfactory results. As no particular advantage is gained by working under

pressure, an ordinary open beaker is used as the extracting vessel, a common thistle-head funnel is bent twice at right angles to form a syphon, and the head is covered with gauze. This is placed on the bottom of the beaker and held in position by an ordinary retort stand clamp. A layer of purified sand is poured in to the depth of half an inch or more, and then the tanning material for extraction, either dry or after digesting overnight in a flask or beaker with, say, 200 cc. of water. I purpose trying whether exhaustion of the air under an air-pump at this stage will not assist the water in penetrating the material. The outer arm of the funnel is now connected with about 30 in. of small rubber tube fitted with a pinch-cock, and the syphon is started by sucking, and allowed to drop slowly into a flask placed below to receive it. If it be desired to extract at any temperature above that of the laboratory, the beaker is placed in a water-bath which is large enough also to contain a flask of water which is used to refill the extractor as it becomes emptied. In case it is found that one litre of water is not sufficient fully to exhaust the material, it is generally best, after about 800 cc. has been passed, to change the receiving flask, and continue the exhaustion till complete, afterwards concentrating the later washings by boiling in a flask with a funnel in the neck, until they can be added to the first 800 cc. In this way only the last remnants of tanning matter are exposed to the possible injury of evaporation. It is sometimes of interest, especially when the extraction is made first at a low temperature and then at a higher, to keep the two extracts separate, and after concentrating the last sufficiently, to make a separate determination of its tanning matter.

It has been shown by Messrs. Seymour-Jones and A. N. Palmer, that many if not all materials will yield a larger amount of tannin at lower temperatures than if extracted throughout at a boiling temperature, and the whole question of temperature in extraction is one which will evidently pay for investigation.

Removal of Matter absorbable by Hide.—After careful comparison between the various digestion methods, and the use of the hide-powder filter, I have come to the conclusion that the latter is not only the most rapid and convenient, but gives the most accurate and constant results, and the most complete absorption of any method which has yet been proposed. In this investigation I have been rather prejudiced against than in favour of the filter method by the fact that it was my own invention. In comparing it with various methods of digestion and percolation, I have noticed that the figures given by the filter were a limit towards which the other processes tended the more nearly the more completely they were carried out, but which they never passed. In all cases which I have compared, the hide-powder filter tends to more complete absorption, and consequently higher results in "tanning substances." The greatest difficulty in the use of the filter in the form given it by the Vienna research station, is that, in spite of the upward filtration, the infusion has a great tendency to pass up the sides of the glass rather than through the hide-powder, so that the inner part of the powder is practically inoperative. This difficulty is largely overcome by the form at present in use at the Yorkshire College, in which, instead of a cylindrical tube about 1 in. diameter and 4 in. long, and holding about 9 grms. hide-powder, the upper part of an ounce bottle is employed, forming a bell-shaped vessel about as wide as it is high, and holding only about 6 gm. of the lightly-packed hide-powder. The syphon tube, of about 9 in. in the longer limb, is allowed to project about $\frac{1}{2}$ in. through the cork, and is plugged with a small tuft of cotton wool, while the powder is retained in position by a piece of muslin held by an elastic band. The general arrangement is very similar to that of the syphon extractor above described, the filter being placed in a tumbler and the liquor added gradually, allowing it to wet the powder by capillarity. This is easily done in less than an hour, when the syphon is started by sucking, and drops very freely. The first 30 cc., which contain most of the soluble matter of the hide, are rejected, and the next 50 cc. used for evaporation to give the "soluble matter not tanning."

Evaporation and Drying.—Portions of 50 cc. each of the infusion before and after passing through the hide-powder filter are evaporated to dryness on the water-bath, and are then dried for 10 minutes in an air-bath at 110° C., cooled in the desiccator and weighed, and again dried for 10 minutes, when the weight will usually be found constant. Long drying is not advisable, as the residues gain in weight through oxidation. Three-inch porcelain basins are generally used.

Water is determined on a separate portion of the original material by drying at 110° C. In the case of block-gambier and liquid extracts, the quantity used should not much exceed 1 gm., and should be spread over the sides of the crucible to expose as much surface as possible, or the drying will be very slow. The temperature chosen has been found to admit of rapid work without danger of decomposition of the tannins. Any catechin present loses its first molecule of water of combination and is converted into catechutannic acid. This also takes place at 100° C., but with such extreme slowness as to render any determination very tedious.

Ash.—It is generally advisable to determine the ash as a check on adulteration and means of distinguishing the character of certain extracts; but it cannot be added into the analysis, as it is partly present in the soluble and partly in the insoluble residues, and its separate determination involves an amount of trouble which is hardly justified by the result.

Calculation.—The amount of extract after hide filtration deducted from the "total soluble extract" gives the "tanning matter absorbed by hide" (which of course includes colouring and other matters which are not strictly tannins). The "total soluble extract" deducted from the dry substance found in the water determination, gives the "matter insoluble in cold water." The extraction and determination of "tannin matter" are of course always done in duplicate, and give results generally differing only by the fraction of 1 per cent. in materials where accurate sampling is possible. This may be illustrated by a series of "oakwood" extracts taken as they occur in the laboratory book without selection.

	A.		B.		C.	
Total soluble extract..	41.3	41.3	34.9	35.0	35.2	38.4
Soluble, not tanning ..	14.1	14.1	4.8	4.7	4.9	15.1
Tanning matters	27.2	27.2	30.1	30.3	30.3	23.3

	D.		E.		F.	
Total soluble extract..	38.1	37.2	41.0	41.5	39.9	39.2
Soluble, not tanning ..	4.8	4.9	13.0	13.4	10.4	9.4
Tanning matters.....	33.3	32.3	28.0	28.1	29.5	29.8

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Hon. Local Secretary:

J. Stanley Muir, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next: Chairman: C. A. Fawsitt. Vice-Chairman: E. J. Mills. Hon. Secretary and Treasurer: J. Stanley Muir. Committee: G. Beilby, W. J. Chrystal, J. S. Macarthur, T. L. Patterson, E. C. C. Stanford, and G. Watson.

Meeting held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, April 5th, 1892.

MR. E. C. C. STANFORD IN THE CHAIR.

THE "DRY HEAT" VULCANISATION OF RUBBER, WITH SPECIAL REFERENCE TO THE USE OF AN IMPROVED VULCANISER.

BY CHARLES A. FAWSITT, F.R.S.E., F.R.S.

For the vulcanisation, or as it is technically termed, the "curing" of rubber, four processes are in use, namely, the steam, dry heat, cold cure, and vapour processes.

The "steam" process is used almost exclusively for all goods termed "mechanicals;" and the goods to be cured are packed, either unprotected, or wholly or partially covered, into large iron vessels into which direct steam is turned until the pressure corresponding to the temperature necessary for the proper curing of the goods is reached, and is continued for a time, which varies according to quality, thickness, &c., of the goods. The "dry heat," "cold cure," and "vapour" processes, are principally used in the curing of waterproof cloth.

The "dry heat" consists in mixing the rubber with a small percentage of sulphur and other ingredients, and "curing" the cloth spread with such a mixture in a stove or air chamber heated by pipes or chambers through which steam or hot air circulates.

The "cold cure" process consists in exposing the rubber composition which has been spread on the cloth to the action of chloride of sulphur dissolved in bisulphide of carbon or other solvent.

The "vapour" process consists in exposing the goods which are to be cured to the action of the vapour of chloride of sulphur alone or mixed with nitric acid in large chambers, or merely by passing the proofed side of waterproof cloth over vessels in which the same reagent is slowly evaporated.

I shall, in what remains of this paper, treat almost exclusively of the curing of waterproof cloth, or, more correctly speaking, of the film of rubber which renders the cloth waterproof.

At present there is a revolution taking place in the rubber trade, so far as the vulcanisation of waterproof cloth

is concerned, in favour of the "dry heat" versus the "cold cure" process; and, considering the usual disinclination of manufacturers to depart from old methods, it has come with extraordinary suddenness, so much so, that it has caused consternation amongst the manufacturers of bisulphide of carbon and chloride of sulphur, whose business will suffer very severely unless new outlets are discovered for their products.

Until within the last two years the majority of rubber manufacturers used the "cold cure" process almost exclusively for the production of single and, to a considerable extent, in that of double texture waterproof garments, and as it was a process which had been gradually developing and increasing for years, its discontinuance was all the more surprising.

In Scotland the manufacturers have all adopted the "dry heat" process, but in England matters have not so far advanced in this direction, as some of the leading firms still cling to the "cold cure" as the safest and best process, but no doubt they will be forced to partially adopt it, as "dry heat" goods are now specially asked for.

The "dry heat" process has been very largely and successfully applied in America, and I think the Americans are to be congratulated as the first to thoroughly work it out, and it is mainly through their experience that manufacturers have been persuaded to adopt it in this country.

Perhaps, before we proceed further, it would be as well to look at the reasons which have brought about this change of front on the part of rubber manufacturers; and I think this can best be done by stating in a few words the advantages and disadvantages of each process. The advantages of the "cold cure" process were:—1st. The production of what is called a "transparent" proofing, which was and still is, though perhaps in a lesser degree, prized for single texture garments. 2ndly. The speed and cheapness of the process compared with the "dry heat." What I mean by cheapness here has nothing to do with the composition of the proofing, merely the cost for curing. 3rdly. The non-efflorescence of cold-cured goods, which is of much importance, and the reason of which has not been satisfactorily explained. Digressing for a moment, I shall mention one or two points in connexion with efflorescence which may be of interest. How is it that in cold-cured rubber we can have, say, 9 per cent. of sulphur present without efflorescence, when in the "dry heat" process 2 per cent. is dangerous? Some may say it is accounted for by the rubber never having been heated above the melting point of sulphur, but I tested this idea by heating pieces of cold-cured rubber containing more than 6 per cent. of sulphur above its melting point, but found no efflorescence. The following may be a possible explanation:—Some time ago a paper was read before the British Association by Thomson (1890, p. 785), in which he stated that when rubber was cold-cured it contained not only sulphur, but chlorine, the latter element being almost invariably double of the former. Now it occurred to me that the non-efflorescence of cold-cured might be accounted for by the sulphur and chlorine existing together in the rubber in combination.

Of course it might be advanced as a reason against such a theory that the greater part of the sulphur can be extracted with bisulphide of carbon, which fact I mentioned in a paper read before this Society (Jour. Soc. Chem. Ind. 1889, 368), but although such is the case, may not the chlorine be extracted at the same time and which would no doubt be the case if it existed as a compound. I am sorry at not having proved or disproved this idea, but want of time has prevented me.

Now, as regards the disadvantages of the cold-cure process:—

1st. The chief cause which led manufacturers to embrace the "dry heat" process, was the loss occasioned by damaged goods when using the cold-cure process, and the damage often arose from causes which, apparently, could not be explained. The blame was usually put upon the oil contained in cloth, but I think this was only occasionally the real cause, and my sympathy was often on the side of the cloth manufacturers, who usually, rather than lose a customer, paid the claim put upon them. No doubt

manufacturers often made mixings which were very unsuited for this process, but naturally preferred to throw the blame on other shoulders.

2ndly. The injurious action of the vapour of bisulphide of carbon on the workmen employed in attending to the "curing" machines. In some works this is reduced to a minimum and is not urged as an objection, but it is not the case in the majority of manufactories.

3rdly. It is put forward by the majority of firms that cold-cured goods do not stand hot or cold climates so well as could be desired, the strong light combined with the heat and perspiration from the body, exerting a powerful decomposing action in hot climates. The light is, I think, the chief agent in bringing about the mischief.

4thly. It is not possible to adulterate the rubber so easily when using chloride of sulphur as the curing agent, which in these days of low prices is of great importance.

My experience so far has been that a piece of rubber cold-cured properly, is the most perfectly vulcanised of any made, but the conditions which ensure say of a piece of sheet being so cured, are perhaps not possible in the case of proofed cloth, at any rate not easily attainable.

The advantages of the "dry heat" process are mostly implied by the disadvantages of the cold-cure process just mentioned, for—1stly. There is comparatively little claim for damaged goods, and cloths can be used containing a proportion of oil which would be inadmissible in the cold-cure process. Now, although the damage arising from the action of the cloth on the proofing is in the dry heat much reduced, yet it must not be inferred that it is entirely absent, as it is noticed with poor quality of black and brown cotton cloths that 12 months is about sufficient to cause the decomposition of good proofing. This is due to the mordants and dyes used. 2ndly. The use of bisulphide of carbon is avoided. 3rdly. The proofing is said to stand extreme heat and cold better than that made by the cold cure. 4thly. A cheap proofing can be worked.

As regards the disadvantages of dry-heat process, we have—

Firstly. The danger from efflorescence which has been the chief cause of complaint against manufacturers; and as black paramattas are coming more into fashion, this is a point of much importance.

Secondly. The large amount of stove space required to turn out a large quantity of waterproof cloth.

Thirdly. The cost per yard for curing is double that of the cold cure; no doubt this is made up for by being able to use a cheaper proofing, but it is a point in favour of the older process.

Fourthly. The non-possibility of producing "transparent" proofing which is distinguished from ordinary "dry heat" proofing by its softness and elasticity as well as its transparency.

It may be asked why not use the "steam" process for curing waterproof cloth when it is used for other goods; and the answer is that although it would cure the rubber well and with less danger of efflorescence than with "dry heat," yet it is fatal to the colours of the cloth and also to the cloth itself. Before the "dry heat" process came in, it was used, but never to a large extent except for black and white sheeting.

What is the "bon ideal" of a vulcanised process for waterproof cloth? This question is difficult to answer satisfactorily, but I should say it would be fulfilled by a process which in the shortest time and at the lowest temperature, consistent with a sound vulcanisation, would produce a proofing which would stand the hottest and coldest climates, and not effloresce, and at the same time could without unusual difficulties be produced at a cost which would enable manufacturers to use it even for cheap goods.

When manufacturers who had been accustomed to work with steam and cold-cure processes began to face the "dry heat" process, a few difficulties presented themselves, which were not easily overcome. For instance, if you take a piece of rubber mixed with 4 per cent. of sulphur, and heat to 250° F. in a "dry heat" stove, it becomes soft and unfit for use, but if the same piece were steam-heated it would cure up satisfactorily. To overcome this, quite a different

class of mixings had to be arranged to satisfy each quality of proofing. Again, the difficulty of avoiding efflorescence and at the same time get a satisfactory vulcanisation caused considerable trouble, and the experience was often gained through the loss of custom, because time is the factor which tells most forcibly as a test on rubber goods. Again, buyers who had been accustomed to purchase the finely-finished transparent garments with a velvety feel, and good elasticity did not readily take to single texture goods with dark proofing, and not so soft to the touch and with less elasticity. Of course, for light cloths it is not of great importance to avoid efflorescence, but for black or dark cloths it is necessary to avoid it completely. This efflorescence could be avoided by using a high temperature or a long-continued heat, but then the cloth suffered. In fact woollen cloth is found to "tender" slightly at 240° F., hence the importance of using a low heat and short time, both being consistent of course with a sound proofing. With ordinary "dry heat" proofing we cannot look for a lower temperature than 238° F., as sulphur melts at that heat; and anything below this is of no use; hence the obvious necessity of bringing up the heat of the stove as quickly as possible to this temperature. As regards the duration of the heat, it altogether depends on the composition of the proofing, but, as a rule, however, for good proofing 1—2 hours at 240°—245° F. reckoned from the time the temperature reaches 240° F. is about what is required.

The management and construction of the stoves requires considerable practical knowledge. Steam at 10 lb. pressure would be more than sufficient to produce a temperature of 238° F., assuming that no heat was lost by radiation and convection, but for large stoves nothing less than 60 lb. is used, and it is more economical to work with a still higher pressure, as the heat can be brought up more quickly to the melting point of sulphur, and so more work can be got out the stove in a given time.

About two years ago my firm was asked for a vulcaniser which would be suitable for the production of transparent proofing by the "dry heat" process, and as I thought such a thing quite feasible I had a series of trials conducted, which resulted in the production of a vulcaniser which answered the purpose, and has been found to be useful, not only for that special class of work, but also for other purposes which had not been anticipated. After completing the laboratory trials, the North British Rubber Company, who have had the longest experience in the "dry heat" process of any firm in Great Britain, kindly undertook the practical trials, and under the superintendence of Mr. A. Douglas have, during 1891, carried them to a successful issue, in so far that they have proved it suitable for the production of "transparent" proofing, and also have introduced it into the manufacture of other goods, such as fishing stockings.

Through their kindness, I am able to show you to-night samples of some of the goods which they are now producing, and the more important of which are the pair of fishing trousers which Mr. Douglas got made for his own use last October, and, although they have been in use since that time, are in very good order; also a new pair of fishing stockings, which show very well the nature of the proofing. The colour you will notice is odd, and can no doubt be improved, but what is wanted in these goods is a good tough proofing, irrespective of appearance. I am informed, moreover, that these stockings if damaged can be repaired, which is a special property. We have also two samples of transparent proofing, which serve to show the results which can be obtained in this direction.

I had hoped Mr. Douglas would have been present to-night to explain the chief points of difference between these sample goods and those made by other processes, but as he was prevented from coming he wrote to me, and, after giving a list of the articles, he goes on to say, "The fishing goods are spread with pure gum, with 4 per cent. of patent vulcaniser. They are heated for two hours, 50 minutes of that time being at 240° F. The rubber is exceedingly tough, more so than it would be by any other process, and the short and low temperature reduce the risk of tendering the fabric very considerably."

The two "transparent" samples are spread with the same gum as the fishing stockings. The silk one was spread July 1891, and vulcanised three-quarters of an hour at 240° F.; whilst the union silk was spread last week, and heated one hour 240° F. This gum, more particularly in very light spread goods, has a very soft and agreeable feel, and looks well, but I am afraid the high price of your patent vulcaniser will seriously interfere with its adoption by manufacturers for the single texture waterproof garment trade, which is to be regretted, as I consider it the best form of vulcanisation at present known for these goods."

I have here also samples of coloured sheet-rubber, kindly prepared for me by Messrs. W. Warne & Co., which contain only 2 per cent. of vulcaniser. The vulcanisers used in these trials were the iodides of the heavy metals mixed with sulphur.

In my patent I claim all iodine and bromine compounds, but so far, have found those of the heavy metals to give the best results. The addition of sulphur was found to be necessary, as without it it was impossible to obtain good results.

The points which were forcibly brought out during the trials were:—1st. The very small percentage of compound which was necessary to ensure complete vulcanisation. The iodide could be reduced to 1½ per cent., whilst the sulphur was 2 per cent., and you can well understand that 3½ per cent. of compound would not affect, to any extent, the transparency of the rubber. 2ndly. The low heat required for complete vulcanisation. This seems a very important point, as most manufacturers experience great difficulty in getting a satisfactory "cure" at a temperature which does not injure the cloth. The extreme sensitiveness of the vulcaniser to heat caused a little trouble at the commencement of the trials, as they were conducted too much on the lines of the ordinary "dry heat" mixings. I remember the first trials which were made had as much as 15 per cent. of the iodide and 6 per cent. of sulphur, and the astonishing thing was, that these samples cured at 200°–205° F., considerably below the melting point of sulphur, which was very unusual, and proves that whatever action takes place it does so in a manner quite different from the ordinary process in which no action is apparent below 238° F., although a considerable proportion of the "curing" agent is present. Of course when using such a high percentage of the vulcaniser you can naturally imagine that a large proportion remains unexhausted, and is ready to still further affect the rubber. This was proved by heating a piece of such rubber to 240°–245° F. for but 39 minutes, when it became quite hard. The property possessed by this vulcaniser of exerting a curative effect considerably below 238° F., although of little practical importance at present, may at some future time receive useful application. 3rdly. The quickness of the cure was rather surprising, as one half hour was sufficient when using 3 per cent. vulcaniser and 2 per cent. sulphur, and when using a high percentage along with a high temperature the "cure" was effected in a few minutes. With 15 per cent. ten minutes at 250° F. would suffice.

A quick cure is regarded by some rubber authorities with suspicion, and, I think, naturally, as the ordinary method employed, and which must force itself upon the mind for comparison, does not cure under two hours at 238° F. I found that with this new compound it was safest to use a small percentage and lengthen the heat, but an hour seemed sufficient for all ordinary purposes, using say 2–3 per cent. with 2 per cent. of sulphur. With these proportions the curing agent seems to be exhausted after one hour's heating. To prove this, a piece of mixed rubber was cut into two pieces: one was heated for one hour at 240° F., and the other for five hours, when they were both equally cured, showing that with the extra three and a half hours heating no further effect was produced. The fact of the vulcaniser curing so quickly and at such a low temperature is a saving, in that more work can be got out of a stove in a given time, which is of considerable advantage in the "dry heat," as large stoves are required to put through a large quantity of cloth.

The continuous stove patented by Waddington, and worked by Messrs. Charles Macintosh & Co. and others, through which the cloth is slowly drawn, ascending and descending many times before it is finally wound upon a roller on the outside, seems to be a move in the right direction, as by this system the cloth can be tested occasionally, and the speed of the rollers regulated according as to whether the proofing is over- or under-cured; it also prevents the creasing and marking of the proofing, which is a common occurrence in ordinary stoves. This system of curing would be specially applicable when using this new vulcaniser, seeing it is more sensitive to heat than that used for ordinary work.

Whilst working with this vulcaniser a difficulty presented itself which caused some trouble, although a simple remedy was found to obviate it. When working with woollen and almost all kinds of union tweeds, the proofing cured up quite satisfactorily, but when working with cotton cloths containing black and brown dyed yarn the proofing became tacky and refused to cure quite satisfactorily. It was very noticeable with, say, a piece of black and white check cotton cloth, because wherever the proofing was upon the black squares it was soft and under-cured, but upon the white squares it was quite cured, and in every respect satisfactorily. Seeing that black woollen cloth was free from this peculiar action, it could only be caused by the different manner in which the dyes were fixed in the two cases. In the case of the cotton, the mordanting material was thought either alone or in combination with the dyestuff to cause the mischief. It being difficult to tell what colours were to blame in cloths containing many colours, I procured cotton-dyed yarn of different colours, and got them knitted into strips, which were then spread with rubber dough containing a proportion of vulcaniser which was known to be more than sufficient to cure it. After curing for two hours at 240°–245° F., the proofing on the white, blues, drabs, and certain shades of brown was quite vulcanised, but on the black and dark browns it was under-cured.

As the black cloth had caused the most trouble, attention was specially directed to it, to find out, if possible, the cause of this action. In the first place the opinion of an experienced dyer was taken as to the probable process used in dyeing the yarn. After a critical examination he reported that the mordant was iron liquor, the "prepared" tannin, and the dye logwood. Three pieces of white cotton cloth were next taken, and after well scouring and drying treated as follows:—

No. 1	soaked in a solution of iron liquor.
" 2	" " " tannic acid.
" 3	" " " logwood.

They were now dried and spread with rubber dough of same composition as that previously used. After drying they were cured two hours at about 240° F., and it was found that in each case the proofing was sound, so separately the reagents did not interfere with the curing. Next, three pieces of cloth were taken, scoured, and treated as follows:—

No. 1	dipped iron liquor, afterwards tannic acid.
" 2	" " " logwood extract.
" 3	" " " then tannic acid, then logwood extract.

After drying they were spread with rubber dough and cured as before, when No. 1 cured, but not Nos. 2 and 3, proving apparently that it was the compound produced between iron oxide and colouring matter of the logwood which accounted for the mischief. Want of time prevented me from going further into the matter, and trying if possible to find what the cause of this action was, i.e., how could this dye compound so influence the iodide or the mixture of iodide and sulphur as to retard its curative action. It almost looked as if the dye compound so affected or combined with the sulphur as to render it less available for the iodide, as the addition of extra sulphur was found to be an antidote as regards the curing, but was inadmissible when working with black cloth because of danger from efflorescence. It was suggested, as a probable explanation, that the tweed cloths which are usually sold might contain some of the

mordant unwashed out, or greasy matter, so pieces of such cloths, containing a good admixture of black and brown were treated as follows:—

- No. 1.—Treated three times with ether, to remove grease.
- No. 2.—Boiled three times in water.
- No. 3.—Boiled weak acid, then water.
- No. 4.—Boiled weak alkali, then water.

After drying they were spread and cured two hours at 240° F., but the proofing was useless, which disproved the theory of grease or mordanting material being left in the cloth.

It has long been known that copper and certain of its compounds exert a deleterious effect on rubber, and this was brought forward lately by Thomson (India-rubber Journal, 1891, 328), but in the above examples copper was absent.

I asked Mr. Christie, of Messrs. J. Orr Ewing & Co., who has had a large experience in the dyeing of cotton yarn, if he could offer an explanation, and he thought the reason might be the presence of peroxide of iron, and suggested the procuring of a piece of buff cotton cloth, much used for window-blinds, and which, he said, would be free from all foreign matter, such as tannic acid and logwood, used in dyeing black and brown yarn. I did this, and found that the action of the vulcaniser was retarded, almost proving that the iron oxide was the cause of the mischief; but if this were proved, the next question would be, what is the reaction which takes place? Although this action was peculiar, and, in the meantime, to me inexplicable, yet a simple remedy was found to allow of its being used on cotton cloths. This consisted, in the first place, in giving the cloth a coat of pure rubber dough, mixed with 2 per cent. of sulphur, and which is often resorted to in ordinary "dry heat" process to avoid "efflorescence."

The action of dyed cloth on rubber proofing is an important question, not only for the rubber manufacturers but also for dyers, and it seems to me that the solving of the problem should not be left to manufacturers, but to the dyeing schools, who, so far as I know, have given the matter little or no attention, and some of the wealthy rubber manufacturers could, with advantage, encourage the investigation of such questions in the technical schools.

An important point in connexion with the use of this new vulcaniser is, that by its means coloured rubber proofing can be easily obtained without adding a large amount of pigment to the rubber. In the ordinary "dry heat" process it is difficult to get a good coloured "proofing," and at the same time keep the proportion of compound so low that it will be elastic.

With this vulcaniser, however, brown, drab, red, blue, and green proofings can be obtained.

I have here a few samples of coloured proofings which Messrs. Campbell, Achnach, & Co., kindly prepared for me, and you can judge better of their appearance and softness to the touch by inspection.

Of course, if wanted, the pigment can be increased, as I have had 360 per cent. added, as per sample shown, and still the rubber was strong and elastic.

The coloured proofings cured up in a time according to the percentage of vulcaniser and compounding material added, but the usual time was three-quarters of an hour at 240°–245° F.

It mixes very well with most pigments, but there are some which retard its action. It appears to me that proofing cured with it could be finished without farina, as the surface after curing is very dry and soft, and, if so, it would be a point in its favour, as farina seems to exert a deleterious action on the surface of the rubber, no doubt through its getting damp and fermenting; besides, farina comes off when wet upon the cloths, and leaves marks, which is objectionable.

Two most important questions in regard to the introduction of this new vulcaniser are, as to its keeping qualities and its cost.

Firstly. As regards its durability, it is impossible to give an answer based on long experience; but when one takes into account the fact that the samples which were made in the preliminary trials 15 months ago are still in good condition, it is surprising, as too much vulcaniser was

used, and the method of working has been much improved. There can be no question, I think, that the "transparent" dry-heat proofing will stand better than that cold-cured in warm climates. To test their heat-resisting properties, a piece of each of these kinds of proofing, and also a piece of that which had been cured by ordinary "dry-heat" process were taken and heated to 306° F. for half an hour. The cold-cured piece was simply rotted away; the ordinary dry-heated piece had quite decomposed, whilst that cured by the new vulcaniser was but slightly so, showing that it was not readily affected by heat. Judging from my own experience, and the interchange of opinion I have had with Mr. Douglas and others, I conclude that there is every probability that the rubber will keep as well as the ordinary "dry heat" rubber.

Secondly, as regards the cost. At first sight it would appear as if the cost would be such as to preclude it from general use, but on looking more closely into the question it wears a different aspect. Taking the average weight of "transparent" proofing on a coat at 2 lb., we have for this weight 4d. worth of vulcaniser. Now there falls to be deducted from this the cost of curing by the ordinary method, which is about one penny, and we must also take into account that by the rapid curing a considerable saving is effected, so the difference in price is certainly not prohibitive. If it is compounded, of course the price can be reduced to that of ordinary curing.

It may be asked, will this compound mix with rubber substitutes, and I may say that the ordinary oil substitute made with chloride of sulphur is quite as unsuitable as it is for all "dry heat" work. Oil vulcanised with sulphur by heat is suitable, but the admixture of different substances is one which only can be determined by the manufacturers themselves.

The cheapening of rubber by adding different foreign materials has become quite an art, and a necessary one, no doubt, and something will soon be found which will serve as an article to cheapen the mixing with the new compound also. It has been tried for double as well as single texture garments, and is very serviceable where a nice pliable proofing is wanted and when a cloth is being dealt with which is easily affected by heat.

It is principally in connexion with "dry heat" that it has been tried, but it gives good results in the steam heater when wrapped up to protect it partially from the steam. I have here a piece of sheet rubber cured 2½ hours at 260° F., which shows that by this process it is possible to bring about good vulcanisation, as the rubber, you will notice, is very strong.

My best thanks are due to Mr. Anderson, who conducted all the experimental work involved in testing the properties of this new vulcaniser; and also to Mr. Douglas, Mr. Burbridge, and Mr. Cairns, for their kindness in preparing samples and giving valuable advice.

DISCUSSION.

The CHAIRMAN said that he thought it would be difficult to exaggerate the value of this paper. Mr. Fawsitt seemed to have made a remarkable discovery in the vulcanisation of rubber. He should like to ask what particular iodide he used.

Mr. J. W. BIGGART said that Mr. Fawsitt remarked that light seemed to have an injurious effect upon the rubber, as instanced in the case of the goods hanging in a shop window. This seemed to indicate that a chemical change took place under the influence of light, and he should like to ask what change it was that actually did take place.

Mr. FAWSITT, in reply to the Chairman, said that the iodide used in all the trials for the fishing stockings and other specimens shown was iodide of antimony. They fixed on that in preference to iodide of tin because antimony was a cheap material and produced good results; iodide of tin also gave good results; but seeing they had commenced with antimony, they did not wish to alter meantime. Regarding the reaction which took

place in the vulcanisation, he had never formed a satisfactory opinion on that point, as they had not had time to go into the subject fully.

With reference to the question asked by Mr. Biggart as to the effect of the rays of the sun on the proofing, he could not give particulars of the chemical change that took place.

ON THE COMPOSITION OF "HUNYADI JANOS" MINERAL WATERS.

BY J. W. BIGGART.

THAT the mineral waters as a class occupy a very important place in *Materia Medica* is an acknowledged fact. Regarding the properties of many of them there is a common belief that to the waters as found in nature belong qualities which art cannot reproduce by any of its preparations or imitations. Many medical men hold this opinion, and for obvious reasons it is a notion suggested and encouraged by all those who have a proprietary interest in any of the wells.

While it is here granted that the artificial waters must and will differ in properties from the natural, if any of the various radicles in the artificial imitations be brought together either in a different order or in different amounts from that which they hold in the natural water, still it is hard to see, how, if these combinations and the gases present in the water be exactly known and the data deduced from them correctly followed, there can or will be any difference between the medicinal qualities of a natural water and its artificial imitation. In short, if the salts present and their amounts be known then the water can surely be prepared. It is on one of these natural mineral waters called "Hunyadi Janos," that this short note and analysis have been prepared, and it may be of some interest to state that it is one of the most popular aperient waters having a sale which is reckoned by several million bottles per annum.

Concerning this water, the writer has heard it repeatedly stated (by medical men) that it possesses properties so peculiarly its own that they cannot be reproduced by art, but, discrediting such a theory, its analysis and examination were undertaken.

The generally accepted opinion concerning the composition of the water is that it contains principally magnesia and sodic sulphates and chlorine combined with sodium as common salt.

For the most part this opinion has been verified, but in one respect, namely, the state of combination of the chlorine, a vital and important difference has been observed, as shall be presently pointed out.

The analysis of the salts left on evaporating a portion of the water gave the following percentages of the different radicles:—

Basic.		Acid.	
Soda	1.00	Silica	Trace.
Magnesia	0.535	Sulphuric acid....	2.32
Lime	0.18	Chlorine	0.101
Iron	Trace.	Phosphoric acid...	Trace.

On looking over these results it is apparent that all the lime must first be calculated to sulphate. After this it is necessary to discover to what base or bases the chlorine is linked. Then it only remains to calculate soda and magnesia left to sulphates. As the condition of the chlorine is the only point which presents any difficulty, the particular state of its combination was arrived at in the following manner:—A measured volume (50 cc.) of the mineral

water was evaporated spontaneously in the air (this precaution was adopted to ensure against any double decomposition taking place between the salts).

After evaporation the salts were taken up with absolute alcohol, which dissolved the chlorides present, but left the sulphates as an insoluble residue. The alcoholic extract was next evaporated to dryness (also in the air) and the residual mass taken up as before. The acids and bases present in this solution were then estimated, and they were found to be practically pure magnesium chloride. Proceeding on these data, and linking the proper bases to their own acids, calculation showed the composition of the water to be as follows:—

	Parts per 1,000.
Calcic sulphate.....	0.41
Magnesian do.	16.05
Sodic do.	25.00
Magnesian chloride.....	1.20
Silica	0.12
Water.....	957.22
	<hr/> 1,000.00

DISCUSSION.

The CHAIRMAN said that the composition of these mineral waters was extremely interesting, and the one which was the subject of this paper was perhaps the most interesting of all. It seemed that waters the same as this and to have the same effect could be artificially made. It was well known that for many years there was a German spa at Brighton, where the waters made were an exact imitation of many of the German natural waters. He had used Hunyadi Janos water in his own house for many years, but had always prepared it himself, and never could find any difference from the natural water. He knew that the composition of the artificial water was always the same, and the natural water was not. He should like to ask if Mr. Biggart found no potash salts in this water, as he understood that there was always small quantities of sulphate of potash and of bicarbonate of soda present?

Mr. T. L. PATTERSON did not think that Mr. Biggart's method of analysis proved conclusively the presence of magnesium chloride in Hunyadi Janos water, as there was no doubt that chemical changes might take place on addition of absolute alcohol to the mixture of salts, resulting in the formation of easily soluble magnesium chloride.

Dr. G. G. HENDERSON agreed with Mr. Patterson in thinking that Mr. Biggart's analysis left it doubtful whether magnesium chloride was present in the natural water. He should like to know whether the dissolved gases had been estimated. He thought there was a large field open to manufacturers of mineral waters, for it would be quite unnecessary in many cases to go to German spas, or to buy the foreign mineral waters imported into this country in such enormous quantities, if these waters could be prepared artificially at home. There ought to be little difficulty about this, seeing that the composition of most of the waters was well known.

Mr. BIGGART, in reply to the Chairman, said that he had examined the residue for potash salts, but had failed to detect them. He had not estimated the dissolved gases.

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any desired proportion, at the moment when it enters the valve-box of the cylinder. For this purpose steam is taken from the boiler through a separate pipe, and carried to a superheater fixed in the smoke-box of the boiler, or heated in any other convenient manner, and thence taken through another pipe to join the saturated-steam pipe, suitable valves being inserted for the regulation of the supply.—B.

A Method and Apparatus for subjecting Liquids having Substances suspended in them to Centrifugal Action, whereby they are brought in Contact only with Sterilised or with other Air, with which they are to be Saturated. O. Imray, London. From A. Bergh, Copenhagen, Denmark. Eng. Pat. 19,071, November 24, 1891.

In the applicant's specification, No. 86, 1891, is described a centrifugal apparatus applicable mainly for treating worts and beer, and a method of so conducting the brewing process that they may be brought into contact with sterilised air only. It is now claimed in the above patent that this method is of great importance in the treatment by centrifugal action and aeration of various other fluids, water, blood, milk, oil, yeast, wine, and spirits. The two last should, however, be first heated to render them capable of taking up more air.

Any gas which mixes readily with the liquids treated, and saturates them may be substituted for sterilised air.

Drawings accompany the specification.—L. de K.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Improvements in the Methods of Heating Liquids, and Generating and Utilising Vapour for Motive Power and the like Purposes, and in Apparatus and Appliances connected therewith. W. H. Watkinson, Sheffield. Eng. Pat. 4596, March 14, 1891.

THE principal novelty involved in this patent consists in loading steam or vapour with liquid in the form of spray or with gaseous matter, for the purpose of diminishing the speed of the issuing steam when acting upon motive power engines of the rotary kind, such as steam turbines, whereby the economical speed of the turbine can be reduced to a more practical limit than has hitherto been attained. The heating of the liquid for the production of steam is accomplished in a heater consisting of narrow cells, in which almost every particle of the liquid is brought in direct contact with the heated walls. The rest of the specification refers principally to the mechanical arrangements involved in carrying out the above objects of heating and spraying the liquid, and mixing the spray with the issuing vapour.—B.

Improvements in the Drying or Superheating of Steam, and Apparatus therefor. T. Mudd, West Hartlepool. Eng. Pat. 5783, April 3, 1891.

THE use of superheated steam in steam engines has hitherto failed owing to the mechanical difficulties encountered through the destruction of the working surfaces, the superheater not being under proper control or adjustment. The patentee proposes to overcome this difficulty by superheating only part of the steam, and mixing it with the saturated steam in

II.—FUEL, GAS, AND LIGHT.

Sulphocyanogen in Coal-Gas. J. V. Esop. Chem. Ind. 1892, 15, 6—10.

THE formation of cyanogen and its derivatives by the destructive distillation of coal is attributed by de Romilly to the conversion of the ammonia into ammonium cyanide at a bright red heat in the presence of carbon. The quantity thus generated depends on the mode of carbonisation. According to Gasch, retorts worked with heavy charges give the largest proportion. If the products of distillation, after leaving the retort, are kept at a sufficiently high temperature, ammonia and cyanogen are found in the gaseous mixture in a free state. If, however, the temperature is allowed to fall below 80°, which is the case in the purification of coal-gas, ammonium cyanide, ammonium thiocyanate, and ferrocyanides are formed. Of the aqueous liquids deposited in the condenser during the manufacture of gas, it is here necessary to consider only ammonia and thiocyanic acid. German gas-liquor obtained from Saar and Ruhr coal gave by analysis:—

	CNSH	NH ₃
	Grms.	Grms.
Gas liquor from Wiesbaden	1.22	18.05
Gas liquor from Karlsruhe	1.51	19.03
Gas liquor from Mainz	2.33	36.05

In the purification of gas by chemical treatment free sulphur, thiocyanic acid, ammonia, and potassium ferrocyanide are the most important constituents to which it is necessary to direct attention in the present paper. The following table gives the percentages of thiocyanic acid,

* Any of these specifications may be obtained by post by remitting *sd.*—the price now fixed for all specifications, postage included—to Sir Henry Reader Luck, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

ammonia, and potassium ferrocyanide contained in gas-purifying material saturated with these impurities:—

—	CNSH	NH ₃	FeCN ₆ K ₄ ·3 H ₂ O
Essen (Krupp)	0·39	0·49	3·02
	0·30	0·39	5·00
	0·52	0·40	1·62
Stuttgart	0·85	1·03	3·51
	0·94	1·02	3·42
Witten	1·09	1·05	3·42
	1·62	2·03	1·42
Leipzig	1·06	1·13	1·03
	1·98	2·31	1·51
Freiburg	1·07	1·57	6·25
Ulm	1·05	1·42	5·43
Mannheim	1·43	1·72	4·85
Hellbroun	2·32	2·13	1·37
Pforzheim	3·53	3·21	1·84
Wiesbaden	1·12	0·23	8·27
	0·92	0·82	6·03
Kaiserslautern	1·13	0·51	5·35
Zurich	1·27	0·92	1·68
Schwetzingen	2·32	0·24	3·05
Andernach	2·53	1·57	1·28
Nürnberg	3·72	1·24	1·53
Mainz	4·25	2·25	1·38

If this material be stored in the cold protected from atmospheric influences, and in layers of moderate dimensions, it may be kept for some time without suffering decomposition. If, however, stored in large masses the temperature gradually rises, the green colour changes to red, acid fumes are liberated in the course of a few days, and finally the sulphur ignites and burns away. At this stage the decomposition of thiocyanic acid has reached its maximum, only about 0·5 per cent. remaining unchanged. A portion is converted into ferrocyanide, and the remainder is wholly decomposed. The quantity of ferrocyanide is thereby increased from 4·3 to 7·2 per cent. The extraction of thiocyanic acid is effected by lixiviating the exhausted purifying agent and evaporating the aqueous extract in enamelled pans. Ammonium thiocyanate crystallises out

and this is then decomposed by the addition of alkalis (hydroxides) or soluble alkaline sulphides. From weak extracts or solutions highly charged with chlorides, sulphates, sulphites, &c., it is preferable to precipitate the thiocyanic acid by means of a cuprous salt and decompose the thiocyanate thus obtained by the addition of a soluble alkaline sulphide. The resulting cuprous sulphide is roasted, the oxide dissolved in hot dilute acid, and the solution used for the precipitation of a fresh portion of aqueous extract. To obtain pure ammonium thiocyanate the crude salt is recrystallised, having been previously treated with barium sulphide. A chemically pure product is obtained by carrying out the process expressed by the equation $(\text{CNS})_2\text{Ba} + (\text{NH}_4)_2\text{SO}_4 = 2 \text{NH}_4\text{CNS} + \text{BaSO}_4$. Barium thiocyanate is obtained from the ammonium salt by the addition of barium hydroxide or preferably barium sulphide. The decomposition is effected in a closed vessel fitted with mechanical stirrers and heated with steam under slight pressure (0·2 to 0·4 atmosphere) to a temperature of 80°–90°, the ammonia being driven off as rapidly as possible. The barium salt may be obtained also from cuprous thiocyanate by fractional precipitation, the undecomposed portion being treated with an excess of barium sulphide, and the resulting solution evaporated after the removal of all traces of metal and barium sulphide. The calcium salt is prepared from the ammonium salt by the addition of calcium hydroxide, ammonia being liberated. The solution is evaporated to 45° B. and allowed to cool when the calcium salt crystallises out in deliquescent but well-defined needles. The potassium salt is obtained by the addition of potassium sulphate or carbonate to alkaline thiocyanates or by precipitating ammonium or cuprous thiocyanate with potassium sulphide. The aluminium salt is prepared by decomposing the calcium or barium salt with alum free from iron.—D. B.

Geological and Economical Conditions of the Westphalian Coal-Beds. Brookmann. J. für Gasbeleuchtung, 1891, 34, 633–636.

AFTER giving an account of the development and present condition of the coal-fields of Westphalia, the author proceeds to consider the classification and nature of various kinds of coal, pointing out at the same time that the terms which he employs are purely relative and only apply to Westphalian coal.

In the following table the percentage of carbon, hydrogen, and oxygen in various carbonaceous deposits, calculated on the ash- and water-free substance, is given; the quantity of available hydrogen, and the yield of coke are given in the fourth and fifth columns respectively, whilst in the sixth column the geological period to which the coal belongs is stated; in the seventh column the products of the natural distillation of the coal are given:—

—	C	H	O	Available H	Coke.	Period of Formation.	Distillation Product.
Wood	44	6	50	..	15	} Present	{ H ₂ O CO ₂
Turf	60	6	34	2	20		
Lignite	65	6	28	3	40	Tertiary	C ₂ H ₆
Forest coal	70	6	24	3	45	{ Chalk	C ₂ H ₆
						{ Jurassic	CH ₄
Flame coal	75	6	19	4	50	} Carboniferous	{ CH ₄ CH ₄ + H ₂ CH ₄ + H ₂ CH ₄ + H ₂ CH ₄ + H ₂
Gas coal	80	6	14	4	60		
Coke coal	85	5	10	4	{ 70 80		
Poor coal	90	4	6	3	50		
Anthracite (coke)	95	2	3	2	85		
Graphite	100	..	..	..	100	Silurian.	

It will be seen from the table that the percentage of carbon increases, whilst that of oxygen decreases, with the age of the deposit, whereas the percentage of hydrogen undergoes no material alteration. This change in composition which takes place in the earth is similar in some ways to that which occurs in gas-making; in the first stages of the distillation of coal the gases evolved are highly luminous, but as the process continues the gases lose their luminosity and finally consist almost entirely of hydrogen.

The quality and the quantity of the coke depends to a great extent on the chemical composition of the coal; an anthracite coal, for example, gives only a loose powdery coke, whereas ordinary gas-coal yields, as a rule, a good cake of porous coke. The colour of the coke obtained from various kinds of coals is very characteristic, and affords a means of estimating the geological age of the coal when other criteria fail.

The quality of a coal may also be judged by its appearance; on examination it will be found that even in coal from the same stratum considerable differences may be observed. In some samples lustrous deep black lines are seen, indicating, as a rule, a low gas-producing power and a low percentage of ash; also greyish black stripes of coal which has a high gas-producing power, but which, at the same time, contains a large percentage of ash. Mineral wood-coal, a non-cokable, fibrous coal, of low gas-producing power and rich in ash, is a very frequent constituent of coals; stripes or layers of cannel, pseudo-cannel, shale, &c., are also frequently met with in one and the same sample, the quality of which will, of course, depend on the predominance of one or other of these varieties.—F. S. K.

New Researches on the Heat of Combustion of Coal, determined by Means of a Calorimetric Shell. Scheurer-Kestner and Meunier-Dollfus. Bull. Soc. Ind. Mulhouse, 1891, 577—589.

THE authors describe some experiments which they carried out with the object of verifying results obtained by them with a Favre and Silbermann calorimeter. The apparatus used was Berthelot's calorimetric bomb, which was placed at their disposal. This consists of a metal shell lined with platinum (to resist chemical action), in which combustion can take place, and an ordinary calorimeter of about 2 litres capacity in which the shell can be suspended, and by means of which the heat developed is observed. The substance to be experimented upon is weighed and suspended within the shell in a perforated platinum capsule. Immediately above this is placed a spiral or fine iron wire, through which a current of electricity can be passed. The lid of the shell, which can be screwed in its place, carries a valve, by means of which oxygen at a pressure of 25 kilos. can be admitted to the interior. This having been done the shell is placed in the calorimeter and the temperature of the whole is allowed to become uniform. The temperature is then observed from minute to minute and a current is sent through the spiral. This, as it heats, sets the combustible on fire. Combustion is sudden and complete, leaving *no combustible residue*. The temperature should be observed during several minutes, but the whole operation is over in a quarter of an hour.

The advantages of the method are (1) simplicity of apparatus, in consequence of which a single experimenter is sufficient, whereas at least two were required with the older apparatus, (2) economy of time, and (3) owing to complete combustion the corrections to be applied are of a lower order than those necessary with the apparatus of Favre and Silbermann. The principal drawback to the use of the new apparatus is in the cost, both of the platinum lining to the shell and of the reservoir for compressed oxygen. When the substance to be experimented upon is coal, it presents the further disadvantage that it is not possible to weigh the ashes. These are scattered by the violence of combustion about the walls of the shell, and, further, it must be remembered that they are soluble in the sulphuric and nitric acids formed during combustion. Their amount can, however, be estimated by determining the amount of the ashes formed in burning known weights

of the same coal. Another source of error arises from the heat of formation of sulphuric and nitric acids, which although negligible in approximate work, must be allowed for if great accuracy is desired. The amount of these bodies formed during combustion is estimated by titration with an alkali, and the heat developed in their formation is calculated by Dulong's law. It is also necessary to allow for the heat generated in the spiral by the current, which, for the particular spiral used, was estimated at 22 calories.

On the whole the authors are of opinion that the results obtained by this method are more reliable than those obtained by the older methods, as the necessary corrections are of so much less relative importance.

In order to make the correction for radiation as small as possible, the calorimeter was placed within a large double calorimeter, the space between the walls of which was filled with water. By this means the correction for radiation was reduced from 0.002° to 0.001° per degree per minute. The authors also found that when the coal was used in pieces instead of in powder, it was possible to obtain complete combustion. In the latter case it was necessary to dilute the oxygen with air, pure oxygen giving rise to explosions which always left a combustible residue.

In general, the results obtained by this method give a lower value for the calorific power than those obtained by former methods. The following table gives the results of an experiment with a particular sample of coal:—

Weight of substance	Gm.
Initial temperature	11°735 ²
Temperature at end of 1st minute	11°000 ²
" " 2nd "	11°600 ²
" " 3rd "	11°650 ²
" " 4th "	11°640 ²
" " 5th "	11°630 ²
" " 6th "	11°620 ²
" " 7th "	11°600 ²
" " 8th "	11°590 ²
Highest temperature	11°650 ²
Initial "	11°735 ²
Rise of temperature	2°915 ²
Correction	+0°039
	2°954 ²

	Calories
Thermal capacity of calorimeter.....	2,400
$2.954^{\circ} \times 2,000 =$	7,059
Deducting for heat generated in spiral...	<u>22</u>
	<u>7,067</u>

$$\frac{7.067}{0.943} = 7,494 \text{ calories per unit weight of the coal.}$$

The mean of several determinations of the composition of this sample showed that only 87 per cent. of it was pure coal.

$\frac{7,494}{87} \times 100$ gives 8,620 calories per unit weight of pure coal. This number is 326 less than that obtained in former experiments by the authors. The authors have also arrived at the conclusion that it is impossible to calculate the heat of combustion of a specimen of coal from its composition. Appended are the observed and calculated values for three samples of coal.

	Calories.
1. Calculated by Dulong's law	8,382
Calculated from total amounts of carbon and hydrogen present	8,706
Observed	8,697
2. Calculated by Dulong's law	8,082
Calculated from total amounts of carbon and hydrogen present	8,501
Observed	8,264
3. Calculated by Dulong's law	8,513
Calculated from total amounts of carbon and hydrogen present	8,685
Observed	8,700

The authors consider that they have proved (in conformity with their earlier researches) that some kinds of coal have a heat of combustion which is greater than that of the carbon and hydrogen which they contain; the heat of combustion of others is less than this, although it is sometimes higher than the heat calculated by Dulong's method.—D. E. J.

Note on the Carbon deposited from Coal-Gas Flames.
W. Foster. Proc. Chem. Soc. 1892 [108], 46.

The author quotes analyses of cokes obtained by carbonising sugar and starch:—

Cane Sugar Coke.—High temperature, carbon 95.0, hydrogen 1.1; low temperature, 94.1 carbon, 1.2 hydrogen.

Starch Coke.—95.0 per cent. carbon, 0.9 per cent. hydrogen respectively.

From the similarity in composition of these cokes to that of the soot obtainable from coal-gas flames, he is of opinion that there is a resemblance in the general character of the chemical processes whereby they are formed.

The Origin of Acetylene in Flames. V. B. Lewes. Proc. Chem. Soc. 1892, [108], 47—48.

The author has sought to determine whether acetylene is the product of high temperature change or of oxidation. The experiments described consisted in passing hydrocarbon gases and mixtures of such gases with others through a heated platinum tube 2 mm. in diameter, which, judging from experiments made to test the point, would seem to be without special action.

On passing methane alone through the tube while a length of 6 in. was heated to 1100° in the flat flame of a broad Bunsen, a product was obtained containing 3.2 per cent. of unsaturated hydrocarbons and 1.8 per cent. of acetylene. The effect of heating methane with other gases is indicated by the following figures:—

	3 per Cent. Oxygen.	15 per Cent. Air.	50 per Cent. Carbon Monoxide.	60 per Cent. Hydrogen.
Unsaturated hydrocarbons.....	2.0	2.0	1.0	1.47
Acetylene.....	1.423	0.656	0.887	0.473
Carbon monoxide.....	1.1	1.0	..	0.490

These results appear to point to acetylene being formed by the action of heat alone.

Ethane heated alone gave a product containing 19.47 per cent. unsaturated hydrocarbons and 3.221 per cent. of acetylene. The effect of heating ethane, diluted with 30 per cent. of hydrogen with air was as follows:—

	15 per Cent. Air.	20 per Cent. Air.	25 per Cent. Air.
Unsaturated hydrocarbons..	7.60	5.78	5.05
Acetylene.....	3.30	3.20	3.11
Carbon dioxide.....	6.00	1.01	1.51
Carbon monoxide.....	1.54	2.53	3.03

The effect of temperature on the formation of acetylene is well shown by the following results obtained on converting Russian petroleum into oil-gas in a Patterson retort:—

Temperature of retort....	500°	700°	800°	900°
Yield of gas per gallon of oil.	12 c.p.	60 c.p.	72 c.p.	81 c.p.
Illuminating power.....	54.8	50.7	57.1	42
Unsaturated hydrocarbons	39.13	36.56	36.55	22.04
Acetylene.....	0.052	0.084	0.38	0.46

PATENT.

Improvements in Machinery for the Manufacture of Peat Fuel. B. G. B. Mills, London. From E. L. Clarke, Montreal, Canada. Eng. Pat. 5980, April 7, 1891.

THE machinery patented consists essentially of a cylindrical mould with a flat-headed screwed revolving plunger, the peat to be compressed into fuel being fed through a hopper on to the screw and compressed into the mould by the head of the plunger. The plunger is actuated by a spindle co-axial with it, to which is communicated a revolving motion to cause the travel of the peat by means of the screw thread, and a longitudinal motion by means of an eccentric driven by a shaft at right angles to that by which the revolving motion is communicated. This arrangement is preferably worked in duplicate, a single central shaft then sufficing to actuate two plungers parallel with itself. The pinion upon the central shaft is sufficiently wide in the face to allow of the reciprocating movement caused by the action of the eccentric to take place without the teeth becoming disengaged. A wooden resistance block is inserted into the mould at the beginning of the compressing operation, its place being afterwards supplied by the peat itself. The thread on the plunger is kept clear by means of a worm wheel working at the bottom of the hopper. The apparatus described is used in connexion with the preliminary disintegrating and drying machine, in which the peat after having been freed from sticks is carried through a cylinder, through which furnace gases are caused to pass, by means of a rotating longitudinal shaft fitted with stirrers, and driven by the same gear as gives motion to the compressing machinery. It is claimed that the heat generated in compressing the peat aids its agglomeration by bringing "to the surface the tarry residue inherent in the peat particles."

—B. B.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Paranthracene. K. Elbs. J. Prakt. Chem. 1891, 44, 467—469.

In 1866 Fritzsche discovered the transformation of anthracene into paranthracene by prolonged exposure to sunlight and recommended this reaction as a suitable means of preparing pure anthracene. The author obtained this hydrocarbon by exposing a saturated solution of anthracene (90 per cent.) in benzene (at 40° to 60°) to the action of sunlight for one week, the solution being heated on a water-bath from time to time for the purpose of re-dissolving any anthracene which may crystallise out. The deposit was filtered off, boiled out with a small quantity of benzene and recrystallised from hot xylene or dimethylaniline. From the former paranthracene separates in colourless lustrous needles, whilst dimethylaniline gives it in the form of laminae. Both melt at 272°—274° with complete conversion into anthracene. Paranthracene possesses no fluorescent properties, and its solution in dimethylaniline may be heated

without change. On prolonged boiling in naphthalene it is, however, gradually converted into anthracene, the change being observable by the original colourless solution assuming a violet fluorescence. It is only sparingly soluble in most solvents. At the temperature of its melting point glacial acetic acid, phenol, thymol, resorcinol, quinol, paranitrotoluene, (1 : 2 : 4)—dinitrotoluene, α -nitronaphthalene, acetanilide, acetoparatoluidide, salicylic acid, and diphenyltrichlorethane dissolve 0.1 per cent. or even less; α -naphthylphenylketone, nitroscendoenene, and diphenyl from 0.1 to 0.2 per cent., and naphthalene, acenaphthene, azobenzene, diphenylamine, and triphenylmethane from 0.2 to 0.3 per cent. Owing to the fact that a solution of paranthracene in naphthalene saturated at the temperature of its melting point was found to contain only 0.229 per cent. of paranthracene, the depressions to be observed are obviously so small that in order to minimise the error as much as possible the results should be calculated from the average of a number of observations. The mean molecular weight of paranthracene calculated from ten sets of experiments comprising in all 118 separate readings was found to be 303, the lowest value observed being 248 and the highest 344. The measurements were made with an ordinary Beckmann apparatus, each degree of the thermometer being divided into 50 parts. The following table gives the results of a complete group of measurements:—

Paranthracene in the Solution per Cent.	Depression.	Molecular Weight (Molecular Depression for $C_{14}H_{10} = 701$).	Number of Trials.
0.059	0.012	344	7
0.108	0.023	329	7
0.132	0.027	342	7
0.146	0.037	276	8
0.229	0.053	303	10

For $C_{14}H_{10}$ the molecular weight is 178, and for $(C_{14}H_{10})_2$ 356, showing that paranthracene is formed from anthracene by the combination of 2 mols. According to Graebe and Liebermann, bromine has no action on paranthracene. The author, whilst confirming this observation, states that in the presence of sunlight, bromine strongly attacks para-

anthracene with formation of dibromanthracenetetrabromide. A similar result was obtained with anthracene when brominated under the same conditions.—D. B.

PATENT.

Improvements in the Distillation of Mineral Oils and Light Bodies, and in Apparatus therefor. J. Laing, Edinburgh. Eng. Pat. 6134, April 10, 1891.

THE chief improvement patented consists in making oil stills of such a form that the upper part only of the liquid in them is heated, and a sort of central well is provided into which the heavy residue can sink, and whence it can be drawn off periodically. The shape of the body of the still somewhat resembles the head of an ordinary still inverted, an annular fire playing on the wider part. The depth of the oil is maintained constant by means of a ball-cock or similar device. It is claimed that by this arrangement the heating is more uniform, and the distillation takes place at a lower temperature than in the ordinary form of still, while a smaller quantity of the oil is "cracked" and a better product is obtained.—B. B.

IV.—COLOURING MATTERS AND DYES.

Dyewood Extracts and their Manufacture. F. F. Mafat. Bull. Soc. Ind. Mulhouse, 1891, 361—452—(concluded). (This Journal, 1892, 154—155.)

THE appended tables show the composition (calculated to 30° B.) of the logwood extracts manufactured at Havre by the two methods already described (this Journal, 1892, 153—155).

Throughout the tables the weights given represent kilos.

LOGWOOD EXTRACTS, HAVRE (FIRST SYSTEM).

Brand.	Wood used.	Yield of Extract at 30° B.	Molasses at 30° B.	Chestnut Extract, at 30° B.	Carbonate of Soda.	Powdered Gypsum.
Logwood extract, dry, pure	1,000	1,000	..	..	..	..
Hemateine, in powder	1,000	1,000	..	30	..	..
Logwood extract, dry, primer, superior	4,000	1,000	256	..	..	..
Logwood extract, dry, prima	1,000	1,000	256	50	5	..
Logwood extract, dry, No. 1	4,000	1,000	365	50	5	..
Logwood extract, dry, No. 2	4,000	1,000	530	200	10	10
Logwood extract, dry, No. 3, Sanford	4,000	1,000	530	200	10	10
Logwood extract, dry, No. 3, for cold countries	4,000	1,000	530	300	20	10
Logwood extract, dry, No. 3A	4,000	1,000	530	350	20	10
Logwood extract, dry, No. 3B	4,000	1,000	530	500	20	12½
Logwood extract, 30° B., pure	4,000	1,000	..	..	..	..
Logwood extract, 30° B., No. 1	4,000	1,000	210	..	2½	..
Logwood extract, 30° B., No. 2	4,000	1,000	280	..	3½	..
Logwood extract, 30° B., No. 3	4,000	1,000	420	..	4½	..
Logwood extract, 30° B., No. 4	4,000	1,000	530	..	5½	..

LOGWOOD EXTRACTS, HAVRE (SECOND SYSTEM).

Brand.	Wood used.	Yield of Extract at 30° B.	Molasses, at 30° B.	Chestnut, calculated to 30° B.	Sumac, calculated to 30° B.	Potassium Ferri-cyanide.	Powdered Gypsum.	Logwood "Feet."
Hemateine in cake.....	11,200	2,800	..	64	..	..	..	..
Logwood extract, dry, 45, refined....	11,200	2,800	468	..	84	..	..	..
Logwood extract, dry, prima.....	11,200	2,800	626	..	84	..	..	..
Logwood extract, dry, No. 2.....	11,200	2,800	1,332	180	..	..	..	..
Logwood extract, dry, No. 3, Sanford..	11,200	2,800	1,724	360	..	..	..	..
Logwood extract, dry, No. 3 B.....	11,200	2,800	1,724	627	..	..	28	450
Logwood extract, 30° B., flowers of log-wood.	11,200	2,800	468	..	..	28	..	..
Logwood extract, 30° B., No. 1.....	11,200	2,800	780	..	..	..	..	..
Logwood extract, 30° B., No. 2.....	11,200	2,800	1,176	..	..	..	..	..
Logwood extract, 30° B., No. 3.....	11,200	2,800	1,566	..	..	..	..	..

The trade names and composition of the fustic extracts manufactured at Havre are given in the following table. The wood is reckoned as yielding 17 per cent. of extract at 30°. The other substances added as solids are calculated

as the basis that quercitron bark yields 30 per cent. of extract at 30°; sumac leaves, 75 per cent. of extract at 30°; turmeric root, 150 per cent. of extract at 30°; and divi-divi, 53 per cent. of extract at 30° B.

FUSTIC EXTRACTS (HAVRE).

Brand.	Wood used.	Product of Extract at 30° B.	Bark at 30° B.	Sumac at 30° B.	Turmeric at 30° B.	Divi-divi at 30° B.	Molasses at 30° B.	Dextrin at 30° B.	Sulphate of Soda.	Alizarin-Orange, 20 per Cent.
Fustic extract, dry, pure.....	6,000	1,020	..	..	..	..	..	..	..	..
Fustic extract, dry, prima.....	6,000	1,020	54	..	..	16	..	180	..	..
Fustic extract, dry, No. 2.....	6,000	1,020	54	92	135	..	..	135	60	..
Fustic extract, dry, No. 3.....	6,000	1,020	54	92	135	..	..	405	60	..
Fustic extract, 30° B., pure.....	6,000	1,020	..	..	..	..	..	..	..	..
Fustic extract, 30° B., yellow JJ.....	6,000	1,020	54	..	..	16	168	..	60	..
Fustic extract, 30° B., medium yellow, JM L.	6,000	1,020	54	..	..	16	252	..	60	..
Fustic extract, 30° B., orange yellow, JO II.	6,000	1,020	54	..	..	16	462	..	15	15
Fustic extract, 30° B., orange JO III.....	6,000	1,020	54	..	..	16	630	..	15	15

The following table gives the trade names of the logwood and fustic extracts manufactured at Rouen, together with the proportions of the materials used in their manufacture:—

LOGWOOD AND FUSTIC EXTRACTS (ROUX).

Brand.	Wood used.	Molasses, 12° B.	Chestnut Extract, 30° B.	Sicilian Sumac.	Quercitron Bark.	Turmeric Powder.	Glucose, 30° B.	Powdered Gypsum.	Total Yield of Extract.	Percentage of Foreign Bodies.
Logwood extract, dry, or Hematine No. 1, guaranteed pure.	8,800	..	..	..	..	..	..	..	1,465	..
Logwood extract, dry, or Hematine No. 2, extra refined.	8,800	..	75	80	..	..	..	..	1,556	6
Logwood extract, dry, prima superior.	8,800	600	..	150	..	..	..	..	2,075	20½
Logwood extract, dry, prima BD..	8,800	720	250	240	..	..	..	..	2,425	30½
Logwood extract, dry, No. 1 BD...	8,800	720	375	240	..	..	..	40	2,545	42½
Logwood extract, dry, No. 2.....	8,800	960	500	240	..	..	..	60	2,875	49
Logwood extract, dry, No. 3.....	8,800	1,340	750	240	..	..	..	80	3,410	57
Logwood extract, dry, Sanford A..	8,800	1,580	875	240	..	..	..	120	3,760	61
Logwood extract, dry, Sanford B..	8,800	1,820	1,000	240	..	..	..	150	4,100	64½
Logwood extract, 30° B., extra Hematine pure.	8,800	..	..	..	..	..	..	..	2,200	..
Logwood extract, 30° B., extra Hematine, refined.	8,800	..	75	80	..	..	..	..	2,335	6

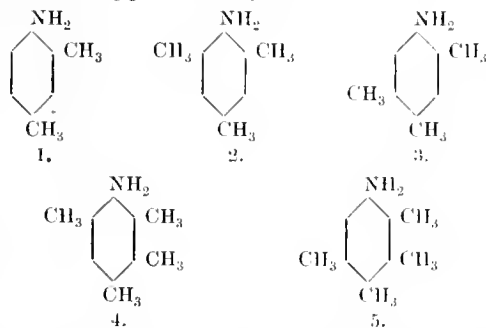
LOGWOOD AND FUSTIC EXTRACTS (ROVEN)—*continued*.

Brand.	Wood used.	Molasses, 30° B.	Chestnut Extract, 42° B.	Silician Sumac.	Quercitron Bark.	Turneric Powder.	Glucose.	Powdered Gypsum.	Total Yield of Extract.	Percentage of Foreign Bodies.
Logwood extract, 30° B., prima superior.	8,800	000	..	150	..	..	..	..	3,150	29½
Logwood extract, 30° B., prima....	8,800	720	250	240	..	..	..	..	3,630	39½
Logwood extract, 30° B., No. 1....	8,800	720	375	240	..	..	..	..	3,760	41½
Logwood extract, 30° B., No. 2....	8,800	930	500	240	..	..	..	..	4,220	48
Logwood extract, 30° B., No. 3....	8,800	1,340	750	240	..	..	..	..	5,000	56
Fustic extract, dry, Cuba, prima superior.	8,800	..	..	180	200	80	150	10	1,545	28
Fustic extract, dry, Cuba, No. 2....	8,800	..	..	180	..	..	675	60	1,500	35
Fustic extract, dry, Cuba, No. 3....	8,800	..	..	180	..	..	900	50	1,760	43
Fustic extract, 30° B., prima superior.	8,800	..	..	180	200	80	450	..	2,250	26
Fustic extract, 30° B., No. 2.....	8,800	..	..	180	..	..	675	..	2,300	35
Fustic extract, 30° B., No. 3.....	8,800	..	..	180	..	..	900	..	2,530	41

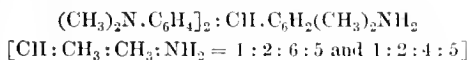
—W. E. K.

Studies on the Colour-Derivatives of Triphenylmethane.
E. Noelting and Polonowsky. Bull. Soc. Ind. Mulhouse, 1892, 28—40.

The following *p*-amido compounds :



in addition to the *p*- and *m*-amido compounds previously mentioned (this Journal, 1890, 53, 279; 1891, 456), condense with tetramethyldiamidobenzhydrol (tetramethyldiamidodiphenylcarbinol). When the condensation is effected by means of sulphuric acid, leuco-compounds are obtained which melt at (1) 158°, (2) 142°, (3) 132°, and (4) 157°, and oxidise respectively into green, blue-green, green-blue, and blue-green dyes. Prehnidine (5) does not condense well. The authors have been unable to decide which of the two formulae—



represents the constitution of the compound obtained from α -*m*-xylylidine, but consider the second more probable, as symmetrical sulpho- and nitro-derivatives are obtained from that base. With mesidine, pseudocumidine, isoduridine, and prehnidine one formula in each case is alone possible.

When the condensation is effected by concentrated hydrochloric acid, the leuco-base from *m*-xylylidine melts at 145°; that from pseudocumidine at 163·4°. Both oxidise badly, in consequence probably of the combination taking place in the *o*-position to their amido-groups. The above-mentioned derivative of prehnidine also oxidises unsatisfactorily for the same reason. Mesidine and isoduridine yield with hydrochloric acid the same leuco-compounds as with sulphuric acid, but less readily.

The dibenzyl-compound obtained by treatment of hexamethyltriimidotriphenylmethane with benzyl chloride yields on oxidation a blue-green dye of sparing solubility. A

more soluble dye, suitable for wool and silk, is obtained by sulphonating the leuco-base before oxidising. As the ethyl-derivative of the compound—



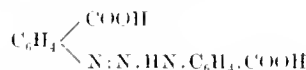
yields on oxidation a green dye of yellower shade than the preceding, it would seem that the methyl-group in the *o*-position to the methane-carbon atom exercises a sensible influence on the shade of the resultant dye.

An isomeric dibenzyl-compound obtained by condensation of dibenzyl-*p*-toluidine and tetramethyldiamidobenzhydrol with sulphuric acid, oxidises to a dye of a pure green shade. In this case the methane-carbon atom is probably directly combined with the benzyl-group and not with the benzene nucleus, since benzylamine similarly yields the leuco-base of a green dye when condensed with tetramethyldiamidobenzhydrol.—E. B.

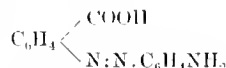
Sealed Notes deposited with the Industrial Society of Mulhouse by E. Noelting: opened October 28, 1891.
Bull. Soc. Ind. Mulhouse, 1892, 40—46.

Notes deposited April 2, 1887.

Note No. 499.—Diazoamidobenzoic acid—



when heated with aniline and aniline hydrochloride, undergoes a molecular interchange forming *amido-azobenzene carboxylic acid*—



The latter dyes yellow on cotton mordanted with alumina and olive on chrome. It may be diazotised and combined with aromatic amines, carboxylic acids, and phenols, yielding derivatives which dye cotton mordanted with metallic hydrates.

Note No. 500.—The hydrazine derivatives of carboxylic acids condense with ketones and diketones forming dyes. Thus dihydroxytartaric acid condenses with *m*-phenylhydrazine-carboxylic acid forming a hydrazone which differs from ordinary Tartrazine in its property of dyeing on alumina and chrome mordants. *o*- and *p*-phenylhydrazine carboxylic acids furnish similar condensation products. The hydrazine carboxylic acids also condense with phenanthraquinone and benzil, but the orange compounds obtained

are devoid of dyeing power. Balay, a student of Noebling's, finds that hydrazine-sulphonic acids condense with phenanthraquinone, forming valuable orange dyes suitable for wool.

Note No. 502.—Nitrotoluic acid—

[COOH:CH₃:NH₂ = 1:2:5] on fusion with soda, yields a compound which dyes unadorned cotton yellow. Reducing agents convert this compound into *diamidostilbene-dicarboxylic acid*, which can be diazotised and combined with phenols and amines, furnishing derivatives which dye unadorned cotton. The author considers it probable that all compounds which contain methyl- and nitro-groups in the *p*-position to each other, are capable of undergoing similar condensation and purposes further studying this reaction.—E. B.

Changes in Chromium Pigments. Papier Zeitung, 1891, 17, 292.

See under VI., next page.

On the Manufacture of Chromium Pigments. C. O. Weber. Dingl. Polyt. J. 1891, 282, 138, 183, and 206.

See under XIII., pages 357—360.

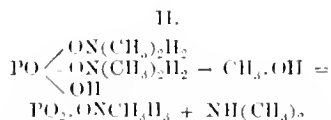
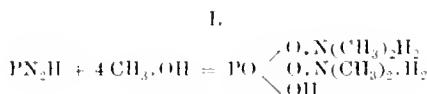
PATENTS.

An Improved Process for Producing Azo-Colouring Matters. A. Fischesser, Lutterbach, Alsace, Germany. Eng. Pat. 3270, February 23, 1891.

In place of α - or β -naphthol used in producing insoluble azo-colouring matters on the fibre, it is proposed to employ β -hydroxynaphthoic acid having a melting point of 216° C. If dianisidine be diazotised and employed as the amine in this process, a blue is obtained resembling indigo, which resists soap and washing. The fibre is impregnated with the solution of the diazo- or tetrazo-compound and passed through an alkaline solution of the β -hydroxynaphthoic acid or *vice versa*. Passing the fibre through weak acid after dyeing is advantageous in developing the colour. If β -naphthylamine be employed it gives a Bordeaux, aniline a yellowish-red, nitraniline a fiery red, and tolidine a deep violet or reddish blue.—T. A. L.

Improvements in the Production and Separation of Methylamines, Ethylamines, Phenylamines, and Naphthylamines. R. Vidal, Paris, France. Eng. Pat. 3622, February 27, 1891.

The above amines are produced by the action of the hydroxy compounds or of the oxides of the hydrocarbon radicles upon nitrides of the metalloids, such as nitride of boron, cyanogen, and phosphane. An amine salt of an acid of the non-metal and an amine result, the change, in the case of phosphane, being represented by the following equations:—



With phospham and methyl or ethyl alcohol the reaction takes place at the ordinary pressure in a closed vessel at 230° C., 1 part of phospham to about 4 parts of the alcohol being employed. The resulting amine remains in solution in the excess of alcohol and can be readily separated.

Phenol and β -naphthol react at 300° C. with phosphane, but only under increased pressure, diphenylamine and β -dinaphthylamine being formed. The phospham is prepared by adding a solution of yellow phosphorus in carbon bisulphide to powdered sulphur, so as to moisten it, and heating the residue, after evaporating off the solvent, to a white heat with ammonium chloride. Boron nitride reacts less readily than phosphane; cyanogen and cyanides only yield traces of fatty or of aromatic amines.—C. A. K.

Improvements in the Manufacture of a Sulpho-Acid of Alpha-Naphthol, and of Colouring Matters therefrom. Read Holliday and Sons, Limited, T. Holliday and P. R. E. Seidler, Huddersfield. Eng. Pat. 5103, March 21, 1891.

If one part of α -naphthol be heated with 2½ parts of sulphuric acid of 66° B. at 100° to 140° F., until a sample on treatment with nitric acid gives little or no precipitate of dinitronaphthol, a new α -naphthol sulphonic acid is formed which can be precipitated from the melt by dilution with water and saturating the solution with salt. After filtration the salt of the new acid can be purified by recrystallisation from water. Another method of separating it from the mixture of α -naphthol sulphonic acids formed simultaneously is to fractionally precipitate them as azo-colours by the addition of diazoxylene or other diazo-compound. The new sulphonic acid forms the colour known as acid yellow when treated with nitric acid, and if a solution of the colour produced by combining diazotised naphthionic acid and an alkaline solution of the new naphthol sulphonic acid be spotted on paper the colour is unaffected by a 10 per cent. solution of sulphuric acid. The new acid is said to differ in these reactions from sulphonic acids of α -naphthol previously known, and is to be used for combination with diazo- and tetrazo-compounds for producing azo-colouring matters.—T. A. L.

Improvements in the Manufacture or Production of Ortho-orydiphenyl-carbon-acid. B. Wilcox, London. From F. von Heyden, Nachfolger, Radebeul, Germany. Eng. Pat. 5122, March 21, 1891.

ORTHO-HYDROXY-DIPHENYL, when dissolved in caustic soda, and the dry salt heated with carbon dioxide under pressure to 100—220° C., is converted into the corresponding carboxylic acid. The product of the reaction is dissolved in water and decomposed with hydrochloric acid when the free acid is precipitated, which melts at 180° C. It can be used as an antiseptic and for the manufacture of colouring matters and of dyestuffs.—C. A. K.

Improvements in the Production of Black Colouring Matters. O. Imray, London. From the "Farbwerke vormals Meister, Lucius, und Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 5994, April 6, 1891.

By fusing the naphthol trisulphonic acid or the naphthosultone disulphonic acid described in German Patent 56,058 with caustic alkalis, a dihydroxynaphthalene disulphonic acid is formed, which will combine with two molecules either of the same or of different diazo-compounds. For example, one molecule of dihydroxynaphthalene disulphonate of soda is dissolved in water with four molecules of caustic soda to a 15—20 per cent. solution, and combined with a solution containing two molecules of diazobenzene chloride. After standing 12 hours the colouring matter is salted out. The most valuable colouring matters are those obtained by combination with diazo-compounds, one of which is sulphonated and the other not. Much deeper black shades can be produced by dyeing in an acid bath in the presence of chromates; the shades range from a blue to a greenish-black.—T. A. L.

Improvements in the Manufacture or Production of Azo-colouring Matters. B. Willecox, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 5984, April 7, 1891.

THIS is an extension of the following: Eng. Pat. 13,665 of 1889 (this Journal, 1890, 854, cf. Ger. Pat. 40,571), Eng. Pat. 3397 of 1890, Eng. Pat. 13,443 of 1890 (this Journal, 1891, 760), and Eng. Pat. 18,517 of 1889 (this Journal, 1890, 1032). All these patents refer to hydroxynaphthalene or naphthylamine sulphonic acids which have now been recognised as containing two hydroxyl groups, or a hydroxyl and an amido group in the 1:1' position. Several azo-colouring matters have already been described in the above specifications, and in addition, the following amines can be employed after diazotisation for combination with the sulphonic acids of 1:1' dihydroxynaphthalene and of 1:1' amidonaphthol.

1. Amido-phenols, amido cresols, and their substitution products which contain the amido and hydroxyl groups in other than an ortho-position.

2. The amidophenol ethers, amido-cresol ethers, amidonaphthol ethers, and their sulphonic acids, with the exception of those already described in Eng. Pat. 18,517 of 1889.

3. Nitraniline, amidoazobenzene, their homologues, and sulphonic acids.

4. Amidonaphthols, amidodihydroxynaphthalene ethers and their sulphonic acids.

5. Amidobenzoic acids and certain of their derivatives.

6. Phenylene, tolylene, and naphthylene diamines substituted in one of the amido groups by alkyl, phenyl, or benzyl and their sulphonic acids.

7. The amidoazo compounds formed by combining with α -naphthylamine or α -amidonaphthol ether the diazo-derivatives of the amines already mentioned under 2, 4, 5, and 6, and in addition the α - and β -naphthylamine trisulphonic acids. The colouring matters are dyestuffs for wool, giving mostly violet to blue shades.—T. A. L.

Production of Amidonaphtholsulpho Acids and of Dyestuffs therefrom. S. Pitt, Sutton. From L. Cassella and Co., Frankfurt-on-the-Maine, Germany. Eng. Pat. 6972, April 22, 1891.

AN extension of Eng. Pat. 16,699 of 1889 (this Journal, 1890, 935), Eng. Pat. 19,330 of 1890 (this Journal, 1891, 917), and Eng. Pat. 1742 of 1891 (this Journal, 1891, 918), which refer to the manufacture of azo dyestuffs derived from amidonaphthol sulphonic acids. Some new amidonaphthol sulphonic acids are described and also other processes for producing acids already known.

1. The acid II described in Eng. Pat. 1742 of 1891 can be obtained as follows: the naphthylamine trisulphonic acid obtained by nitration and reduction of the naphthalene trisulphonic acid of Eng. Pat. 15,716 of 1885 (this Journal, 1886, 662), when heated with caustic alkalis to 170°–190° yields after acidification an amidonaphthol disulphonic acid identical with acid II.

2. A new naphthalene trisulphonic acid is produced by sulphonating naphthalene β -disulphonic acid. This forms a mono-nitro derivative, which, on reduction yields a new naphthylamine trisulphonic acid of which the neutral sodium salt is easily soluble in water with a green fluorescence. If the acid be treated with caustic soda in an autoclave it is converted into a new amidonaphtholdisulphonic acid, of which the orange diazo-compound is turned blue by alkalis and can be precipitated by salt.

3. The naphthalene β -sulphonic acid gives a dinitro-derivative and on reduction forms diamidonaphthalene sulphonic acid, which is nearly insoluble in cold water. Heated with dilute mineral acids to 120° C. under pressure, it also is converted into a new amidonaphthol sulphonic acid nearly insoluble in cold water.

4. By sulphonating β -naphthylamine, the γ -disulphonic acid is not the only product formed. If, therefore, the crude melt be fused with caustic alkalis instead of the pure β -naphthylamine- γ -disulphonic acid, the γ -amido- β -naphthol sulphonic acid formed is somewhat altered as well as the

colouring matters therefrom. The colouring matter from tetrazodiphenyl (diamine black) becomes more violet.

5. By heating β -naphthylamine trisulphonic acid (corresponding to the known β -naphthol trisulphonic acid) with caustic alkalis according to Eng. Pat. 15,175 of 1889 (this Journal, 1890, 854), a β -amidonaphthol disulphonic acid is produced which can be used for the purposes of this invention. These amidonaphthol sulphonic acids are employed for the production of colouring matters as already mentioned in the previous patents. The specification also describes the preparation of new dyestuffs from colouring matters of which the acid II is one of the components. For instance, the colouring matter obtained from tetrazodiphenyl and amidonaphthol disulphonic acid II, which is a blue, can be diazotised and when combined with resorcinol gives a green which dyes unmordanted cotton. If α -naphthylamine be substituted for the resorcinol, a bluish black dyestuff results.—T. A. L.

Improvements in the Manufacture and Production of Dyes belonging to the Rhodamine Series, and of New Materials for Use in their Preparation. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen-on-the-Rhine, Germany. Eng. Pat. 7258, April 27, 1891.

THE dyestuffs of the rhodamine series (Eng. Pat. 15,374 of 1887; this Journal, 1888, 745) cannot be converted into sulphonic acids by direct sulphonation. Certain benzylated m -amidophenol derivatives can be condensed with phthalic anhydride to yield new basic rhodamine dyestuffs, which on sulphonation yield sulphonic acids capable of employment as ordinary acid dyestuffs. Mono-methyl- or ethyl- m -sulphanilic acid is converted by the action of benzylchloride and caustic soda in an aqueous solution into methyl- or ethyl-benzyl- m -sulphanilic acid. This on fusion with caustic soda yields methyl- or ethyl- m -amido-phenol, which when heated with phthalic anhydride gives dimethyl- or diethyl-dibenzyl-rhodamine. The sulphonation is performed with fuming sulphuric acid, containing about 30 per cent. of sulphuric anhydride, and the sulphonic acid obtained dissolves to a fluorescent solution in hot or cold water, dyeing wool and silk from an acid bath in red shades fast to light and alkalis.—T. A. L.

VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

Changes in Chromium Pigments. Papier Zeitung, 1891, 17, 292.

THE pigments used at present in paper staining are generally aniline-lakes obtained by precipitating the solutions of the various aniline dyes with solutions of sulphate of alumina and sodium carbonate.

The chrome yellows are obtained by precipitating a solution of lead acetate with a solution of bichromate of potash. Red and orange chromes can be produced by treating chrome yellow with caustic soda or potash.

Blanc fixe, which is used in the manufacture of "enamelled" papers, is the product of the precipitation of a solution of barium chloride with dilute sulphuric acid.

Generally speaking, the aniline lakes are very fugitive, more particularly so in direct sunlight. In paper staining they are mixed with blanc fixe, and those lakes produced from acid coal-tar colours give in these mixtures better results than the lakes from basic dyes. The glue which also forms part of these mixtures ought to be perfectly neutral.

The chrome yellows, which were always considered perfectly fast to light, according to the author, are quite unworthy of this reputation, and as a matter of fact are even more fugitive than the aniline lakes. Chrome

pigments precipitated upon the vegetable fibre are fairly fast, but their mixtures with aniline pigments and *blanc fixe* do not stand well at all.

The changes of the chromium pigments are due to the following causes:—

1. Insufficient agitation of the mixed pigments, causing the heavy chrome yellows to settle on the bottom of the vessel.
2. Mixture of yellow and basic orange chromes.
3. Too high a working temperature.

The decomposition of the glue with which the pigments are mixed may cause evolution of sulphuretted hydrogen which will very seriously affect the shade of the chrome yellow mixture.

Aniline pigments in similar mixtures are not liable to such changes.—C. O. W.

The Composition of Turkey-red Oil. P. Juillard. Bull. Soc. Chim. 1891, 6, 638—656.

See under XII., pages 355—357.

PATENTS.

Improvements in Means for Use in Electrolysis. J. Marx, Frankfurt-on-Maine, Germany. Eng. Pat. 6266, April 24, 1890. (Second Edition.)

See under XI., page 353.

Improvements in and Apparatus for Electrolysing and Bleaching. J. Marx, Bad-Vanheim, Germany. Eng. Pat. 3738, March 2, 1891.

See under XI., page 353.

Improvements in the Formation of Ozone in Presence of Air or Oxygen, and Apparatus therefor. A. Schueller and W. J. Wisse, The Hague, Holland. Eng. Pat. 5222, March 24, 1891.

See under XI., page 354.

A New or Improved Composition of Ink for Reproduction of Copies by the Manifold Process and the like. W. Sherwood, Loughborough. Eng. Pat. 5437, March 26, 1891.

The invention consists in making an ink composed of an appropriate aniline dye dissolved, together with borax, in water and boiled linseed oil. In a typical case which is quoted, 10 parts "aniline dye powder nigrosine No. 15" are mixed with four parts of powdered borax, 10 parts of boiling water added, the whole allowed to digest for 8 or 12 hours, and 10 parts of boiled linseed oil added. The details of the process may be varied.—B. B.

A Process and Apparatus for Increasing the Bleaching Properties of Chlorine Gas. C. Kellner, Manchester. Eng. Pat. 22,638, December 23, 1891.

See under XI., page 354.

Improvements in Inks for Printing, Stamping, and the Like. C. M. Higgins, New York, U.S.A. Eng. Pat. 93, January 2, 1892.

See under XIII., page 362.

VII.—ACIDS, ALKALIS, AND SALTS.

The Solubility of Sodium Carbonate and of Sodium Bicarbonate in Solutions of Sodium Chloride. K. Reich. Monatsh. 1891, 12, 464—473.

THE method adopted by the author for the determination of the solubility of sodium carbonate in sodium chloride consisted in treating an excess of the deca-hydrated carbonate with solutions of sodium chloride of varying strengths at 15° C. in suitable flasks, the mixing being effected partly by shaking and partly in a rotating machine worked by a water motor. After the mixing by hand the contents of the flasks were allowed to stand overnight, and the final mixing in the rotating machine given the following morning for 1—2 hours. Variations in the time of mixing between these limits were found to give concordant results. The solutions were then filtered and the filtrates titrated with decinormal silver nitrate and with seminormal hydrochloric acid to determine the sodium chloride and the sodium carbonate respectively.

In the following table *x* and *y* are the number of parts of sodium chloride and of sodium carbonate respectively dissolved by 100 parts of water:—

<i>x</i> , (NaCl)	<i>y</i> , (Na ₂ CO ₃ ·10 H ₂ O) Observed.	<i>y</i> , (Na ₂ CO ₃ ·10 H ₂ O) Calculated.	Difference.
0·00	61·12	61·41	+0·01
4·03	53·86	53·88	—0·02
8·02	48·00	48·05	—0·05
12·02	43·78	43·77	+0·01
16·05	40·96	40·91	+0·05
19·82	39·16	39·15	+0·01
23·70	39·06	39·06	0·00
27·93	39·75	39·81	—0·08
31·65	41·11	41·37	+0·07
35·46	43·77	43·78	—0·01
37·19	45·22	45·10	+0·12
37·27	45·32	45·16	+0·16

In the two last experiments a mixture of sodium chloride and sodium carbonate was treated with a quantity of water insufficient to dissolve either constituent, in which case it is seen that the solubility of both salts increases somewhat as compared with the calculated result. This calculated value is obtained from the first 10 of the above observations by the method of least squares for a parabolic curve of the third order, corresponding to the equation—

$$y = 61·406 - 2·091077x + 0·055493x^2 - 0·000297357x^3$$

The results show that the solubility of sodium carbonate in sodium chloride solutions decreases with an increase in the quantity of sodium chloride present at first, and then increases and therefore there must be a certain strength of sodium chloride solution in which the solubility of sodium carbonate is a minimum. This minimum value calculated from the above equation is with $x(\text{NaCl}) = 23·15$.

$$y(\text{Na}_2\text{CO}_3 \cdot 10 \text{H}_2\text{O}) = 39·05.$$

From the above equation the solubility of anhydrous sodium carbonate in sodium chloride can be calculated, the resulting equation being—

$$y_1 = 16·4082 - 0·70749x_1 + 0·0166143x_1^2 + 0·00010258x_1^3$$

in which x_1 and y_1 represent the proportions of sodium chloride and of sodium carbonate respectively contained in

100 parts of the solution. From this the following numerical values result:—

x_1 (NaCl)	y_1 (Na_2CO_3) Observed.	y_1 (Na_2CO_3) Calculated.	Difference.
Per Cent. 0.00	16.42	16.408	+0.012
2.92	14.47	14.476	-0.006
5.80	12.87	12.833	-0.043
8.61	11.62	11.614	+0.006
11.31	10.70	10.680	+0.020
13.71	10.11	10.096	+0.014
15.98	9.76	9.764	-0.004
18.26	9.62	9.653	-0.033
20.06	9.73	9.730	0.000
21.75	9.95	9.935	+0.015
22.45	10.12	10.060	+0.060
22.48	10.13	10.064	+0.066

The minimum solubility in this case corresponds to—

$$x_1(\text{NaCl}) = 18.22$$

$$y_1(\text{Na}_2\text{CO}_3) = 9.65$$

The following table gives the solubility of the anhydrous carbonate in sodium chloride solutions of various percentage strengths:—

x_1 NaCl	Na_2CO_3	x_1 NaCl	Na_2CO_3
Per Cent.		Per Cent.	
0	16.408	12	10.488
1	15.717	13	10.244
2	15.060	14	10.041
3	14.438	15	9.880
4	13.851	16	9.762
5	13.299	17	9.686
6	12.783	18	9.655
7	12.305	19	9.667
8	11.864	20	9.725
9	11.461	21	9.828
10	11.097	22	9.977
11	10.773		

The determination of the solubility of sodium bicarbonate in sodium chloride solutions was determined by passing carbon dioxide into saturated solutions of sodium carbonate in sodium chloride at 15° C. Solutions of sodium chloride of various strengths were employed in which so much sodium carbonate was dissolved that a small quantity of bicarbonate was precipitated after passing in the carbon dioxide, the latter being passed until the solution ceased to colour turmeric paper. The resulting solution was then rotated as described, at 15° C., and the sodium chloride and sodium bicarbonate determined volumetrically after filtration. No allowance was made for the slight increase of pressure due to the liberation of carbon dioxide in the shaking; 0.2 parts of carbonic acid were allowed for as being taken up by every 100 parts of solution. The results thus obtained go to show that the quantity of bicarbonate precipitated from solutions of sodium carbonate in sodium chloride by carbon dioxide at 15° increases with an increase in the strength of the original sodium chloride solution.

The following numerical values have been calculated from the results obtained:—

Per Cent. NaCl in the original Solution.	Na_2CO_3 in 100 parts of this Solution.	NaHCO_3 left in Solution after passing in CO_2	Precipitated NaHCO_3	Per Cent. of Na_2CO_3 of precipitated as NaHCO_3
10.642	10.884	2.968	14.252	82.62
15.804	9.782	1.869	13.634	87.95
15.932	9.768	1.847	13.635	88.07
21.618	9.915	1.061	14.053	93.25
23.71	10.31	0.886	15.504	94.6

The last result is obtained from the curve for the solubility of anhydrous sodium carbonate in sodium chloride solutions.
—C. A. K.

On the Decomposition of Sodium Nitrate by Sulphuric Acid. C. W. Volney. J. Amer. Chem. Soc. 1891, 13, 246—251.

When distilling nitric acid from the usual mixture of sodium nitrate and sulphuric acid it is frequently observed that at certain periods a violent reaction sets in, and that the contents of the retort are carried over into the receivers. The general supposition is that overheating is the cause of this. The author here distils a mixture of 2,500 grms. of sodium nitrate and 2,600 grms. of commercial sulphuric acid (sp. gr. 1.837 at 67° F.) in a glass retort having a capacity of about two gallons, and heated in a bath of paraffin; temperature of the bath and the temperature of the evolved products were noted. The results obtained show that the products of distillation pass over in three distinct fractions, and that the frothing commences with the beginning of each part of the reaction preceding distillation of the various strengths of nitric acid, although the temperature of the bath did not greatly exceed the temperature of the distilling products. The first fraction passing over showed the temperature 77°—90° C. and weighed 960 grms.; its specific gravity was 1.5193 at 60° F., and in colour it was almost white; the second fraction showed the temperature 94°—109°, weighed 565 grms., had a sp. gr. 1.505, and was very faintly yellow; the third fraction showed the temperature 117°—122°, weighed 316 grms., had a specific gravity of 1.42, and was of a light yellow colour. The author considers the reactions best explained by the existence of several hydrates of nitric acid; the sodium nitrate is not completely decomposed by sulphuric acid at a low temperature, and the decomposition takes place in stages, frothing occurring as each stage is suddenly reached.—T. L. B.

The Nitrate Fields of Chili. C. M. Aikman. Blackwood's Mag. March 1892, 1—9.

THE chief deposits at present being worked are those lying in the Pampa of Tamarugal, in the province of Tarapaca. They stretch at a distance of thirty or forty miles inland, from Pisagua southwards to somewhat beyond the town of Iquique. This huge desert, as has been already indicated, seems to be entirely destitute of all vegetation and animal life. Even in the immediately adjoining country the only kind of vegetation that seems to grow is a species of *acacia*. The few streams that are found in this neighbourhood are entirely fed by the melting snow from the Cordilleras. Darwin describes the appearance presented by these pampas as resembling "a country after snow, before the last dirty patches are thawed."

Scattered over the pampas, at various distances from one another, are situated the *oficinas*, or nitrate manufactories, where the raw material is refined. Seen from a distance, their most conspicuous features are their tall black chimneys. According to Dr. Russell, they present a general resemblance

to gas works, with the adjuncts of a coal-mine. Nearer approach shows them to consist of a cluster of buildings, with open boiling-pans, liquor-vats, and machinery of different kinds. There is something very striking in the presence of these *oficinas*, so indicative of life and enterprise in the midst of sandy deserts, and dependent for everything on external supplies brought from a great distance. Of these manufactories there are a considerable number in different parts of the pampas. Many of them are old, and not in work. Most of those in active work at present are the property of foreigners; and two-thirds of the nitrate exported from Chili is said to come from *oficinas* owned by English companies. Beside the *oficina* are the houses of the manager and his staff, and the huts of the native workmen. Every *oficina* possesses a public store, or *pulperia*, where the employes obtain their provisions. The whole group of buildings constitutes what is called a *maquina*. The extent of the property of each manufactory naturally varies, but some of the largest estates extend over 12 square miles.

The *caliche*, or raw nitrate of soda, is not equally distributed over the pampas. The most abundant deposits are situated on the slopes of the hills which probably formed the shores of the old lagoons. An expert can tell, from the external appearance of the ground, where the richest deposits are likely to be found. The *caliche* itself is not found on the surface of the plain, but is covered up by two layers. The uppermost, known technically as *chuca*, is of a friable nature, and consists of sand and gypsum; while the lower—the *costra*—is a rocky conglomerate of clay, gravel, and fragments of felspar. The *caliche* varies in thickness from a few inches to 10 or 12 feet, and rests on a soft stratum of earth called *coca*. The mode in which the *caliche* is excavated is as follows: A hole is bored through the *chuca*, *costra*, and *caliche* layers till the *coca* or soft earth is reached below. It is then enlarged until it is wide enough to admit of a small boy being let down, who scrapes away the earth below the *caliche* so as to form a little hollow cup. Into this a charge of gunpowder is introduced, and subsequently exploded. The *caliche* is then separated by means of picks from the overlying *costra*, and carried to the refinery. Both in appearance and composition it varies very much. In colour it may be snow-white, sulphur, lemon, orange, violet, blue, and sometimes brown like raw sugar. The *caliche* found in the Pampa de Tamarugal contains generally about 30 to 50 per cent. pure nitrate of soda; that in the province of Atacama contains from 25 to 40 per cent. The subsequent refining processes, which consist in crushing it by means of rollers, and then dissolving it, need not here be described. It may be sufficient to mention that the process used is that known as systematic lixiviation, and is analogous to the method introduced by Shanks in the manufacture of soda. The chief impurity in the raw material is common salt; gypsum, sulphates of potassium, sodium, and magnesium, along with insoluble matters, are the other impurities. The manufacture of iodine, which, as has been already noticed, is found in the nitrate beds, is also carried on at these *oficinas*.

Formerly the refined article had to be carried to the coast on mules; now, however, there is railway communication, which maintains a constant and ever-increasing traffic with Iquique, Pisagua, and the other nitrate ports. Of these, Iquique is by far the most important. In respect of its situation and surroundings, this little town is one of the most striking in the world. The following is Darwin's description of it when the "Beagle" visited it in 1835:—

"The town contains about 1,000 inhabitants, and stands in a little plain of sand at the foot of a great wall of rock 2,000 feet high, here forming coast. The whole is utterly a desert. A light shower of rain falls only once in very many years; the ravines are consequently covered with detritus, and the mountain sides covered with piles of white sand, even to a height of 1,000 feet. During July a heavy bank of cloud stretches over the ocean; it seldom rises above these walls of rocks on the coast. The aspect of the coast is most gloomy. The little port, with its few houses, seemed overwhelmed and out of all proportion with the rest of the scene. The inhabitants live like persons on board

of ship. Every necessary is brought from a distance; water is brought in boats from Pisagua, about 40 miles by water, and is sold at the rate of 4s. 6d. an 18-gallon cask. Very few animals can be maintained in such a place. I hired with difficulty, at the high price of 4l., two mules and a guide to take me to the nitrate of soda works." Since 1835, however, the appearance of the town has changed very much for the better. The enormous development of the nitrate trade has effected a corresponding development in Iquique. Its population is now between 16,000 and 20,000, very largely consisting of foreigners; and the town can boast of a fairly imposing appearance. Much of its food supplies has still to be brought from a distance, but the town now possesses a water supply of its own. The example of a town of this size so dependent on external sources is indeed unique.

The question of the extent of the nitrate of soda deposits is naturally one of very great interest, especially from the agricultural point of view.

Lefrange, a French writer, estimated a few years ago that they still contained about 100,000,000 tons of pure nitrate of soda. Opinions on this point differ very considerably, and it seems wellnigh impossible to arrive at any very accurate estimate. The number of years they will last will depend, of course, on the amount of annual exportation. This, at present, falls little short of 1,000,000 tons. If this amount is maintained they should last, according to experts, some twenty or thirty years at least.

Hitherto the Government of Chili has been content to allow foreign enterprise to open up the nitrate fields, imposing a heavy tax on all nitrate manufactured. The enormous source of revenue which nitrate of soda is to the Chilean Government may be inferred from the fact that one *oficina* alone pays about 750l. per diem, or in round numbers 250,000l. per annum, of export duty on the nitrate there manufactured.

PATENTS.

Improvements in the Preparation of Chlorine. G. E. Davis and A. R. Davis, Manchester. Eng. Pat. 6416, April 28, 1890. (Reprint.)

THE claims embodied in the original patent (this Journal, 1891, 463) are abandoned, with the exception of the second claim for "the utilisation of the water charged with impurities from the wash tower D for preserving the normal strength of the nitric acid employed in the operation . . ."

—H. A.

Improvements in the Manufacture of Chlorine. G. E. Davis and A. R. Davis, Manchester. Eng. Pat. 6698, May 1, 1890. (Reprint.)

THE claims of the original patent (this Journal, 546, 1891) are restricted to "the process of manufacturing chloronitrous gas by acting upon an aqueous solution of hydrochloric acid with nitrosulphuric acid in the presence of air in a tower packed with suitable material . . ."

—H. A.

Treating Ores and Residues containing Zinc by means of Bisulphate of Soda for the Production of Commercial Products. A. M. Clark, London. From F. E. Costes, "La Société anonyme de Produits Chimiques Etablissements Malétra," Paris, France. Eng. Pat. 1374, January 24, 1891.

See under X., page 352.

Improvements in the Treatment of Composite Ores containing Zinc. P. Hart, Manchester. Eng. Pat. 2000, February 4, 1891.

See under X., page 352.

Improvements in Apparatus for the Condensation of Nitric Acid. E. Edwards, London. From O. Guttman and L. Rohrmann, Krauschwitz, Germany. Eng. Pat. 10,629, June 22, 1891.

The inventors find it important in the condensation of nitric acid "that the nitric acid as formed should be brought out of contact with the impurities contained in the gases as quickly as possible." This is effected by a double connexion of the still with the receivers. A series of top-connexions, consisting of upright pipes and bends, enables the gases to pass from receiver to receiver, whilst an inclined main connected with the bottom of each receiver makes possible the drawing off of the condensed acid as it is formed. To prevent the gases from the still or the receivers from entering this main, the latter is divided into chambers by means of partitions or diaphragms between each receiver inlet, which chambers communicate through elbows luted with acid (this Journal, 1890, 862).—H. A.

X.—METALLURGY.

The Melting Points of the Gold Aluminium Series of Alloys. W. C. Roberts-Austen. Roy. Soc. Proc. 1892, 50, 367—368.

By means of the Le Chatelier thermo-couple the author has found that, although a white alloy of gold and aluminium containing 10 per cent. of the latter has a melting point 417°C . below that of gold, yet the purple alloy AuAl_2 has a melting point 32.5°C . higher than gold. Alloys containing more aluminium have melting points which fall continuously to 660°C . The author points out that the purple alloy is the only known case of an alloy, free from mercury, having a higher melting point than that of the least fusible of its constituents, and that this affords strong

evidence of its being a true compound of gold and aluminium.—J. C. C.

The Molecular Changes of Iron. H. Morcillon. Bull. Soc. Ind. de Mulhouse, 1891, 629—656.

THE author has examined the effect of various thermal and mechanical conditions upon a specimen of wrought iron having a tensile strength of 38 kilos. per sq. mm.* and an elongation on 200 mm. of 26 per cent.

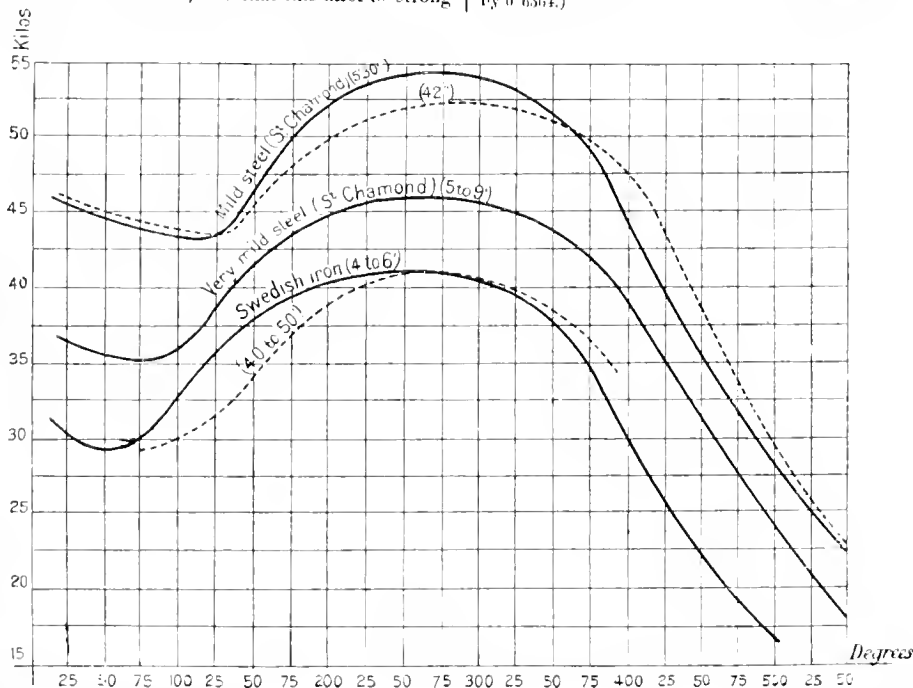
(1.) *Effect of Temperature.*—The effect of heating iron having a fibrous structure is to give rise to a crystalline granular condition, the result being more noticeable the higher the temperature and the more its influence is prolonged. Quenching in water does not modify the granular state produced by the heating. By annealing at a temperature below that to which the iron has been subjected in order to change its fibrous structure to a crystalline one its original condition is to a great extent restored.

(2.) *Effects of Mechanical Work.*—The general effect of working in the cold is to lead to the production of a granular structure and to cause a partial separation along the lines of welding. In extreme cases the extension diminishes to a mere fraction of its normal amount, and although the tensile strength is considerably raised, the material becomes brittle and unreliable.

(3.) *Effect of Annealing.*—By annealing at suitable temperatures the fibrous character can be restored to iron which has assumed a crystalline condition from one or other of the causes mentioned above.

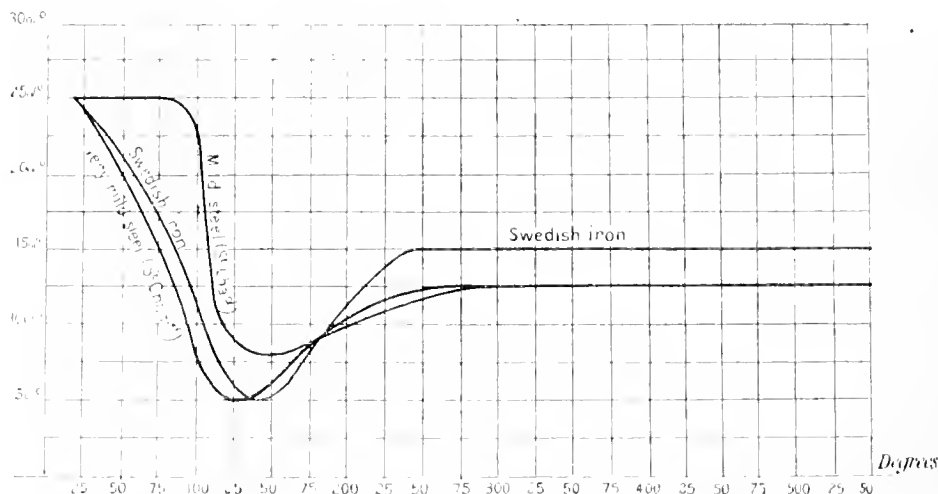
The molecular alteration indicated by the appearance of the fracture has a considerable influence on the mechanical properties of the iron. The alteration from the fibrous to the crystalline state is generally accompanied by a diminution in tensile strength, while the elastic limit is but slightly altered and the elongation is decreased. Although a red heat appears to be necessary to bring about the changes recorded above, yet considerable alterations in the mechanical properties of iron and steel take place at lower temperatures, as has been shown by A. le Chatelier (*Genie Civil*, 147, 107; cf. this Journal, 1889, 710). In all cases in his experiments the tensile strength decreased from a temperature of 15°C . up to 80°C . above which it rose again and attained a maximum at 250° — 300°C . These results are shown more clearly in the diagram below.

* (To convert kilos. per sq. mm. into tons per sq. in. multiply by 0.06364.)



A difference is observed according to the speed with which the test is made, the dotted lines uniformly following a different course from the continuous lines which represent the figures obtained by the slower tests. The elastic limit appears to decrease in proportion as the temperature is

increased. The diminution is very slight at first, but beyond 300° C. it becomes extremely rapid and difficult to measure. The effect upon the elongation is shown by the diagram below.



It is noticeable that if a test piece be heated to a moderate temperature, *e.g.*, 100° C., and then slightly stretched, it will be found to give a higher tensile strength when tested afterwards at the ordinary temperature than one which has not been thus treated. The elastic limit is also raised and the elongation decreased. The following table shows some figures obtained in this way:—

SWEDISH IRON.

Tested at 15° C.	Tested at 15° C. after being stretched 3 per Cent. at 150° C.
Tensile strength, 30.9 kilos. per sq. mm.	38.14 kilos. per sq. mm.
Elongation, 25 per cent.	15 per cent., including the original 3 per cent.

VERY MILD STEEL (SAINT CHAMOND).

Tested at 15° C.	Tested at 15° C. after being stretched 3.5 per Cent. at 220° C.
Tensile strength, 36.18 kilos. per sq. mm.	40.45 kilos. per sq. mm.
Elongation, 25 per cent.	12.5 per cent., including the original 3.5 per cent.
Elastic limit, 24.6 kilos. per sq. mm.	39.5 kilos. per sq. mm.

The practical deductions from these facts as to the probable changes that may occur in iron worked at a slightly elevated temperature are sufficiently obvious, especially when it is considered that these temperatures are those frequently attained by boiler plates. The phenomenon in question is not confined to the temperature mentioned, as at the ordinary temperature repeated strains on a test piece are known to raise the elastic limit by successive increments without affecting the ultimate tensile strength. Thus in a series of tests made by H. Deschamps (Revue Universelle des Mines et de la Métallurgie, November 1890) the following results were obtained with a steel which when tested in the ordinary way had an elastic limit of 30.3 and a tensile strength of 55.7 kilos. per sq. mm.

		Kilos. per Sq. mm.
Experiment (1) ...	Elastic limit.....	30.4
	Tensile strength.....	31.3
Experiment (2) ...	2nd elastic limit.....	35.3
	Final tension.....	39.3
Experiment (3) ...	3rd elastic limit.....	40.3
	Final tension.....	41.4
Experiment (4) ...	4th elastic limit.....	45.3
	Final tension.....	49.2
Experiment (5) ...	5th elastic limit.....	49.2
	Final tension.....	53.2
Experiment (6) ...	6th elastic limit.....	53.2
	Final tension.....	55.5

Metal which has suffered such a change as is here indicated, having its elastic limit approximating to its ultimate tensile strength, is obviously a very dangerous material.

The foregoing results refer to iron which has been subjected to physical changes only, its ultimate chemical composition having been left unaltered. Deep-seated alterations of structure are also brought about by variations in composition. For example, a specimen of "burnt" iron with a coarse crystalline structure and extremely cold-short taken from the hearth of a welding furnace contained 0.764 per cent. of phosphorus with 0.139 per cent. of silicon and a trace of carbon, while the original iron before "burning" had taken place contained at most 0.2 per cent. of phosphorus, the increment being due to contact with the slag from the molten portion. It has been contended that the fibrous or granular structure of iron is primarily dependent on the manner in which fracture has been effected. This is to a certain extent true, but does not invalidate experiments in which the method of fracture is kept identical in all cases where comparisons have to be made.

With regard to the influence of the impurities usually present in iron on the grain of the metal, carbon makes the structure closer and finer, approximating eventually to that of steel, while silicon within ordinary limits (say up to

0·15 per cent.) has but little effect; phosphorus renders the grain coarse and more crystalline, and sulphur has no very marked influence. Manganese is not commonly present in appreciable amount in ordinary puddled irons.—B. B.

On the Possibility of Extracting the Precious Metals from Sea-Water. C. A. Münster. (Norsk Tekniak Tidsskrift, Kristiania, 10th Vol., No. 1., February 29, 1892.)

THE author recounts the experiments of Malaguti, Durocher and Sarzeand, estimating the amount of silver present in sea-water, and the later ones of Sonstadt, proving the presence of gold. After pointing out several possible sources of error in the various processes adopted he describes the method used by himself. Sea-water was taken from Kristiania Fjord, and 100 litres were evaporated to dryness, giving 1,830 grms. of residue. This was ground, and divided into portions of 300 grms., each of which was mixed with 100 grms. of litharge, 100 grms. of pure KNaCO_3 , and four grms. of carbon from starch, and the silver and gold determined.

The result was,—19 mgrms. silver and 6 mgrms. gold per ton of average sea-water.

By check experiment this result was modified to a final result, the effect of which was that one ton of average sea-water contains 20 mgrms. of silver and 5 mgrms. of gold per ton, worth respectively 0·03 and 0·19 of a penny.

Considering the extremely small amounts of precious metals present, the author considers that no method of precipitation in tanks can possibly be successful, instancing the failure of H. Munktel, who tried precipitation with protosulphate of iron and milk of lime, at Bømmelø, on the west coast of Norway. He thinks that the precipitation must be effected in the sea itself, where the water is continuously renewed by a natural current, and points out that the copper sheathing of vessels has long been known to precipitate silver under these circumstances, estimating that at least one gm. is precipitated per annum on each square metre of surface exposed.

He proposes that a channel about 60 metres wide between two small islands, well sheltered from sea or wind, where there is a current of about 4 metres per minute, should be selected for the experiment, such rocky islets being common off the Norwegian coast; across this channel, 60 plates of galvanised iron each 2 metres \times 3 metres, should be arranged at an angle of 30° to the stream, and an electric current be sent through the series to precipitate the precious metals. The power required theoretically for this purpose he calculates at only $\frac{1}{2}$ H.P., and thinks that to produce a current of such trivial potential difference in practice would only require a few horse-power, which could cheaply be obtained from water-power, wind, or even by the thermo-electric principle utilising the difference of temperature between the sea and the air. The large anodes required could be cheaply prepared from wood, impregnated with graphite and tar, and carbonised, high conductive power not being required for such a feeble current. If all the precious metals passing these plates were precipitated, he calculates that over 300,000l. would be obtained per annum, and as the working expenses would be most trivial, if only $\frac{1}{1000}$ th or even $\frac{1}{10000}$ th of this amount were obtained, it would still pay well; he therefore thinks the experiment well worth a trial.—J. H. C.

PATENTS.

Improved Method or Process for Treating Metal-bearing Bodies, and the Recovery of Metals therefrom. W. C. Loe, London. Eng. Pat. 5937, April 18, 1890.

FREE milling matrices are pulverised to float and calcined with one-fortieth part of potassium hydrate and one-eighth part of sulphur to a dull red heat for 2—4 hours. The product is then washed in tanks at 200° (F. 2°), and the liquor drawn off at the top. The latter is then treated with a saturated solution of calcium sulphide, when a black slime is precipitated. This is roasted and the residue fluxed and

refined by known means. If necessary, the potash and sulphur may be brought into solution by boiling with water before being added to the ore. The sulphur may be omitted if the ore contain sufficient of that element. Complex ores are first mixed with a saturated solution of ferrous sulphate, dried and roasted, and are then treated with potash and sulphur. If the ore contain less than $2\frac{1}{2}$ per cent. of iron sufficient oxide of iron must be added to make up the deficiency.—H. K. T.

An Improved Method for Treating Cupreous Liquors for the Purpose of utilising the same. C. Höpfner, Giessen, Germany. Eng. Pat. 18,080, November 10, 1890.

THIS patent consists of precipitation processes for extracting copper and other metals from crude copper solutions derived from the roasting and lixiviation of copper pyrites and from other sources.

The copper solution is first converted into a mixture of cupric chloride and sodium sulphate by the addition of either sodium chloride or copper sulphate, and the copper is then precipitated as cuprous chloride by treating the liquor with metallic copper, silver being precipitated as metal at the same time. The solution now contains only sodium sulphate together with traces of iron, nickel, &c. The latter are precipitated by known processes, and the liquor then treated for the separation of Glauber's salt. If the original liquor is acid, it is first neutralised by the addition of cuprous or cupric oxide. Cuprous sulphide, oxide, or carbonate can be used instead of metallic copper for precipitating copper from the cupric chloride solution. In this case iron, manganese, and other metals are also precipitated. The necessary cuprous oxide is obtained by treating cuprous chloride with caustic lime. The copper precipitate, which may contain metallic copper, cuprous and cupric oxides, and cuprous chloride, is next dissolved in a neutral or alkaline solution of some chloride which will dissolve cuprous chloride, such as sodium, potassium, cupric or magnesium chloride, when silver, bismuth, arsenic, and antimony are left behind as metal or oxidised compound. Metallic copper is obtained in a state of purity from the solution by electrolysis. Other methods of extracting the copper from the cuprous precipitate are to treat it with lime and utilise the oxides which are produced. Or the cuprous oxide precipitate may be heated with sulphuric acid, when metallic copper and cupric sulphate are obtained. Reduction by iron can also be used. As the oxidation and chlorination of pyrites by roasting is often incomplete, it is advisable to separate magnetic pyrites from the roasted mass by means of magnets before leaching, and to submit these pyrites to a separate treatment.—H. K. T.

Improvements in Apparatus for and Process of Treating Zinc Ores. W. West, Denver, Colorado, U.S.A. Eng. Pat. January 20, 1891.

THIS is a process for the reduction of ores occurring in America, consisting of a mixture of sulphides of zinc, lead, iron, and copper, together with some gold and silver, and has especial reference to the economical extraction of the zinc. The process consists in roasting the ore so as to obtain sulphurous anhydride, and then allowing this gas, after it has been cooled to a temperature below 180° F., to act upon a moist and previously roasted portion of the ore, thereby forming soluble sulphite of zinc. The latter is then dissolved out with water, the zinc precipitated as hydrate with ammonia and reduced in the usual way. The ammonia is recovered by distilling the liquor from the above precipitation with lime and the extracted ore is treated by the usual methods for the remaining metals. The apparatus used in the process consists of a roasting chamber heated from below, a zig-zag flue which conveys the hot sulphurous anhydride, and which is covered with iron plates to form a floor on which previously extracted ore can be dried; thus effecting at one and the same time the drying of the ore and the cooling of the gas, further cooling apparatus if necessary, a blower to exhaust the gas from the roasting chamber and force it into the leaching vessel, a pipe conveying steam

which mixes with the gas before it enters the leaching tank and furnishes the necessary moisture and a leaching vessel provided with a false bottom on which the ore is supported. The chief novelty of the process consists in the use of a mixture of sulphurous anhydride gas and steam instead of a solution of the gas in water, whereby the bulk of liquid to be treated is greatly reduced and the production of sulphuric acid, and consequent solution of copper and iron, avoided.

—H. K. T.

Improved Gold Extracting Reagents. J. H. Poilok, Glasgow. Eng. Pat. 1309, January 24, 1891.

This patent is for improvements in the chemicals used in the processes described in Eng. Pats. 17,495 of 1887, 16,796 of 1888, and 5578 and 10,298 of 1889 (this Journal, 1890, 444, &c.) A small proportion of sodium sulphite is now melted in with the nitre cake to remove any trace of nitric acid, any increase of acid desirable being obtained by adding sulphuric acid to the nitre cake before the addition of the sulphite. Also instead of using crystallised ferrous sulphate to precipitate the gold, the crystals are first broken and then raised in a steam-heated vessel furnished with agitators to any desired temperature. By raising the temperature from 100° C. to 150° C. the salt is left with only one molecule of water, and is therefore lighter and costs less for transport.

—E. T.

Treating Ores and Residues containing Zinc by Means of Bisulphate of Soda for the Production of Commercial Products. A. M. Clark, London. From F. E. Costes, "La Société Anonyme de Produits Chimiques, Etablissements Malétra," Paris, France. Eng. Pat. 1374, January 24, 1891.

ACCORDING to the present invention, zinc turnings, filings, and other scrap, scum and dross from molten zinc, galvanisation residues, slimes from the washing of calamines and blendes, calamines or blendes too poor in zinc for distillation, and other waste products containing zinc, are utilised by treatment with the waste residues from the manufacture of nitric acid, known as bisulphate of soda. The zinc waste is mixed with a variable proportion of bisulphate of soda according to its richness in zinc (thus zinc ashes containing 70 per cent. of zinc would require $2\frac{1}{2}$ or 3 times their weight of bisulphate), introduced into a reverberatory furnace with refractory lining, and the charge withdrawn immediately the mass becomes pasty and homogeneous, and after nearly all the vapours have ceased to disengage. The zincic frit obtained is thrown into water, which dissolves the sulphates of zinc, sodium, and iron, leaving the gangue and impurities in the residue. The solution is decanted off, and after separating the iron by any suitable means, the sulphate of soda is crystallised out and prepared for the market. The zinc in the mother-liquors is then precipitated either by lime-water, sodium sulphide, or ammonia, and the precipitate of oxide or sulphide of zinc calcined in a muffle furnace, the temperature in case of the sulphide being kept below 400°–500° C. The product is a zinc white, which has a good colour, is unctuous, and covers well.

If metallic zinc is required, the oxide or sulphide should be well washed, moulded into bricks, and highly calcined; the product is an oxide containing 70 per cent. of zinc, which on reduction distils over in one-half less time than that required by ordinary calcined calamines.

If ammonia is used for precipitating the zinc, the sulphate of ammonia is crystallised out from the mother-liquors, but if lime-water or sulphide of sodium have been used, the mother-liquors may be utilised for the manufacture of barium sulphate or "blanc fixe" by adding to them a weak solution of barium hydrate of low quality, and collecting the precipitate.—S. B. A. A.

Improvements in the Treatment of Composite Ores containing Zinc. P. Hart, Manchester. Eng. Pat. February 4, 1891.

This process is intended for poor ores of a composite nature in which the metals exist as sulphides or partly as sulphides and partly as oxides. The ore is finely powdered, mixed with sulphuric acid of sp. gr. 1.750 and heated to 300° to 400° F., gases consisting chiefly of sulphurous anhydride are given off and are conducted into a sulphuric acid chamber and converted into sulphuric acid. The mass is next gradually heated to redness to render iron salts insoluble and is then lixiviated. Copper is removed from the solution by means of zinc and the solution of zinc sulphate is then evaporated and crystallised or used for any purpose for which it is suitable. Any lead which the ore may contain will be found as sulphate in the residue and may be extracted by means of a strong solution of brine or other solvent, the metal being separated from the solution by electrolysis or other means. Or the magna of silica, lead sulphate, &c. may be smelted in the ordinary manner. No apparatus other than that used in the manufacture of sodium sulphate is required.—H. K. T.

A Process for the Extraction of Tin from Tin Slags and Tin Refuse by Lead or its Salts, Carbonaceous Matter, Fluorspar, or other suitable Fluxes. F. H. Mason, London. Eng. Pat. 10,985, June 27, 1891.

TIN slag or refuse from tin-smelting is crushed so that the largest pieces do not exceed the size of a walnut, and mixed with 15 per cent. of fluorspar or other suitable flux, a quantity of lead ashes or salts of lead containing three times as much lead as there is tin in the slags, and sufficient anthracite to reduce both the lead and tin compounds. The mixture is charged into a reverberatory or low blast furnace, and the temperature raised until the mass melts. The whole is then kept at a uniform heat and well rabbled until the bubbling ceases; a little anthracite is then thrown in, and the rabbling continued until the mass is again quiet; the metal is then run out and cast into ingots. These ingots are next subjected to a process of liquation, the portions first liquating out being collected apart; the other portions are heated and poled, the product being an alloy of tin and lead which may be utilised as solder.—S. B. A. A.

Improvements in Blast Furnace Linings. J. T. King, Liverpool. From J. Gayly, Braddock, U.S.A. Eng. Pat. 13,690, August 14, 1891.

THE brickwork lining of the boshes and hearths of a blast furnace generally undergoes rapid corrosion until, owing to certain reactions, a carbonaceous deposit is formed on these parts, which to some extent arrests the destructive action. This coating, however, is liable to be removed by slags of exceptional composition. The inventor, therefore, proposes to line the walls of the boshes with graphitic bricks composed preferably of 75 parts of fireclay and 25 parts of graphite set in a mortar of the same material, and forming a layer of 18 in. or less in depth. The bricks are tempered, moulded, and burnt in the usual manner, no sensible deterioration being caused by the last operation; the proportions of the ingredients may be varied, other forms of carbon substituted for graphite, and 20 per cent. or less of lime or 5 per cent. or less of magnesia may be added to render the bricks more refractory and durable.

—S. B. A. A.

Improvements in Apparatus for Leaching Ores in separating Gold and Silver therefrom. W. D. Bohm, Chiswick. Eng. Pat. 14,737, September 1, 1891.

IN treating certain ores by forcing a leaching solution upwards through them and then through a filter at the upper part of the vat, the filter is liable to become clogged and the working impeded. According to the present invention this is obviated by the use of a vat provided with a filter both at the top and bottom with corresponding

openings, the vat being arranged so as to turn on trunnions when required, and reverse the position of the filters. The bearings contain passages through which the liquid is forced into and passes from the vat, and which communicate with the openings at the ends of the vat, the connexions being reversed when the vat is turned. For the mechanical details of the construction of the vat and attached gearing the drawings and description in the specification must be consulted.—S. B. A. A.

Improvements in Blast Furnace Linings. J. Johnson, Liverpool. From J. Gayly, Braddock, U.S.A. Eng. Pat. 19,330, November 9, 1891.

THE inventor proposes to line the boshes and hearth of blast furnaces with bricks composed of coke and tar for the purposes explained in the preceding abstract (Eng. Pat. 13,690, of 1891). The bricks are prepared as follows: Good hard coke of graphitic appearance and low in ash is ground in a pug mill, heated, thoroughly incorporated with 5 to 15 per cent. of hot tar according to the pressure obtainable at the moulding machine, moulded into bricks and fired at a low temperature in a muffle furnace. Anthracite coke and charcoal may be used in addition to ordinary coke in the manufacture of the bricks. The latter are generally arranged as a lining to the boshes and hearth, but in iron jacketed furnaces, they may form the whole thickness of the wall in those regions.—S. B. A. A.

Improvements in the Treatment of Ores. A. M. Clark, London. From C. G. Richardson, W. D. Firstbrook, Toronto, and E. H. Davis, Montreal, Canada. Eng. Pat. 20,521, November 25, 1891.

ACCORDING to this invention ores containing sulphides, arsenides, or sulpharsenides are freed from sulphur and arsenic by treatment with steam. The ore is pulverised, placed in a closed receptacle which is kept in a state of constant agitation and may be heated or otherwise, and superheated or other steam is passed in until the ore contains no more sulphur and arsenic than is desirable. The bases remain as oxides; the sulphur and arsenic may be recovered by collecting the sulphuretted and arseniuretted hydrogen evolved and treating these gases in any suitable manner.

—S. B. A. A.

An Improved Method of Treating Plumbiferous Copper Mattes and Ores. C. James, Swansea. Eng. Pat. 22,041, December 16, 1891.

THE process described is an improvement on the method of Eng. Pat. 13,739 of 1891 (this Journal, 1891, 1012), and deals with the same classes of material. According to the improved process the matte is crushed, completely calcined, preferably in a revolving calciner, mixed with *raw matte*, and silica or siliceous ore or other matter in such proportions as to provide sufficient sulphur to combine with all the copper present and sufficient silica to form a silicate of iron and lead; the mixture is then melted in a reverberatory furnace. If the proportion of silica be so adjusted as to be quite neutralised by the lead and iron present the products will be a rich regulus or coarse copper entirely free from lead, and a lead slag nearly free from copper. Any silver or gold originally present in the matte is almost entirely concentrated in the copper regulus.

Ores containing more than 15 per cent. of lead cannot be completely calcined, and are best reserved for admixture with calcined ores of lower lead content. For example, 8 parts of a thoroughly calcined matte containing 36 per cent. of copper and 16 per cent. of lead mixed with 3 parts of a raw matte containing 32 per cent. of copper and 24 per cent. of lead, yielded on fusion a coarse copper with 90 per cent. copper free from lead and a slag containing 19 per cent. of lead. Deoxidation of the matte during fusion, as in the "roaster" process, or by addition of oxidising agents, with the simultaneous introduction of silica, is also claimed.—S. B. A. A.

Improved Material for making Amalgam for Filling Teeth and Method of Manufacturing the same. G. Jüterbock, Berlin, Germany. Eng. Pat. 22,211, December 19, 1891.

FOR the purpose of filling teeth, dentists dissolve an alloy of silver and tin in mercury, and, if required, add a certain proportion of gold or platinum. The alloy is supplied in filings or chips which are contaminated with dirt and small particles of metal from the cutting tool, and are, moreover, liable to oxidation. This is remedied according to the present invention by rolling the alloy into sheets, which are electro-plated with gold and cut into pieces. The layer of gold protects the alloy from oxidation, but at once dissolves in mercury, exposing the pure alloy, which is rapidly amalgamated.—S. B. A. A.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Improvements in Means for Use in Electrolysis. J. Marx, Frankfurt-on-Main, Germany. Eng. Pat. 6266, April 24, 1890. (Second Edition.)

THE apparatus described is especially suited to the electrolysis of such solutions as that of sodium chloride, where the materials resulting from electrolysis at one electrode must, as far as possible, be kept apart from those set free at the other. For this purpose the liquid is always employed in a shallow layer with pointed anodes dipping a short way into it, while the cathodes, placed alongside, are covered by hoods to catch the hydrogen liberated. No diaphragms are employed.—E. T.

Improvements in Electro-depositing. W. Gibbings, Garston. Eng. Pat. 2518, February 12, 1891.

A BEAM of insulating material is placed on each side of the tank, below the surface of the electrolyte. The plates are supported by projections at the top which rest at each side on the beams. Current is led in and out by the end plates, but as all the plates are insulated from each other, except through the electrolyte, it is as though a number of cells had been formed, each plate acting as a division wall and being a cathode to one cell and anode to the next. By placing the supporting beams sufficiently low down, the plates may be wholly immersed and waste in that way prevented.—E. T.

Improvements in and Apparatus for Electrolysing and Bleaching. J. Marx, Bad-Nauheim, Germany. Eng. Pat. 3738, March 2, 1891.

IN the electrolysis of sodium chloride by such apparatus as that described in Eng. Pat. 6266 of 1890 (see above), it is impossible to prevent a certain amount of recombination between the chlorine and the alkali liberated. The patentee diminishes this by treating the electrolysed solution with carbon dioxide so as to leave alkaline carbonates or bicarbonates and hypochlorous acid. The liquor is then again electrolysed, perhaps with the addition of more chloride, and the acid present prevents so much of this recombination taking place. If a bleaching solution is desired, the recombination is rather favoured, and a larger amount of carbonic dioxide used, so as to produce more hypochlorous acid, which acts as a bleaching agent. To absorb the carbonic acid, the liquor is allowed to flow down an inclined plane furnished with ridges in an atmosphere of the gas.—E. T.

Improvements in the Electric Reduction of Aluminium and other Metals, and in the Production of Alloys therefor. T. L. Willson, Brooklyn, U.S.A. Eng. Pat. 4757, March 17, 1891.

A CRUCIBLE of carbon is made the anode while a carbon rod, introduced through a non-conducting lid, serves as cathode. The current consequently passes upwards through the ore in the crucible, to the negative electrode above. To prevent wasting of either electrode, powdered carbon or coal, &c. are fed in. For aluminium bronzes, copper is fed in with the ore. With iron ore and corundum an aluminium steel can be made.—E. T.

Improvements in the Formation of Ozone in Presence of Air or Oxygen, and Apparatus therefor. A. Schneller and W. J. Wisse, The Hague, Holland. Eng. Pat. 5222, March 21, 1891.

THE ozonising chamber contains a number of electrodes enclosed in tubes of glass or other good di-electric material. These electrodes are alternately + and -, but as they are joined up to a transformer or alternating current dynamo giving a large E.M.F., their polarity is perpetually changing. Drawings are also given of apparatus for freeing the air or oxygen of dust and moisture before passing it into the ozonising chamber.—E. T.

Improvements in Electric Batteries. H. I. Harris, London, and W. H. Power, Anerley. Eng. Pat. 5918, April 6, 1891.

THE invention consists in the use of iron and sulphur cells as the electrodes of a battery, and water as the exciting fluid. The sulphur cell is insulated from the iron, and they are closed by a water-tight lid. The water is led in at the bottom of the outer cell, percolates under pressure through the brimstone, and is siphoned off from the inner cell. The supply can be regulated by a tap.—G. H. R.

Improvements in Galvanic Batteries. S. Marcus, L. Patz, and R. Grebner, Vienna, Austria. Eng. Pat. 6243, April 11, 1891.

THE invention consists in making one of the electrodes of cylindrical shape, the other being placed within it in the form of a triangle, square, or other suitable prism, so that the two electrodes come into close proximity at certain points, whilst between these points hollow spaces are left for the electrolyte.—G. H. R.

Improvements in Automatic Regulating Apparatus employed in connexion with Galvanic Batteries. J. Y. Johnson, London. From F. Gendron, Bordeaux, France. Eng. Pat. 6247, April 11, 1891.

ACCORDING to this invention, which is specially applicable to two fluid cells, the several vessels containing the liquids are arranged in a frame having three stages with insulating rollers, on which the vessels can be readily moved. The two upper shelves carry the battery cells, while the tanks containing the liquids are placed on a lower one. A small motor driven by a current from the battery works the two circulating pumps, which may be of any suitable construction, but are preferably "Sansay pumps," specially designed for acid liquids. One pump is used for the exciting liquid, and the other for the depolariser. Each pump is connected with the corresponding store tanks by branch pipes provided with stop-cocks and valves worked automatically by sliding rods, so arranged that when one set of valves is open the other is shut. The sliding rod is provided with ratchet-shaped teeth, and is capable of being moved laterally by an electro-magnet so as to bring the lateral projections into the path of one or other of the legs of a forked lever, to which the motor imparts a continuous vibrating motion. By engaging with this lever the rod is caused to work the valves and place the pump

in connexion with the different tanks. Similar mechanism controls the number of cells in action at one time, and puts them in or cuts them out as required.—G. H. R.

Improvements in Electrical Accumulators or Storage Batteries. C. P. Elieson, London. Eng. Pat. 7697, May 4, 1891.

THIS invention consists in building up the electrodes of a series of corrugated envelopes of cylindrical or other desirable shape, composed of thin lead or other suitable metal, and preferably perforated. These envelopes are placed one within the other, and the corrugations are so arranged that those of one cylinder cross, or are at an angle, to those of adjacent cylinders. Suitable means are provided for preventing them coming into contact.—G. H. R.

Improvements in Electrodes for Electric Accumulators. W. P. Thompson, Liverpool. From H. O. Tudor, Rosport, Luxembourg. Eng. Pat. 8227, May 13, 1891.

THE improvements consist in forming the electrodes of a plate, the two surfaces of which are provided with grooves or ridges of any suitable form or depth, instead of the plain plate mentioned by the inventor in Eng. Pat. 11,543 of 1887; and these grooves or ridges have on each side of them other smaller grooves, running horizontally or vertically as previously described.—G. H. R.

Improvements in Galvanic Batteries. R. Haddan, London. From I. Cabanyes, Paris, France. Eng. Pat. 8845, May 25, 1891.

THE improved cell is constructed as follows:—the outer case is composed of two cases of wood placed one within the other, the space between being filled with melted paraffin. The carbon electrode is composed of a number of carbon rods fixed to a copper connecting ring. A suitable number, preferably four of these, are connected to form one electrode. The zinc rods dip into porous jars placed within each group of carbons, and are so arranged that any one may be removed and replaced while the battery is working. The solution for the carbons in the outer case or jar consists of a mixture of equal parts of nitric acid and hydrochloric acid, to which mixture is added water acidulated with 5 per cent. of sulphuric acid. The volume of water is equal to the volume of the two acids together.—G. H. R.

A Process and Apparatus for Increasing the Bleaching Properties of Chlorine Gas. C. Kellner, Manchester. Eng. Pat. 22,438, December 23, 1891.

THE chlorine is treated in the same way as air when it is desired to produce ozone. Two pieces of apparatus are described. The first consists of two test tubes, one inside the other, and fused together at the top. The chlorine passes, by a tube at the bottom of the outer test tube, into the space between the two, and passes out near the top. The inner tube contains sulphuric acid as one electrode, while more sulphuric acid, in which the outer tube is immersed, serves as the other electrode. In the other apparatus the gas passes by a zigzag course between flat vessels, alternately + and -, containing sulphuric acid. The polarity is rapidly changed in the usual way.—E. T.

Improvements in and relating to Secondary Batteries. J. B. Entz and W. A. Phillips, Bridgeport, Conn., U.S.A. Eng. Pat. 1484, January 26, 1892.

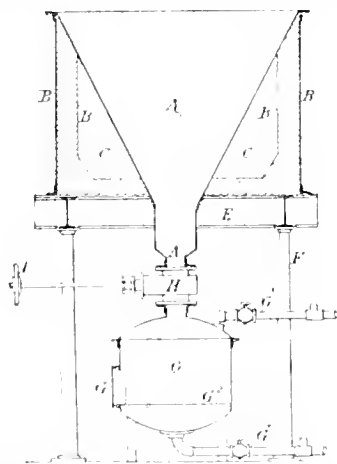
THE object of the invention is to render the electrolytic action more uniform over the surface of the plates during charge and discharge, thus securing longer life to the cell. This is effected by heating the bottom of the cells, thus causing the liquid to circulate.—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

The Glycerin and Artificial Butter Industry under United States Patents. E. Starek. School of Mines Quarterly, 1892, 13, 131—141.

ONE of the earliest commercial methods for the manufacture of glycerin is that of saponifying fats by means of lime and distilling off the glycerin with superheated steam; it however necessitates the use of sulphuric or oxalic acid to neutralise any free alkali and to decompose the lime soaps for the recovery of the fatty acids. No early American patent appears to have been issued for such a process, but lime is used in conjunction with superheated steam by Werk (U.S. Pat. 1858, 21,711); and, later, oxides of zinc and tin, "chloride of lime," and a mixture of zinc oxide and lime is used to effect the saponification and separation of the fatty acids from glycerin and water by Litzelman (this Journal, 1883, 43), Max Ams and Litzelman (U.S. Pat. 1883, 272,510), and Banjard (U.S. Pat. 1883, 280,894). Glycerin is, however, obtained on a large scale by the decomposition of fats with superheated steam, and from the sub-lye of the soap maker. Tilghman (U.S. Pat. 1854, 11,766) devised an apparatus whereby fat or oil in a fluid state is emulsified with water, and the emulsion passed through a coil of iron tubing heated to the temperature of melting lead, and then through a cooling coil heated to 212° F., from which it escapes into the receiving vessel. Wright and Fouché (U.S. Pat. 1859, 22,765) constructed an apparatus in which the decomposition is effected by the continuous circulation of highly-heated water in a finely-divided state through the fats; and since then forms of apparatus have been devised whereby the fats are thoroughly atomised by the steam while they are undergoing decomposition. (See Sahfeld (U.S. Pat. 1878, 201,704), Kuehne (U.S. Pat. 1879, 215,372), Babbitt (U.S. Pat. 1883, 275,976; 1885, 316,104).)

Clovis (U.S. Pat. 1881, 242,272) recovers glycerin from soap lyes by neutralising the same with hydrochloric acid; Battershall (this Journal, 1883, 91) neutralises with sulphuric acid; whilst Domeier and Hagemann (U.S. Pat. 1887, 371,127) precipitate the soapy matters as insoluble soaps, and subsequently concentrate the lye, the remaining fatty and resinous constituents being decomposed by hydrochloric acid, and mechanically removed with clay or alumina. The manufacture of resin soap simultaneously with that of glycerin is covered by the last-mentioned patentees (U.S. Pat. 1888, 385,105); whilst Mitting (U.S. Pat. 1888, 385,367) precipitates the fatty and resinous impurities by the addition of barium or strontium chloride, and the latest attempts have been directed towards preventing the mechanical occlusion of glycerin by the salts, this



APPARATUS FOR THE MANUFACTURE OF GLYCERIN.

being effected by the apparatus of Domeier and Hagemann (U.S. Pat. 1890, 428,468). A is the boiler in which the concentration is effected, B the enclosing brickwork, C the fire space, D the metal outer wall, E and F girders, G the receptacle for the precipitated salts; it can be separated from A by closing the valve H. G¹ is a door through which the collected matter is removed, G² a strainer or perforated plate. Soap-lye or brine containing less glycerin than that adhering to the mineral crystals can be admitted through G³, the deposits remaining on the strainer G², whilst the liquid escapes by G¹. At the commencement of the operation, A is filled with soap-lye, and as it is in communication with G, the latter is also filled; when the boiling liquor in A becomes more concentrated the precipitates formed pass into G. The apparatus is fed through G⁴, the liquor contained in G being thus pushed into the boiling portion. As soon as G is filled with deposited crystals, H is closed, the excess of liquor removed through G⁵, and the crystals washed as described, and removed. H is now opened and the process repeated.

Some manufacturers precipitate the soap by an excess of alkali, which is then removed by treatment with more fat (Babbitt, U.S. Pat. 1870, 107,324), or by treatment with carbonic acid, which converts the alkali into bicarbonate insoluble in glycerin (Mellen, U.S. Pat. 1890, 422,140). Hydrate of iron is employed for the last mentioned purpose by Domeier and Hagemann (U.S. Pat. 1892, 453,829).

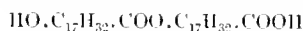
The concluding portion of the paper deals with artificial butter, and mentions some 10 American patents for its production, extending from 1873—1882.—A. R. L.

The Composition of Turkey-Red Oil. P. Juillard. Bull. Soc. Chim. 1891, 6, 638—656.

IT is well known that the product of the action of monohydrated sulphuric acid on castor oil, after removal of the excess of acid by washing with a solution of an alkaline salt, consists essentially of two portions, one of which is soluble, the other insoluble, in pure water. According to Liechti and Suida (this Journal, 1883, 540) the soluble portion has the constitution $(C_{11}H_{21}O_5 \cdot C_3H_5 \cdot OH)_2SO_4$. Müller-Jacobs (this Journal, 1884, 412), on the other hand, looks upon it as a sulphonic acid of ricinic acid; while Benedikt and Ulzer (this Journal, 1888, 329) consider it to be a ricinosulphuric ester of the formula $H_8O_4 \cdot C_{17}H_{32} \cdot COOH$. The portion insoluble in water is, in the opinion of Liechti and Suida, dihydroxyricinic acid; in that of Müller-Jacobs, Benedikt, and others, a mixture of ricinic acid and unaltered ricinolein.

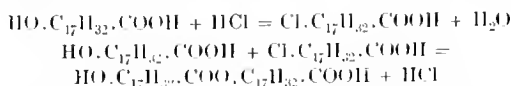
The author has shown (Arch. de Genève, 1890, 24, 134 and 1891, 25, 275; see also this Journal, 1891, 171) that, in spite of its inaccuracy, the formula of Liechti and Suida gives a molecular weight closely approaching that of the soluble portion obtained by washing in the cold; and that the formula proposed by Benedikt and Ulzer represents the actual state in the molecule of the sulphuric acid residue, though it is much too simple to express the constitution of the chief soluble compound produced, since, as the author has discovered, polymerisation of the fatty acids is accomplished simultaneously with their esterification by the action of sulphuric acid.

Ricinic Acid, $HO \cdot C_{17}H_{32} \cdot COOH$, contains an alcoholic hydroxyl group, by reason of which it is capable of readily yielding ethers; thus with acetic acid it yields an acid ester of the formula $C_2H_3O_2 \cdot C_{17}H_{32} \cdot COOH$; with oleic acid, similarly, an oleoricinic acid $C_{18}H_{34}O_2 \cdot C_{17}H_{32} \cdot COOH$; and with ricinic acid, ricinoricinic or diricinic acid—

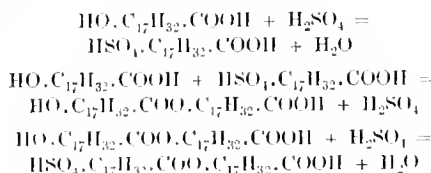


The last-named compound contains a hydroxyl group which enables it to condense with another molecule of ricinic acid, forming tricinic acid, which in turn is condensable with 1 mol. of ricinic acid, yielding tetrarinic acid, and with two, yielding pentarinic acid. These poly-ricinic acids may be produced from ricinic acid by the

action of hydrochloric acid, their formation probably taking place in two stages, thus—

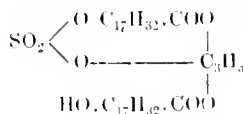


With sulphuric acid a similar series of changes takes place—

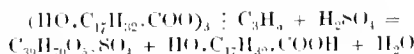


and so on, to the formation of pentaricinic acid. In this case, however, the intermediate compounds have been isolated and examined.

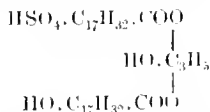
The immediate action of sulphuric acid on castor oil is to produce a diricinoleinsulphuric anhydride of the formula—



according to the equation—



The formation of this body being presumably preceded by that of diricinoleinsulphuric acid—



This anhydride in contact with ricinic and sulphuric acids then slowly undergoes change into polyricinosulphuric and polyricinic acids.

Properties of the Polyricinic Acids.—The portion of Turkey-red oil which is insoluble in water and which usually amounts to about one-third of the whole, consists of a mixture of ricinolein (when, as is generally the case, the oil is prepared from castor oil and not from ricinic acid), and mono- and polyricinic acids. Its quantity may be increased by prolonging the duration of the washing of the acid oil; after several months' contact with water, the sulphuric acid residue being completely eliminated from the acid magma. Polyricinic acids are further producible by keeping the washed Turkey-red oil at a temperature of 20°–30° for several weeks, as well as by the action of hydrochloric acid on ricinolein or ricinic acid at the ordinary temperature or more rapidly (in 2–3 hours) at 95°–100°. They were first obtained in a fairly pure state by the author by fractional separation from commercial Turkey-red oil which had undergone spontaneous decomposition. The latter appeared as a viscid liquid, soluble in ether, light petroleum, and benzene, imperfectly in acetic acid, and sparingly so in cold, but easily so in hot alcohol; its molecular weight, determined by Raoult's method (phenol being used as solvent and the lowering of solidifying point being compared with that produced by aceticricinic acid) was 994. On the addition of alcohol to the ethereal solution of this oil a voluminous, oily precipitate was obtained which, after being washed several times with alcohol, had a molecular weight corresponding with that of *pentaricinic acid*. The ethereal-alcoholic mother-liquor, after the evaporation of the ether, deposited an oil which was washed with concentrated alcohol and submitted to analysis, giving numbers corresponding with those required for *triricinic acid*. The alcoholic solution from which the latter compound had separated, was cooled to 0° and a precipitate

obtained which was purified with warm alcohol, the residue then showing a molecular weight of 592 approaching that of *diricinic acid* (578).

Penta- and tetraricinic acids are viscid oils; are completely insoluble in cold, concentrated alcohol; sparingly soluble in acetic acid; freely so in ether, light petroleum, and benzene; their alkaline salts are difficultly soluble in dilute alcohol. Submitted to prolonged treatment with hydrochloric acid, they do not undergo further condensation; suspended in alcohol and treated with dry hydrochloric acid gas, they are slowly transformed into ethyl ricinate. In common with the other polyricinic acids, they are undecomposed by boiling solutions of alkaline carbonates, but are converted by boiling solutions of caustic alkalis into salts of monoricinic acid. *Triricinic acid* is soluble in ether, light petroleum, acetic acid, and excess of alcohol; its alkaline salts in dilute alcohol. *Diricinic acid* is soluble in all proportions in light petroleum, ether, acetic acid, and absolute alcohol; its alkaline compounds are insoluble in water, but soluble in dilute alcohol; on titration with normal potash solution and phenolphthalein it absorbs a smaller quantity of alkali than it theoretically should.

Properties of the Polyricinosulphuric Acids.—A mixture of the various polyricinosulphuric acids is readily obtained by precipitating with common salt an aqueous solution of washed Turkey-red oil, after removal of the portion extractible with ether by treatment with that menstruum. This mixture, after the spontaneous evaporation of the ether, which it retains in small amount, appears as a viscid, yellow oil; is hydrated; soluble in all proportions in water, alcohol, and ether; and in aqueous solution readily dissolves ricinic acid and ricinolein, and less readily the polyricinic acids. It is decomposed by boiling water, or more rapidly by boiling dilute acids into fatty acids, glycerin, and sulphuric acid. This portion of the Turkey-red oil constitutes about two-thirds of the total oil-magma, and consists chiefly (three-fourths or so) of diricinoleinsulphuric anhydride, as is proved by its high neutralising equivalent; thus in two experiments 2.24 and 2.82 per cent. of KOH were respectively required, while diricinoleinsulphuric acid, which has approximately the same molecular weight, requires 9.39 per cent. Left some time at the ordinary temperature in the presence of a slight excess of caustic potash, the anhydride is converted into diricinoleinsulphuric acid. The latter compound is very unstable; when liberated by a mineral acid from its alkaline salts, it decomposes almost instantly into monoricinosulphuric acid, ricinic acid, and glycerin. The anhydride in an aqueous solution, to which a small quantity of mineral acid has been added, suffers a similar change, but is quite stable in solution in excess of pure water. In concentrated aqueous solution, however, it gradually decomposes successively into polyricinosulphuric and polyricinic acids. The anhydride is further decomposed by boiling solutions of caustic alkalis and of alkaline carbonates in excess into monoricinosulphuric acid, ricinic acid, glycerin, and an alkaline sulphate; if normal potash solution be added in successive small doses to a solution of the anhydride whilst being heated for a period of 18 hours, there is required to neutralise 12 to 16 times the amount required in the cold. Boiling alcoholic potash decomposes the anhydride almost completely into monoricinosulphuric acid and ricinic acid, a trace only of potassium sulphate being produced. This greater resistance of potassium monoricinosulphate towards alcoholic than towards aqueous potash, the author considers to be probably due to the production in the former case of a salt containing two atoms of potassium, which is stable in the presence of excess of alkali.

In the author's opinion the diricinesulphuric acid described by Scheurer-Kestner (this Journal, 1891, 471) is not a uniform substance, but a mixture of that acid with diricinoleinsulphuric anhydride, monoricinosulphuric acid, and fatty acids insoluble in pure water, which a single treatment with ether is insufficient to remove from aqueous solution.

Composition of Turkey-red Oil.—The Turkey-red oils of commerce vary considerably in composition. As a general rule, however, they consist of a mixture of diricinoleinsulphuric anhydride and of the alkaline (sodium or am-

monium) salts of diricinoleinsulphuric, mono- and polyricinoleinsulphuric, and of mono- and polyricinic acids, along with unaltered ricinolein.

Analysis of Turkey-red Oil.—In addition to the usual estimation of the fatty acids, the glycerin and sulphuric acid should be determined, the latter by precipitation as barium salt, after decomposing the oil-mixture by boiling with hydrochloric acid. In view also of the different shades yielded in dyeing and printing by the various components of the oil, a determination of the molecular weight of the fatty acids present in the soluble and insoluble state, is desirable. This may be accomplished by Raoult's method, but care must be taken, when decomposing the soluble portion, that a sufficient amount of water is used to bring the whole of it into solution, otherwise the results obtained are too high. The author condemns the method of testing Turkey-red oil suggested by Scheurer-Kestner (this Journal, 1891, 471) in which the soluble and insoluble portions of the oil are directly estimated by titration with standard ammonia, litmus and phenolphthalein being successively employed as indicators. This method gives inaccurate results, especially when diricinoleinsulphuric anhydride is present in the oil, which is almost invariably the case.—E. B.

On the Nitrogenous Bases present in the Cotton Seed. W. Maxwell. Amer. Chem. J. 1891, 13, 469—471.

See under XXIII., page 372.

PATENT.

An Improved Sheep Dip. A. Robertson, Oban. Eng. Pat. 20,395, November 21, 1891.

See under XVII.,—C., page 365.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

On the Manufacture of Chrome Pigments. C. O. Weber. Dingl. Polyt. J. 1891, 282, 138, 183, and 206.

Chrome Greens from Chrome Yellows.—It has become customary to apply the term of chrome green not only to chromic hydrate (Guignet's green) and other compounds of chromic oxides, but also to the green pigments which represent mixtures of chrome yellow and Prussian blue.

The quality of these mixed chrome greens depends upon—

- (a) the nature of the chrome yellow used,
- (b) the nature of the Prussian blue used,
- (c) the process of producing the mixture of the two.

Only those chrome yellows possessing a pure lemon colour will produce bright greens, but the brightness of the green has very little to do with the brightness of the yellow, provided the latter is only free from even the slightest touch of orange, which always tends to produce shades known as olive-greens or moss-greens.

Lemon shades of chrome yellow are generally obtained by the simultaneous precipitation of lead sulphate and lead chromate, and it might appear that the proportion of sulphate and chromate contained in such a yellow would be a matter of indifference so long as the proper shade of chrome yellow was obtained, and this is certainly so as far as only the shade of the resulting chrome greens is concerned. But on a closer investigation of this matter we find that the proportion of sulphate contained in a chrome yellow stands in the inverse ratio to the covering power of the green obtained from it. This makes it desirable to keep the proportion of lead sulphate in chrome yellows intended for chrome greens as low as possible, and very

seldom we find in a chrome yellow for green the proportions of lead sulphate and lead chromate to be more than 2·5 of the former to 5 of the latter.

The following formulae yield chrome yellows of this description which are well adapted for the manufacture of chrome greens:—

I.

36 lead acetate (or 32 lead nitrate),
7·5 potassium bichromate,
7·5 sulphate of alumina,
5 carbonate of lime (Paris white).

The solution of the lead salt is precipitated with the united solutions of the bichromate and the sulphate of alumina to which the lime carbonate has been added.

II.

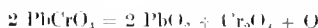
26 acetate of lead,
7·5 potassium bichromate,
3·5 Glauber's salt crystallised,

or—

III.

36 acetate of lead,
7·5 potassium bichromate,
7·8 Glauber's salt, calculated,
9 soda ash.

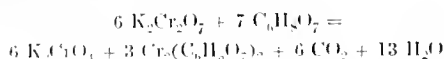
After precipitation the yellows are washed once or twice by decantation, and in the interest of the beauty of the product this ought to be done in the least possible space of time. The chrome yellows are thus obtained in the form of a thin paste to which the Prussian blue, also in paste, is added, the quantities of course depending entirely upon the required shade of green. After well agitating the mixture of yellow and blue the green is pressed and dried. This process of manufacturing chrome greens is very old, but it is still largely practised. The process is, however, a very unsatisfactory one, as it is difficult to always produce a desired shade of green and it involves also a waste of Prussian blue, as the latter even when in a paste cannot be brought in such a state of fine subdivision as to be capable of producing its maximum effect. Very remarkable is the great fugitiveness of greens prepared in this manner, an hour of exposure to direct sunlight often being sufficient to destroy the shade of the green, turning it a dirty-looking yellow. This bleaching is accompanied by evolution of considerable quantities of cyanogen and proceeds independently of the presence of oxygen, nor is it in the least retarded by exposing the green in vacuo or in an atmosphere of pure oxygen, ozonised oxygen, hydrogen, nitrogen, or carbonic acid. On treating such a bleached green with dilute nitric acid, ferric oxide and chromic oxide are found in solution, but no lead, the latter probably being converted into peroxide, thus:—



Considerably faster greens are obtained by adding the well-diluted paste of Prussian blue to the solution of the lead salt before precipitation, but this method is no more economical as regards the use of Prussian blue than the former.

The function of lead sulphate in chrome yellows has been exhaustively treated in a former article (this Journal, 1891, 709—712), but attempts to produce chrome yellows suitable for the manufacture of chrome greens free from sulphate of lead were frequently made. The first practicable process was originated about 12 years ago, and consists in the precipitation of a solution of lead acetate with a solution of bichromate of potash partially reduced by acetic or citric acid. 20 lb. of bichromate are dissolved in 6 gallons of boiling water and 2 lb. of powdered citric acid added. A violent reaction ensues, and eventually a dark olive-brown solution is obtained, with which a solution of 56 lb. of lead acetate in 100 gallons of water is precipitated. The resulting chrome yellow possesses a dull, very greenish shade, and produces with Prussian blue exceedingly bright and strong shades of chrome green. As the result of a

careful analytical investigation of this process the reaction between potassium bichromate and citric acid was found to proceed according to the equation—



This equation, verified by experiment and analysis, shows that, not as might have been expected, the whole of the citric acid is oxidised, but that about 30 per cent. of the total quantity is converted into chromium citrate, so that on precipitation of the lead salt with the above chromate mixture a small quantity of lead citrate is simultaneously precipitated; and further experiments revealed the fact, that this small quantity of citrate prevents the "turning" of the shade of the "lemon chrome" obtained. Careful observation of the following rules will entirely prevent the turning of chrome yellows:—

1. The yellow must be precipitated in the presence of excess of lead salt.

2. Simultaneously with the chromate of lead must be precipitated the lead salt of an acid easily oxidisable by chromic acid. This lead salt must be insoluble in the free acid forming on precipitation of the chromate.

3. If such lead salts are used the free acid of which would dissolve the lead salts of the oxidisable acids, the precipitation must be performed by means of mono-chromates.

That the "turning" of the chrome yellows is due to a decomposition of the lead chromate into a basic salt, whereby chromic acid is set free, the slightest traces of which have a most detrimental influence upon the beauty of the shade, is now an established fact. The cure for the tendency of the chrome yellows to decompose in this manner is the presence of a small quantity of the lead salt of an easily oxidisable organic acid, which also prevents the rapid destruction (oxidation) of chrome greens, a process which, as shown above, is also an oxidation process.

Chrome Yellows for Chrome Greens.—For the manufacture of chrome yellows for chrome greens ferrocyanhydric acid or its soluble salts are very suitable, as, owing to the insolubility of ferrocyanide of lead in dilute nitric acid, they allow of the production of these pigments from nitrate of lead.

The method of manufacturing chrome greens by adding the Prussian blue paste to the solution of the lead salt before precipitation, or by adding it to the already formed chrome yellow, has been shown above to be uneconomical and there is no doubt that the best and most economical form in which the Prussian blue can be used is that of a solution. As is well known, Prussian blue may be dissolved in certain acids or salts, and these solutions are most advantageously employed in the manufacture of chrome greens. Oxalic acid has been used for this purpose by Vogel, who dissolves the Prussian blue in 10 per cent. of its weight of oxalic acid, then adds a solution of bichromate of potash and subsequently precipitates with this mixture a solution of lead acetate. The following proportions have been employed by Vogel:—

- 20 Prussian blue,
- 2 oxalic acid,
- 40 potassium bichromate,
- 100 lead acetate.

It will be noticed that the chrome yellow contained in this green is also free from sulphuric acid, and the beauty and fastness of the green so obtained must be ascribed to the presence in it of a small quantity of lead oxalate. In adding the solution of bichromate to the solution of Prussian blue containing the oxalic acid a very violent reaction takes place, but there is no doubt that it proceeds on the same line as the one between bichromate and citric acid, and accordingly comes to a standstill as soon as all free oxalic acid has disappeared, partly through oxidation, partly through formation of chromium oxalate. In perfect agreement with this assumption is the observation that neutral oxalates are not oxidised by solutions of bichromate, either hot or cold.

There is a large number of other substances capable of dissolving Prussian blue, but as a rule they are more expensive than oxalic acid, especially so considering that oxalic acid not only acts as a solvent for the blue, but is also essential in producing full and fast shades of chrome yellow.

The capability of potassium ferrocyanide to dissolve Prussian blue is also utilised in the manufacture of chrome greens. But whereas oxalic acid easily dissolves dry Prussian blue, ferrocyanide of potassium dissolves this pigment satisfactorily only in the form of a paste. The quantity of ferrocyanide used is best about 20 per cent. of the weight of the Prussian blue which is to be dissolved, a few minutes' boiling being sufficient to produce a dark blue solution which may be filtered without leaving any residue on the filter. On addition of indifferent salts, such as Glauber's salt, to such solutions, the blue is apparently precipitated as it settles from the solutions, but on stirring it up the apparent precipitate can be filtered through filter-paper almost as completely as the original solution. On addition of a solution of bichromate to the solution of the blue, the former of course acts at once with great energy on the ferrocyanide contained in the latter, and the blue apparently is precipitated, although the mixture filters without any residue. By precipitating with this mixture a solution of lead acetate or nitrate, greens are obtained which in beauty rival brilliant green lakes, and owing to the ideal state of sub-division of the blue, the latter is enabled to produce in every case its maximum effect. The following proportions may serve as an example:—

V.

- 300 Prussian blue (4 per cent. dry),
- 2.4 ferrocyanide of potash,
- 18 potassium bichromate,
- 50 lead acetate.

This corresponds to the following proportions according to Vogel's method:—

VI.

- 300 Prussian blue (4 per cent. dry),
- 2 oxalic acid,
- 18 potassium bichromate,
- 50 lead acetate.

These two greens, although practically identical in regard to their chemical composition, differ very much in their appearance, which no doubt is due to the difference in the amount of bichromate reduced in the course of the two processes respectively. The result obtained in working according to the proportions VI. may be considerably improved upon by using oxalate of ammonia instead of oxalic acid for the solution of the Prussian blue:—

VII.

- 300 Prussian blue (4 per cent. dry),
- 3 oxalate of ammonia,
- 18 potassium bichromate,
- 50 lead acetate.

The shade of this green is brighter than that of chrome green VI., and at the same time very much bluer than even that of chrome green V., and this shows that by using oxalate of ammonia even less blue is necessary for the production of a certain shade than by using either oxalic acid or ferrocyanide. Moreover, green VII. is distinguished by its truly remarkable fastness. This latter method might be used on a large scale with considerable advantage.

A combination of the above-described oxalate and ferrocyanide processes has been in use for some time in this country and in America, and the chrome greens obtained by the combination of these two methods are remarkable for the delicacy and purity of shades, as well as for their great fastness to light. It is not easy to see why chrome greens obtained by the combined methods should be at all superior to those produced by either of the two methods. Considering, however, that oxalic acid and potassium ferrocyanide act at boiling temperature not only upon the Prussian blue, but also upon each other, and that ferric oxide, which is invariably produced by the action of oxalic

acid on Prussian blue, is eventually re-converted into blue through the ferrocyanide present, the *rationale* of this method is explained to a considerable degree. The following formulæ are types of this method:—

	a.	b.	c.
Lead acetate.....	100	100	100
Litharge	50	50	50
Potassium bichromate	50	50	50
Prussian blue (dry)	25	50	100
Oxalic acid.....	4	7	15
Potassium ferrocyanide.....	5.5	10	13

The lead acetate and litharge are together converted into basic acetate in the manner described in a former paper (this Journal, 1891, 709). This lead solution is run into a large tub filled with water to about one-third. Oxalic acid and ferrocyanide are then dissolved in about 60 gallons of water, and to the boiling solution is added the finely-powdered Prussian blue. After half an hour's boiling the bichromate is added to the solution, and the lead salt is then precipitated with these united solutions. The precipitated green is washed in the usual manner; it is the finest and fastest chrome green which is known at present.

If desired, neutral lead acetate or lead nitrate may be used instead of the basic acetate, but it is worth mentioning that different lead salts produce also greens more or less differing in appearance. This is rather difficult to explain, but it is nevertheless a well-known fact, and very probable in some relation to the often-made observation that yellows made from nitrate of lead give very bad results in calico printing, only yellows from lead acetate being available for this purpose.

Like the chrome yellows, the chrome greens are generally "filled" with some indifferent mineral "base," not only in order to produce lower grades, but also to give them such physical properties as are required to make them suitable for various applications, properties which the pure greens either do not possess at all or in an insufficient degree. It is not only of importance which "bases" have been added to a green, much depending also on the manner in which the two have been combined. The most important of these bases are barium sulphate, mineral white (gypsum), china clay, alumina hydrate.

Barium sulphate and mineral white are principally used for the manufacture of low grades of green, and it is advisable to use for moderate "reductions" exclusively mineral white; for high "reductions," mineral white and barium sulphate are preferable, generally the barium sulphate constituting the larger portion of the mixture of the two "bases." For purposes where such substantial bases as the two before mentioned are not desired, as in the case of paper-staining, alumina hydrate and china clay are used. The alumina hydrate is now always prepared from aluminium sulphate by precipitation with sodium carbonate, but great care must be taken to have the alumina salt free from iron, 0.008 per cent. of which will give the otherwise brilliant white aluminium hydrate a peculiar dead and dirty-looking shade, the effect of which on the shade of a chrome green is greater than might be anticipated. With regard to the china clay employed as a "base," that which in composition comes nearest to the formula, $(Al_2O_3)_2(SiO_2)_3, 3H_2O$, will be found the best.

It used to be customary at one time to add the whole of the "base," which was intended to be incorporated in a chrome yellow or chrome green, to the solution of the lead salt before precipitation, the idea evidently being to precipitate the chrome pigment upon the base, and so to obtain as close a union as possible between pigment and base. This method is now practically abandoned as it has been found more advantageous to either add the base to the solution of the lead salt at the same rate as the precipitation of the pigment is proceeding, *i.e.*, simultaneous with the latter, or to add the base to the pigment after precipitation. In

each of the two cases the "base" or mixture of "bases" is suspended in a sufficient quantity of water and run, either during or after the precipitation of the pigment, into the precipitation tub through a moderately fine sieve (No. 40). These remarks refer particularly to the use of barium sulphate and mineral white.

If aluminium hydrate is employed as "base," a special method has to be followed in order to ensure a perfect union between aluminium hydrate and the chrome pigment, the specific gravities of which are so very different. To the precipitated pigment is added a solution of sulphate of alumina, about 15 per cent. of the whole quantity which it is intended to precipitate, and subsequently an equivalent quantity of soda carbonate is slowly and carefully run into this mixture in order to precipitate aluminium hydrate. In this way a most intimate mixture of the chrome pigment and a small quantity of aluminium hydrate is obtained. The evolution of carbonic acid which accompanies the precipitation of the aluminium hydrate, assists very materially in producing the compound pigment in a very voluminous form, in which it can readily be mixed with almost any desired quantity of ready-formed aluminium hydrate. Where chrome pigments are intended to be filled not only with aluminium hydrate but also with sulphate of barium, mineral white, or china clay, it is advisable to add these, during or after the precipitation, before the incorporation of any of the aluminium hydrate, which is then proceeded with as above described.

A matter of very great importance in the manufacture of chrome greens is the quality of the Prussian blue employed for this process, an unsuitable blue producing very poor results even with the best yellows. Practically pure Paris blue is manufactured in a great variety of shades, ranging from a bright ultramarine to a very deep blue-violet. The lighter shades of Prussian blue are especially useful for the manufacture of zinc greens, the dark shades are the most suitable for chrome greens. In this manner particularly three shades of pure Paris blue are used, *viz.*, Paris blue ultramarine shade (milori blue, steel blue, Chinese blue), Paris blue indigo shade, and Paris blue-violet or "red" shade.

The principle of the manufacture of these three blues is the same in every case, namely, the oxidation of the "white paste" obtained on the precipitation of potassium or sodium ferrocyanide with a ferrous salt. The shade of the blue is greatly influenced by the conditions under which it is produced, the most important of which are (1) the proportions of ferrocyanide and ferrous salt used in the precipitation of the white paste, (2) the particular ferrous salt employed, (3) the oxidising agent and the acid in the presence of which the oxidation is performed.

1. *Prussian blue ultramarine shade:* 100 lb. of ferrocyanide are dissolved in 450 galls. of water, the solution is heated to boiling, 25 lb. of hydrochloric acid 28° Tw. = 1.14, are added, and the boiling continued for half an hour. Into this boiling solution is then run a solution 65 lb. of ferrous chloride ($FeCl_2$) in 50 galls. of boiling water; or the two solutions are run simultaneously into a large tub partly filled with boiling water. After precipitation, the contents of the tub must be well agitated and the boiling continued for at least half an hour. The tub is then filled up with cold water and the precipitate left to settle for three days, when the supernatant liquor is siphoned off, the precipitate boiled up with steam and subsequently oxidised by adding to the boiling mass in turns 25 lb. of hydrochloric acid and 12 lb. of chlorate of potash or soda. The oxidation being complete, the tub is again filled up with cold water and the acid completely washed out of it by decantation. The water used for the washing is of great importance, and ought to contain no lime, especially not in the form of carbonate, very small quantities of which suffice to destroy the "bloom" of these pigments. If, however, a hard water must be used, acidifying with acetic acid will almost entirely prevent its harmful influence.

11. *Prussian blue indigo shade:* 100 lb. of ferrocyanide and 90 lb. of ferrous sulphate are dissolved in separate tubs, and to the solution of the ferrous salt 25 lb. of sulphuric acid 168° Tw. = 1.84, and $1\frac{1}{2}$ lb. of stannous chloride are added. The two solutions are run simultaneously into the

precipitating tank, which is partly filled with boiling water; the boiling is to be continued during and for about 30 minutes after the precipitation. The white paste is again left to settle for some days and then oxidised either by means of nitric acid or by means of bichromate.

In oxidising with nitric acid the white paste is run into a rectangular lead-lined vat, with a barrel-shaped bottom and a hood on the top which has an opening on one of the narrow sides only, allowing an agitator to be inserted in order to mix the paste during the process of the oxidation. Opposite to that opening a spacious clay pipe is fitted in the hood, through which the noxious vapours developed during the oxidation may be drawn in a chimney or furnace. A lead pipe carrying a funnel penetrating the side of the vat and terminating on the bottom of it is arranged. Through it 50 lb. of sulphuric acid 168° Tw., and subsequently 32 lb. of nitric acid 78° Tw. are added to the white paste, which is well mixed all the time. After the development of nitrous acid from the mixture has ceased, the blue is transferred to the washing tubs to be freed from acid. If bichromate is used for the oxidation of the white paste, the oxidation may be performed in the precipitation tub after having run off the supernatant wash-water. 50 lb. of sulphuric acid are added to the white paste, and the oxidation is effected at the boiling temperature, by adding gradually a solution of 28.5 lb. of bichromate in 28 galls. of boiling water. The chromium sulphate clings to the blue very obstinately, and great care must be employed to wash it out completely.

III. Prussian blue red shade: The precipitation of the white paste for this blue is performed in exactly the same manner as above described, using 100 lb. of ferrocyanide and 90 lb. of ferrous sulphate. The oxidising agent used is ferric sulphate, which produces blues of an excellent dark shade very suitable for the ordinary chrome greens. Before oxidising the supernatant water is run off the white paste, to which 25 lb. of sulphuric acid 168° Tw. are added and the mixture heated to boil. 150 lb. of ferric sulphate (ferric liquor) prepared as below are then added, the boiling being continued for half an hour. The filtrate from a sample of the oxidised blue must distinctly show the presence of an excess of ferric salt. The oxidised blue is purified by washing in the usual way.

Although the ferric liquor is a commercial product, it is advisable to prepare it especially for this process, the commercial article containing frequently a large proportion of ferrous salt. It is best prepared in a number of large Woulf's bottles (tourils) which are connected amongst themselves, with the usual clay pipes and with a chimney or absorption tower to draw away the large quantities of nitrous acid evolved. The bottles are charged with 10 galls. of water, 64 lb. of nitric acid 78° Tw., and 60 lb. of sulphuric acid 168° Tw. To this hot mixture 300 lb. of finely-crystallised or ground ferrous sulphate are slowly added. The oxidation proceeds very rapidly but quietly. It is advisable to keep the bottles warm during the operation, for which purpose they are placed in a steam-heated wooden box from which only the tops of the bottles and the bottom taps for drawing off the liquor project.—C. O. W.

Changes in Chromium Pigments. Papier Zeitung, 1891, 17, 292.

See under VI., page 345.

Efflorescent Resins. M. Bamberger. Monatsh. 1891, 12, 441—463.

See under XX., page 365.

PATENTS.

Improvements in and relating to the Manufacture of Paints or Paint-Stocks. G. W. Scollay, New York, U.S.A. Eng. Pat. 2382, February 10, 1891.

THE inventor combines the preparation of paint or paint-stock with the refining of vegetable oils in the following ways:—

1. By mixing with commercial yellow cotton-seed oil a suitable quantity of ochre or other pigment, which combining with the impurities of the oil forms a paint or paint-stock, at the same time refining the oil. When ochre is used all uncombined water must first be expelled. Umbers must be heated until they assume a deep brown colour; siennas until they show a light red colour. Overheating, causing all constitutional water to be expelled ought to be guarded against, as it renders the pigments inert. From four to twelve parts of the grease are mixed with one part of above pigments, and after about 40 minutes the oil is separated from the insoluble sediment by any convenient means. In this way a superior quality of oil and a merchantable paint or paint-stock are obtained.

2. A barrel of oil is mixed with from two and one-half to four pounds of caustic soda, agitated for about 40 minutes, then left to settle. The refined oil is drawn off, the residue is soap or soap-stock, which may be converted into paint or paint-stock by means of chloride of calcium and similar salts.

3. The oil is first partially refined by treating it with a small quantity of caustic alkali, and the refining is subsequently completed by treating with ochre.

4. The oil may be treated with any metallic salt and caustic alkali simultaneously, or by any combination of the above described reagents.

Paints or paint-stocks of the above description are converted into paints of greater variety and brilliancy in colour in the following manner:—

To make yellow paint, soap stock is converted into lead plaster by means of acetate of lead, this lead-soap is then acted upon with bichromate or chromate of soda.

Blue paint is obtained by treating the soap-stock with iron salts first and then with ferrocyanides.

Green paint is produced by boiling the soap-stock with arsenious acid, on addition of copper sulphate a vivid green is obtained.

The paints may be washed with water and dried at a moderate heat.

The paint or paint-stock obtained as above described is used for treating or filling pigments in order to make them less absorbing. The pigments are mixed with those paints or paint-stocks and 10 per cent. of naphtha. On heating the paint or paint-stock is dissolved and penetrates into the pigment, the naphtha is volatilised. Pigments treated in this manner can be converted into paints with much less oil than the untreated pigments, and the paints so obtained are of excellent drying power.—C. O. W.

A New or Improved Composition of Ink for Reproduction of Copies by the Manifold Process and the like. W. Sherwood, Loughborough. Eng. Pat. 5437, March 26, 1891.

See under VI., page 346.

Improvements in the Production of White Lead or Basic Carbonate of Lead from Galena or Sulphide of Lead Ore, or from suitable Residual Products or Substances containing Sulphide of Lead. Watson Smith and W. Elmore, London. Eng. Pat. 5501, March 28, 1891.

THIS is essentially a combination of known methods for the production of oxide of lead from galena, sulphide of lead ore, or from other substances containing sulphide of lead, with MacIvor's method (Eng. Pat. 10,426, 1888) and MacIvor and Smith's process (Eng. Pat. 16,093, 1890) for the production of white lead by the action of acetate of ammonia and carbonic acid, with various modifications, upon oxide of lead.

Solutions of acetate of lead or tribasic acetate of lead prepared in the manner described in the above-mentioned patents contain copper if the galenas or other sulphides of lead used for the preparation of the oxide of lead were contaminated in this manner. From the above solutions the copper is removed, after all, or practically all, lead has been precipitated, by slightly acidulating the solutions with acetic acid, and either treating it with zinc, preferably in the form of "gossamer zinc," or with an electric current, employing carbon electrodes, the copper being deposited upon the cathode.

The inventors describe in detail the process of carbonating the ammoniacal solutions of lead acetate by a fractionating method in order to obtain white lead of uniform and high basicity and at the same time free from copper, which latter may cause yellow discolouration of the pigment.

The galena or other sulphide of lead may be at once smelted for reduction to metal, the eliminated sulphur being converted into sulphuric acid, or sulphites, or bisulphites respectively. The rough metallic lead is melted on a bone-ash or clay bed and exposed to a current or blast of air to form litharge, which is removed by means of suitably-arranged overflows or mechanical means. The first portions of litharge formed are contaminated with iron, and are smelted with a fresh lot of ore or sulphide. Those fractions containing only most minute traces of iron are used for solution in acetate of ammonia.

Any silver contained in the original ore or sulphide of lead is left on the bone-ash or other bed, and may be recovered by smelting with a suitable flux.—C. O. W.

Improvements in Pigments having a Lead Basis. C. A. Bingham, Manchester. Eng. Pat. 5681, April 2, 1891.

This is a process devised to utilise the plumbic hydrate obtained in accordance with the inventor's process of manufacturing nitrate of ammonia (Eng. Pat. 5442, 1890). The pigments are prepared by adding to the plumbic hydrate solutions of suitable aniline colours. In some cases the operation is aided by heating the mixtures.

—C. O. W.

Improvements in or appertaining to Preservative Coatings for Iron or other Structures. J. Robson, Southsea. Eng. Pat. 5977, April 7, 1891.

The invention refers to a mixture of rosin pitch, residues from the distillation of mineral oil or ozokerite, American asphaltum, melted with sufficient paraffin wax to give fluidity and freedom from stickiness when hot.—C. O. W.

Improvements in the Treatment of Gums and the Preparation of Varnishes therefrom. G. H. Smith, London. Eng. Pat. 7036, April 23, 1891.

The patentee claims the utilisation of the property observed by him, to be possessed by soft readily soluble gums, of aiding the solution of harder and more refractory gums, in an appropriate solvent, such as linseed or other oil. He gives as an example the treatment of kauri gum for making a varnish therefrom. About one pound of a soft gum, such as gum dammar, is dissolved in linseed oil and added to 16 lb. of kauri gum, and heated to a temperature of from 400°–500° F. whereby solution is said to be effected. In place of gum dammar "a small quantity of the liquid products of distillation of these gums and resins, such as is given off upon the treatment by fusion of gums in ordinary processes of varnish making as now practised, and which liquid products of distillation are now practically wasted" may be used.—B. B.

Improved Manufacture of Size Paint. A. J. Boulton, London. Eng. Pat. 7695, May 4, 1891.

ONE lb. wheat flour is boiled to form a paste, and a solution of 1 oz. of alum is added.—C. O. W.

Improvements in the Process of and Apparatus for the Manufacture of White Lead. A. Honman and V. Vullier, Williamstown, Victoria. Eng. Pat. 8022, May 9, 1891.

The invention consists mainly in preserving the basic acetate of lead at a uniform temperature of about 120° F., and in the conversion into white lead of the sulphate of lead, produced in the roasting of sulphide of lead ore and dissolved in caustic soda, caustic potash or ammonium acetate, by precipitation with a solution of carbonate or bicarbonate of soda, potash or ammonium. In carrying out the process ordinary galena is roasted in a reverberatory furnace of special construction at a low red heat for a sufficient time to drive off the greater part of its sulphur. When this is accomplished the roasted ore is placed in one of a series of tinned copper cylinders where it is treated with a hot solution of lead acetate at 15° B. and steam. The solution so obtained is run into settling tanks, and from these the clear solutions are conveyed into vats in which the liquor is kept at an even temperature of 120° F., when it is subsequently treated with a current of carbonic acid, the supply of which is cut off as soon as the specific gravity of the solution has decreased to 15° B. The precipitated white lead is drawn off then from the bottom of the tanks which are at once refilled with a fresh quantity of basic acetate of lead until the original density of 18° B. is again reached, when the carbonating operation is at once repeated. The lead liquor drawn off with the carbonate of lead is separated from the latter and pumped back to the above-mentioned extraction cylinders, and when the oxide of lead therein has been entirely dissolved the sulphate of lead which forms portion of the residue is dissolved by a solution of caustic soda or potash. The solution thus made is conveyed to a tinned copper pan wherein the white lead is precipitated by means of a solution of carbonate of soda or potash or ammonia.

The construction of the special plant devised for the carrying out of these processes by the inventors cannot be understood without the drawings accompanying the specification.—C. O. W.

Improved Rust- and Acid-Proof Paint. R. Lender, Berlin. Eng. Pat. 20,274, November 21, 1891.

This invention relates to a rust- and acid-proof paint for metals and other materials. Natural iron silicate is the chief ingredient, which is reduced to a fine powder and ground into a paint with a suitable quantity of ozonised or otherwise oxidised linseed oil or varnish.—C. O. W.

Improvements in the Manufacture of Venetian-red. W. J. Wigg, Frodsham, Cheshire. Eng. Pat. 21,279, December 5, 1891.

This invention consists in an improved method of uniting and combining Venetian-red with indifferent white bodies, such as powdered barytes, gypsum, or the like. Residual copper liquors containing about 10 per cent. of chloride of iron and 16 per cent. of sulphate of soda is treated with a large excess of milk of lime or other similar oxide, and after precipitation the mass is oxidised with a current of steam and air. Afterwards the precipitate is washed and filter-pressed. The specification is accompanied by a set of drawings.—C. O. W.

Improvements in Inks for Printing, Stamping, and the like. C. M. Higgins, New York, U.S.A. Eng. Pat. 93, January 2, 1892.

The patentee states that castor oil, oil of cassia and carbolic acid, "and its substitute creosote," have no action on india-rubber, and are well suited for forming a non-drying ink for stamps, type writer ribbons, and the like. Aniline dyes are readily soluble in the mixture. As an example of a stamp ink there is quoted the following recipe: four fluid ounces of castor oil are mixed with one fluid ounce each of carbolic acid and oil of cassia, and one ounce of ethyl violet or other aniline dye dissolved therein. The solution takes place cold, but may be aided by stirring and heating. The proportions may be varied according to the purpose in view.

—B. B.

XV.—MANURES, Etc.

The "Bordeaux Mixture," a Remedy for Vine Mildew and Potato Disease. M. Perret. "Standard" Agricultural Reports.

See under XVIII.—C., pages 361—365.

PATENT.

Improvements relating to the Conversion into Manure of the Refuse and Foul Matters from Cities and Towns. L. Lamattina, Rome, Italy. Eng. Pat. 22,192, December 18, 1891.

See under XVIII.—B., page 364.

XVI.—SUGAR, STARCH, GUM, Etc.

A Crystalline Magma of Invert-Sugar. F. G. Wiechmann. School of Mines Quarterly, 1892, 13, 149—151.

A SAMPLE of granulated sugar polarising 99.9—100 was inverted with hydrochloric acid (sp. gr. 1.2) using 0.0265 per cent. on the weight of sugar; the product was a colourless syrup, having a density of about 80° Brix, (43.11° Beaumé) and contained 84.8 per cent. of invert-sugar; it had a slightly acid reaction. The syrup was placed in a well-corked flask, and was exposed to diffused and direct sunlight at a temperature of 24° C., and after three months, it had become a white crystalline magma.

An aqueous solution of the magma having a sp. gr. 1.1427 at 15° (= 32.7° Brix) was prepared; $\frac{100}{32.7} = 3.058$; hence 3.058 grms. of the solution contained 1 gm. of dry substance.

(I.) 39.827 grms. of this solution (= 13.024 grms. on the dry substance) were made up to 100 cc.; of which 50 cc. were further diluted to 1 litre, and 35 cc. of the latter solution (= 0.2279 grms. of dry substance) were added to 50 cc. of boiling Fehling's solution (Saxhlet's formula) together with 15 cc. of water, the boiling being maintained for two minutes. As the mean of three experiments 0.394 gm. of metallic copper was obtained; according to Meissl (Zeits. d. Ver. f. Rübenz. Ind. 1879, 1034), 0.2278 gm. of pure invert-sugar reduces 0.404 gm. Cu, so that the amount of copper obtained corresponds to 0.2212 gm. of invert-sugar, and the sample contained 97.06 per cent. of invert-sugar and 2.8 per cent. of sucrose on the dry substance.

(II.) 30.58 grms. of the above-mentioned solution (32.7° Brix), corresponding to 10 grms. of dry substance were dissolved in water, diluted to 100 cc. at 17.5° C. and polarised at 20; this solution gave $[\alpha]_{D, 20} = -18.16$,

whereas Gabbe's value for a 10 per cent. solution of pure invert-sugar is $[\alpha]_{D, 20} = -20.018$; assuming that the 2.8 per cent. of sucrose preserves its usual optical properties, the value corrected for the latter is $[\alpha]_{D, 20} = -20.02$.

26.048 grms. of the magma were dissolved in water, made up to 100 cc., and the solution polarised at 20° in a 200 mm. tube. The reading immediately after preparation was 7.9, and this gradually increased to -23.3 at the end of 23 hours. 50 cc. of the solution were heated with 5 cc. of hydrochloric acid (sp. gr. 1.2) at 67° C. for five minutes, when it was cooled, made up to 100 cc. and polarised, the readings being -26.2 to -26.6, which remained constant after 20 hours.

A solution of the magma corresponding to 10 grms. of the dry substance in 100 cc. had a sp. gr. 1.03853 at 17.5° C., whilst the specific gravity of a solution of pure invert-sugar of this concentration is, according to Herzfeld, 1.03901.

Five grms. of the magma were placed in a test tube together with a thermometer, and slowly heated in a water-bath. It commenced to liquefy at 50°, and liquefaction was complete in 29 minutes, the temperature then being 60.5° C. After 12 days it commenced to resolidify, and crystallisation progressed slowly.

Two grms. of the magma placed in a vacuum over concentrated sulphuric acid lost 9.7 per cent. in 645 hours. The author considers it probable that the transformation of the 2.8 per cent. of sucrose is only a question of time; the specimen is being exposed to full daylight, and should complete inversion be effected, a careful determination of the relative amounts of dextrose and levulose present will be made, and the question as to whether it consists of pure invert-sugar in the crystalline form elucidated. (Compare Wohl and Kollrepp, this Journal, 1890, 957.)

—A. R. L.

Pine-Tree Sugar. H. W. Wiley. J. Amer. Chem. Soc. 1891, 13, 228—237.

BERTHELOT examined a sugar from *Pinus lambertiana* (Ann. de Chim. 1856 [3], 46, 76), and found it to have the empirical formula $C_6H_{12}O_5$, a specific rotatory power $[\alpha]$, 58.6, and to form a compound, $C_6H_{12}O_5 \cdot 2 PbO$, when treated with ammoniacal lead acetate; also that the rotatory power was unaltered when the sugar was treated with concentrated hydrochloric acid at 100° for 10 minutes. The author commenced the study of pine-tree sugar from *Pinus lambertiana* (California), but a paper by Maquenne on the same subject (this Journal, 1890, 311) anticipated his work to a large degree. Maquenne's sugar, which he named β -pinite, was obtained from *Pinus lambertiana* (Nebraska), but as this tree does not grow in Nebraska, Maquenne must have been mistaken as to the origin of the sugar. The author concludes from a comparison of Berthelot's and Maquenne's work that the compounds obtained by both these chemists are one and the same, and that Berthelot's specific rotatory power is too low. In the present research the following method of isolating the sugar is adopted. The crude sugar is boiled with successive portions of 95 per cent. alcohol to remove some of the colouring matter, the dried residue dissolved in water, and the solution filtered while hot through animal charcoal; the filtrate is treated with basic lead acetate, and the lead precipitated from this filtrate by sulphuretted hydrogen, the filtered solution being concentrated and once more filtered through animal charcoal. The clear solution is evaporated to the crystallising point, agitated, and allowed to remain, when crystals separate in 2—4 days; the concentrated syrup may also be placed in a jar surrounded by ice and three times its volume of absolute alcohol stirred in, when the whole of the sugar separates in 10—15 hours; in either case the crystals are washed successively with alcohol and ether, dried at 50°, and finally placed over concentrated sulphuric acid until of constant weight. The specific rotation appears to be independent of the concentration, and was found to be $[\alpha]_D = 65.01$, thus confirming Maquenne's value (*loc. cit.*). When the sugar is distilled with sulphuric acid a trace of furfural is produced;

whilst on oxidation with nitric acid large quantities of rhodozone acid are obtained, and a small quantity of a yellowish substance, which is, perhaps, pieric or croconic acid. It does not yield an osone with phenylhydrazine, but when treated with calcium, barium, or strontium hydroxides, precipitates are produced which become crystalline on remaining.

In conclusion, the author refers to the formation of β -inosite (Maquenne, *loc. cit.*), and also to Combes' work (this Journal, 1890, 311), according to whom Maquenne's β -pinite is identical with matezite, and β -inosite with matezodambose.—A. R. L.

The Specific Rotatory and Cupric Reducing Power of Invert Sugar and of Dextrose obtained from Cane Sugar by means of Invertase. J. O'Sullivan. *Proc. Chem. Soc.* 1892 [1893], 56.

See under XXIII., page 372.

XVII.—BREWING, WINES, SPIRITS, Etc.

Cask Plant. A. Hartley. *Trans. Inst. Brewing*, 1892, 5, 85—111.

The first portion of the paper treats of coopers' work, and includes a detailed account of the different varieties of oak used in making brewers' casks, the sorting of the staves, and the different ways of sawing them, the judging of the workmanship of a cask, branding, numbering, &c. In dealing with cask capacity, it is pointed out that the amount of wood surface exposed to the beer is very much larger in small casks than in large ones.

A few words on repairing are followed by a list of coopers' prices current in London and Burton.

The seasoning of casks is usually accomplished by soaking them for 1—2 days in a solution containing about 1 lb. salt and $\frac{1}{2}$ lb. soda to the barrel. After emptying the casks are filled with cold water for an hour or so and then scalded out and steamed.

The same treatment may be used with advantage for curing acid casks, the solution being made double the strength, and followed by treatment with sulphurous acid.

With reference to the cure of mouldy or stinking casks, a great deal depends on the extent of the evil: if only slight the casks should be scrubbed and treated with sulphurous acid, if more pronounced, they should be filled with warm water containing about 1 lb. to the barrel of chloride of lime and a pint of strong sulphurous acid; if the casks are very bad, the staves must be shaved or the casks broken up. Occasionally lengthened exposure of the unheaded casks to the weather will cure stinkers. Another method of curing them is by the use of enamel, but this is not recommended.

The best way of storing empty casks is to stack them with their heads out and the bunghole downwards; or the casks as they are received back containing the hops and bottoms may be placed in the store until required; this is, however, rather risky in warm weather, or the casks may be cleaned as soon as received, and then stopped down with a little sulphurous acid.

With regard to the general preparation of casks for filling, the author does not consider unheading necessary, but if in good condition recommends rinsing with hot water followed by treatment with sulphurous acid and testing with steam.

Great stress is laid on the "passing-in" of casks; none should be passed which have the slightest taint about them.

—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOODS.

The Glycerin and Artificial Butter Industry under United States Patents. E. Starek. *School of Mines Quarterly*, 1892, 13, 131—141.

See under XII., page 353.

Zinc in Preserved Foods. J. E. Allen. *Chem. Zeit.* 1891, 15, 1714.

It is well-known that copper often occurs in preserved foods, and is in fact wilfully added to improve the colour of the articles, but addition of zinc seems to serve no useful purpose.

The author has, nevertheless, tested samples of preserved peas, which, although free from copper, contained a large proportion of zinc. They had a pleasant green colour.

—L. de K.

On the Occurrence of Tin in Canned Food. H. A. Weber. *Journ. Amer. Chem. Soc.* 1891, 13, 200—207.

The following method was employed:—The contents of each can were emptied into a large porcelain dish, and the condition of the inner portion of the can noted; after thoroughly mixing the contents, 50 grms. were weighed off and incinerated in a porcelain dish. The residue was treated with an excess of concentrated hydrochloric acid evaporated to dryness, and the residue extracted with dilute hydrochloric acid, filtered and washed, the insoluble residue being again incinerated and treated as above. The solution thus obtained was treated with hydrogen sulphide, the precipitate collected after 12 hours, and the tin weighed as stannic oxide. The following table shows the amounts of stannic oxide obtained in the various samples tested:—

Sample.	SnO ₂ Grains per lb.	Remarks.
Canned pumpkin	2.97	
" "	3.11	Can corroded.
" "	0.38	"
Hubbard squash	1.85	Can badly corroded.
Canned tomatoes	0.81	Inner coating corroded.
" "	0.98	Can corroded.
Canned peas	0.48	No visible corrosion.
Canned mushrooms	1.10	Inner coating discoloured.
Canned blackberries	0.80	Inner coating corroded.
Canned blueberries	2.10	Can badly corroded.
Canned salmon	0.94	Inner coating corroded.
Canned pears	0.51	Can corroded.
Canned peaches	2.58	Can badly corroded.
Canned blackberries	4.20	" "
Canned cherries	2.80	" "
Canned pumpkins	1.29	Can corroded.
Canned baked sweet potatoes	0.92	"
Canned peas	0.50	Can slightly corroded.
Canned beans	1.08	Can corroded.
Canned salmon	0.30	Can slightly corroded.
Canned condensed milk	0.00	No visible corrosion.
Canned pineapples	0.48	Can corroded.
" "	1.11	"

Sample No. 7, "Canned Peas," contained an amount of copper equivalent to 3.95 grains per pound of copper sulphate, and this was in addition to the above-mentioned tin. It will thus be seen that all the samples examined, except the condensed milk, contained an amount of tin salts likely to be injurious to health.—A. R. L.

(B.)—SANITARY CHEMISTRY.

Further Observations on the Efficacy of Sand-Filters as employed in the Waterworks at Zürich. J. f. Gasbelenchtung, 1891. 34, 704—709.

Numerous bacteriological examinations, during a number of years, of the Zürich water supply, before and after filtration through sand, have led to certain conclusions which may be summarised as follows:—

Fränkel and Piefke's assertion that sand-filters offer no absolute protection against pathogenic organisms is disputed, as being not applicable to all sand-filters; and their statement that the number of bacteria present in the filtered water is simply proportionate to the rate of filtration and to the number of organisms existing in the water originally, is shown to be erroneous. On the contrary, the author finds that under the conditions obtaining at Zürich, the number of developable spores in the filtered water is small and fairly constant, and quite independent of the degree of original pollution or the rapidity of filtration (3 to 12 metres per day). It is of importance, however, that the filters be allowed time to acquire their "normal" working condition, and that the rate of filtration be uniform. In the case of new filters, or after cleaning, &c., the action is for some time abnormal, and the water during filtration may even take up organisms from the sand. This fact may possibly explain the bad results obtained during the trial of sand-filters at the Stralau waterworks in Berlin (this Journal, 1890, 642—643).

It may be mentioned that the bulk of the Zürich water-supply is drawn from the lake, and after filtration it is very constant in composition, both chemically and bacteriologically (see also this Journal, 1889, 998).—H. T. P.

PATENTS.

Improvements in the Means employed for the Purification and Decolorisation of Water, Dye, and other Manufacturing Refuse-liquors, Sewage, or other Aqueous or Saline Liquids. W. H. Watson, Bolton. Eng. Pat. 4177, March 9, 1891.

The inventor employs for the above purpose a filter-bed composed of some kind of iron slag, such as "tap cinders," "mill-cinders," "mill-slag," blast-furnace slag, basic or phosphatic slag, &c., either alone or in conjunction with sand (preferably refuse moulding sand), gravel, cobbles, charcoal, &c.—H. T. P.

Improved Means for Delivering and Distributing Polluted Water upon and over a Filter-Bed. J. D. Garrett, Southwold. Eng. Pat. 4677, March 16, 1891.

The apparatus employed consists of an over-shot water-wheel mounted in bearings on a travelling carriage which is arranged to pass automatically on rails over a long filter-bed. A comparatively short trough is attached to the frame of the carriage and moves with it. The forward end of this trough overhangs the water-wheel, whilst the other end is supported on rollers which run on rails extending the whole length of the filter-bed. Over and parallel to the moving trough is a fixed trough equal in length to the filter-bed, and provided at suitable intervals with valves for the exit of the water that is discharged into it from a drain pipe. These valves are raised and lowered one after another as the carriage travels along by means of a projecting rib attached to the moving trough. The sewage which flows from the fixed into the moving trough passes to the water-wheel, causing it to revolve, and subsequently falls on the filter-bed. The carriage, and the hopper for distributing

earth, &c., over the filter-bed, are driven by means of belts or chain gearing from the shaft of the water-wheel. The apparatus is provided with reversing gear, operated automatically, as may be desired. The filter-bed is preferably constructed of concrete, and is covered with a layer of earth, &c., spread out between walls of rushes and perforated tiles. The polluted water, falling on the filtering medium, soaks through it laterally, and passing through the perforations in the tiles, finds its way into channels on each side of the bed.—H. T. P.

Improved Apparatus applicable to the Cleansing or Filtration of Sewage and other Liquids. W. Birch, Manchester. Eng. Pat. 7466, April 30, 1891.

This apparatus is more particularly intended for removing the suspended matter from sewage, &c. It consists of a series of tanks arranged on the same level, or of a long sluice divided into separate compartments by means of transverse partitions, the upper edges of which are below the level of the edges of the sluice. The first of these partitions is preferably made somewhat higher than the rest. The sewage or other liquid is discharged into the first tank, which it fills. It then overflows into the second, and so on until all the compartments are filled, after which the liquid flows in a level stream over the tops of the partitions. The bulk of the liquid in the tanks being comparatively stagnant, the particles in suspension settle, and, passing through a flat or conical perforated false bottom, fall on the floor of the tank. Each compartment is provided with a flushing pipe below the false bottom, by means of which the deposit of sludge may be periodically removed.—H. T. P.

Improvements relating to the Conversion into Manure of the Refuse and Foul Matters from Cities and Towns. L. Lamattina, Rome, Italy. Eng. Pat. 22,192, December 18, 1891.

According to this process, town refuse is converted into manure by subjecting it to ammoniacal fermentation. By this means putrefactive fermentation and the possible development of pathogenic organisms are arrested, and all danger to public health is avoided. The inventor proceeds as follows:—Upon an impermeable basis of clay or cement, heaps, 3—6 metres high, are constructed of farm dung, town refuse, and earth in alternate layers, each set of layers being slightly moistened with water. At regular intervals iron rods are built into the mass in such a manner that when withdrawn, holes are left for the insertion of a thermometer. The heaps are preferably arranged in pairs, the two beds being placed end to end and sloping in opposite directions. A pit is dug in the ground between the two heaps, and suitable gutters are provided so that the drainings from the manure may run into it. During fermentation the drainings are continually pumped back on to the heaps, and the ammonia and sulphuretted hydrogen formed are absorbed by scattering over every alternate set of layers of the heap a layer of ground ferrous sulphate. When the temperature of fermentation has fallen to 30° C. an extra layer of earth is spread on the heaps and they are left for three months, the edges of the beds being watered once or twice weekly during the first month. After this time the heaps will have diminished in bulk by about one-third, and the manure will be fit for use. The manure thus obtained is said to be greatly superior to ordinary farm dung.—H. T. P.

(C.)—DISINFECTANTS.

The "Bordeaux Mixture," a Remedy for Vine Milder and Potato Disease. M. Perret. "Standard" Agricultural Reports.

An important communication was made by M. Michel Perret at the recent meeting of the National Agricultural Society of France in relation to the preparation of the famous Bordeaux mixture in a form at once innocuous to foliage, more speedily active than the ordinary mixture, and

less liable to be washed away by rain. It has been found that the copper in the mixture is so slowly soluble that the solution does not keep pace with the progress of vine mildew or potato disease in the case of a virulent attack. Moreover, when sulphate of copper is simply mixed with water, the acid salt, in drying, is concentrated, and injures the foliage to which the mixture has been applied. It has been suggested that ammonia should be used to neutralise the sulphate of copper, but the sulphate of ammonia thus produced is nearly as injurious to the foliage as the sulphate of copper is. Therefore it was desirable to find a harmless dissolvent of the copper, and sugar, on account of its affinity for the bases, suggested itself to M. Perret. Accordingly he set himself to obtain the solution of copper by forming saccharate of lime, which he added to the sulphate of copper, thus producing a double decomposition by the reaction of the sulphuric acid on the lime, and by that of the sugar on the copper, forming sulphate of lime and soluble saccharate of copper. Now it is indispensable to maintain an excess of lime in order that the mixture may remain alkaline, and it is difficult to determine the limit of saturation in making the ordinary Bordeaux mixture. But where sugar is added a simple phenomenon gives certitude on this point. The formation of saccharate of copper takes place only in the presence of an excess of lime, and the complete saturation of the copper is verified at the moment when the mixture shows a blue tinge, the unsugared Bordeaux mixture being colourless. Thus M. Perret has been able to determine the correct proportions of the ingredients, and his prescriptions, converted into English quantities, will be valuable to those who intend to make experiments during the present season. Twenty pounds of quicklime are dissolved in 80 gallons of water, and to this solution 20 lb. of molasses dissolved in 10 gallons of water are added, while stirring briskly. Lastly, 20 lb. of sulphate of copper, previously dissolved in 10 gallons of water, are also added. Thus, 100 gallons of a mixture are obtained which deposits slowly, does not enumber the distributing machine, and yet sticks well to the foliage, in spite of a moderate washing by rain. The use of molasses instead of sugar causes the mixture to assume a greenish hue.

PATENTS.

Improvements in the Manufacture or Production of Ortho-xydiphenyl-carbon Acid. B. Willcox, London. From F. von Heyden, Nachfolger, Radebeul, Germany. Eng. Pat. 5122, March 21, 1891.

See under IV., page 344.

Improvements in or Relating to the Manufacture of Disinfectant Tablets or Blocks, or the like for Use in Water-Closets, Urinals, Drains, and other Places or Articles. H. B. Thornton, Liverpool. Eng. Pat. 17,421, October 13, 1891.

The disinfectant blocks are prepared by mixing together permanganate of potash, or other disinfectant, paraffin wax, sulphate of calcium or any other suitable cement, and some absorbent material such as asbestos, cotton yarn, pumice stone, cinders, &c. The mixture is made into a paste with sodium hydrate solution, and subsequently moulded into blocks, tablets, or lozenges, &c. Sodium carbonate and salt may be added to the mass at this stage in order to increase the efficiency of the disinfectant. Afterwards the blocks may be coated with paraffin wax or other material, only a small portion of the surface being left bare to allow the liquid in which the blocks are placed to get at the internal substance. In use the blocks may be placed in the tank or other receptacle itself, when the discharge is regular and frequent, but when the discharge is irregular, as in the case of water-closets, the tablet is preferably so arranged that it comes into contact with the water only at each emptying and filling of the cistern.—H. T. P.

An Improved Sheep Dip. A. Robertson, Oban. Eng. Pat. 20,395, November 24, 1891.

The sheep dip in question forms a paste which is said to be freely soluble in four times its bulk of water. From the solution a "dip" may be prepared combining all the advantages of the simple "arsenical" and "carbolic" dips. The paste is made from the following materials:—

	Parts.
"Arsenious acid	2
Carboresylic oil	6½
Carbolic acid	2
Rosin and grease mixture.....	3½
Soda lye.....	1½"

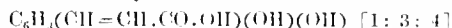
The rosin and grease mixture, previously heated nearly to the boiling point, is boiled with a portion of the soda lye. The arsenious acid dissolved in the remaining lye is then added and the whole thoroughly boiled. Finally the carboresylic oil and carbolic acid are added and well mixed with the other ingredients by stirring.—H. T. P.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

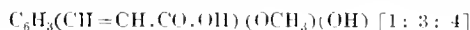
E crescent Resins. M. Bamberger. Monatsh. 1891, 12, 441—463.

The author has previously examined a number of balsams and resins with a view of determining the number of "methoxyl" groups present (this Journal, 1889, 925, and 1890, 659), and in the present paper deals with the nature of the constituents of the resins of the black fir, *Pinus Laricio*, and of the pine, *Picea vulgaris*. Full details of the physical nature of the two resins are given.

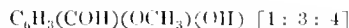
1. *Resin of Pinus Laricio*.—This resin is readily soluble in alcohol and ether, almost insoluble in petroleum ether, melts at about 100° C. and turns red on exposure to air. It gives the reaction for phloroglucinol. When it is dissolved in alcohol and the alcoholic solution treated with steam until the alcohol has been distilled off, a portion of the dissolved resin is precipitated whilst a portion goes into solution which separates out in crystalline crusts on standing. This extract, after careful purification, was found to consist essentially of caffeic acid—



which fact was confirmed by converting the acid into its diacetyl and dihydro-derivatives. Smaller quantities of ferulic acid—

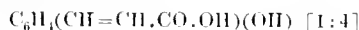


and of vanillin—



were also found in the above aqueous extract. When fused with caustic potash the resin yields catechol and proto-catechuic acid, the latter resulting from the decomposition of the ferulic acid.

2. *Resin of Picea Vulgaris*.—This melts at about 100° C. and when treated with steam in alcoholic solution by the above method, yields a solution from which a crystalline residue results upon evaporation. This residue contains para-cumaric acid—



and vanillin. The presence of ferulic acid could not be ascertained with certainty, and in neither of the resins was abietic acid found. On fusion with caustic potash catechol together with a mixture of protocatechuic acid and para-hydroxybenzoic acid, appear to result.—C. A. K.

The Substances contained in the Petals of Gentiana verna.
G. Goldschmidt and R. Jahoda. Monatsb. 1891, 12,
479—485.

The petals of *Gentiana verna*, when extracted with 80 per cent. alcohol, yield a reddish violet solution, from which a dark red sticky mass results on evaporating off the alcohol. This residue is partially dissolved by water, the colouring matter of the solution being precipitated on the addition of lead acetate; the filtrate from the colouring matter, which itself could not be examined owing to the readiness with which it decomposes, appears to contain a mixture of sugars—probably glucose and levulose. The portion of the extract insoluble in water consists of a mixture of three compounds—one of which preponderates considerably, and which can be separated by fractional crystallisation from alcohol. To this chief constituent the name of *Gentiol* is given. It is a white amorphous powder, melting at 215° — 219° C., and which, according to analysis and a molecular weight determination by the cryoscopic method in phenol solution, has the formula $C_{30}H_{48}O_3$. It forms a tri-acetyl compound, and is therefore to be regarded as a trihydroxy-compound, $C_{30}H_{45}(OH)_3$. On oxidation it yields an acid, melting at 127° C., the composition of which was not ascertained owing to lack of material. When distilled over zinc dust in an atmosphere of hydrogen a greenish oil having a tarry smell is formed, which boiled at 210° C. under a pressure of 22 mm. The second body occurring in the above residue forms white crystalline plates, melting at 215° — 217° C. to which the formula $C_{38}H_{54}O_3$ is assigned from analysis, and a determination of the molecular weight. A third substance consisting of a yellow amorphous powder, melting at 240° C., was also isolated from the mixture, but in too small quantity for further examination.—C. A. K.

Contributions to the Knowledge of the Aconite Alkaloids.
Part II. The Alkaloids of True Aconitum napellus.
W. R. Dunstan and J. C. Umney. Proc. Chem. Soc. 192 [108], 42—44.

The authors have examined the alkaloids of true *Aconitum napellus* plants grown by E. M. Holmes at the instance of the British Pharmaceutical Conference. The alkaloids were extracted from the roots by the following process, which precludes the possibility of the occurrence of hydrolysis, &c.—The solution obtained by percolating with cold rectified fusel oil (boiling point 100° — 132°) was agitated with water acidified with 1 per cent. of sulphuric acid, and the resin having been removed by extracting the acid solution so obtained with chloroform, the liquid was made just alkaline with dilute ammonia and extracted with ether, which dissolved out a considerable quantity of alkaloid, but left in solution a further and smaller quantity, which was subsequently extracted by agitation with chloroform. The alkaloid soluble in ether was obtained as a gum-like mass incapable of crystallisation. By conversion into bromhydride it was separated into a crystallisable and an uncrystallisable salt.

The crystalline product was identified as the salt of aconitine, the crystalline and highly toxic alkaloid already described by one of the authors and Dr. W. H. Ince (C.S. Trans. 1891). The alkaloid separated from the pure bromhydride melted at 188.5° (corr.), and afforded on combustion numbers agreeing with the formula $C_{33}H_{45}NO_{12}$. The specific rotation of the bromhydride in aqueous solution was ascertained to be $[\alpha]_D = -29.65$, a value which agrees with that previously recorded. As some doubt exists as to the solubility of aconitine in water, a determination was carefully made with this pure specimen. The mean of two determinations gave 1 grm. in 4,431 grms. of water as the solubility at 22° ; Jürgens had previously recorded the far greater solubility of 1 in 745 at the same temperature.

The non-crystalline bromhydride furnished a gummy alkaloid soluble in ether and alcohol, but only sparingly soluble in water, the aqueous solution being alkaline to litmus, and very bitter, but not giving rise to the tingling sensation so characteristic of aconitine. Not only the alkaloid, but also the chlorhydride, sulphate, nitrate, and aurichloride prepared from it could not be crystallised.

This alkaloid is not identical either with aconine or with the pieraconitine of Wright and Luff. The authors propose to assign to it the name *napelline*, which was first given to the alkaloid now known as pseudoaconitine, and afterwards by Hübschmann to a substance which the work of Wright and Luff showed to be a mixture chiefly composed of aconine. The napelline obtained in the manner described is probably associated with another amorphous alkaloid.

The alkaloid soluble in chloroform was proved to be aconine, the compound which is obtained together with benzoic acid on hydrolysing aconitine.

The roots of true *Aconitum napellus*, therefore, must be held to contain three alkaloids, one of which is crystalline, viz., aconitine, two being amorphous, viz., napelline and aconine. Indications have been obtained of the presence of a fourth alkaloid, which is amorphous and closely resembles napelline.

The authors find that the juice expressed from the roots contains a large proportion of amorphous bases, but very little aconitine, the greater part of this latter remaining in the root, from which it may be extracted, together with the remainder of the amorphous alkaloids, by exhausting with amyl alcohol. The total quantity of amorphous alkaloid obtained amounted to more than twice that of aconitine.

The physiological results so far obtained point to the conclusion that crystalline aconitine is by far the most toxic of the alkaloids contained in *Aconitum napellus*.

Contributions to our Knowledge of the Aconite Alkaloids.

Part III. The Formation and Properties of Aconine and its Conversion into Aconitine. W. R. Dunstan and F. W. Passmore. Proc. Chem. Soc. 1892 [108], 44—46.

Owing to the uncertainty which exists with reference to the product of the hydrolysis of aconitine, the authors have re-investigated the subject, using a pure alkaloid. Wright and Luff have stated that when aconitine is hydrolysed the sole products are aconine and benzoic acid. More recently, however, Dragendorff and Jürgens have asserted that the hydrolysis occurs in two stages, their contention being that benzoic acid and an alkaloid identical with the pieraconitine isolated by Wright and Luff from the roots of supposed *Aconitum napellus* are formed in the first stage, while in the second stage the pieraconitine is hydrolysed into benzoic acid, methyl alcohol, and aconine, which last is the final product of hydrolysis.

The authors have carefully hydrolysed pure aconitine by heating it with water in closed tubes at 150° , and the alkaloid extracted from the solution by ether was proved to be a mixture of aconine with unaltered aconitine. Using pure aconitine, action occurs precisely in accordance with the equation $C_{33}H_{45}NO_{12} + H_2O = C_{26}H_{41}NO_{11} + C_7H_5O_2$, leaving little doubt that aconitine is benzoylaconine.

Anhydroaconitine was obtained by the interaction of aconine and ethyl benzoate at 130° ; as the anhydro-compound is convertible into aconitine, the partial synthesis of the alkaloid thus effected leaves no doubt that it is benzoylaconine.

Up to the present time neither aconine nor its salts have been obtained in a crystalline state. The authors have hitherto been unsuccessful in all their attempts to crystallise aconine, but they have succeeded in crystallising several of its salts, viz., the chlorhydride, bromhydride, sulphate, and nitrate. All these salts are very soluble in water, the chlorhydride being least soluble and the easiest to crystallise; it is best prepared by crystallisation from a mixture of alcohol and ether; when dried at 100° it melts at 175.5° (corr.). The crystals deposited from alcohol have the composition $C_{26}H_{41}NO_{11} \cdot HCl \cdot 2 H_2O$. When dried at 100° they still retain one molecular proportion of water, which is, however, lost at 120° . The aqueous solution is levorotatory: $[\alpha]_D = -7.71^{\circ}$. It combines with auric chloride forming an aurichloride considerably more soluble than the corresponding aconitine salt.

Aconine was prepared from the pure chlorhydride by adding silver sulphate and subsequent treatment of the aconine sulphate with exactly sufficient baryta water. The solution on evaporation furnished a hygroscopic, brittle gum

which refused to crystallise; this melted at 132° (corr.), and on analysis it afforded numbers agreeing with the formula $C_{26}H_{41}NO_{11}$, which is that proposed by Dunstan and Ince from the results of their study of pure aconitine. Aconine is very soluble in water; the aqueous solution is alkaline. Its aqueous solution is slightly bitter and gives rise to a burning sensation in the mouth, but does not produce the tingling which is characteristic of aconitine. In respect of its action on polarised light aconine exhibits the same peculiarity as aconitine. Its salts are levorotatory, whilst a solution of the alkaloid is dextrorotatory, $[\alpha]_D + 23^{\circ}$. When heated with alkalis aconine slowly resinifies.

The examination of various agents on aconine has so far not led to any important results. Nitrous acid fails to attack it. The principal product of its oxidation by alkaline permanganate is oxalic oxide.

By the action of methyl iodide on aconitine a crystalline *aconitine methiodide* ($C_{26}H_{45}NO_{12} \cdot CH_3I$) was obtained, which melts at 219° (corr.). The *aconitine methyldroxide* prepared from the compound ($C_{26}H_{45}NO_{12} \cdot CH_3OH$) is amorphous, and the salts which it yields do not appear to crystallise.

A Study of the Conditions which determine Combination between the Cyanides of Zinc and Mercury; and of the Composition and Properties of the Resulting Double Salt. W. R. Dunstan. Proc. Chem. Soc. 1892 [109], 51—53.

WHEN a solution of zinc sulphate is added to a solution of mercuric potassium cyanide [$HgK_2(CN)_4$], or when mercuric chloride is added to a solution of zinc potassium cyanide [$ZnK_2(CN)_4$], a white precipitate is formed which has been stated, on the authority of Gmelin, to consist of a double cyanide of zinc and mercury of the formula $ZnHg(CN)_4$. This, the author has shown, is not the case (Pharm. J. 3, 20, 653; J. Chem. Soc. Abstr. 1890, 855). The precipitate loses a large quantity of mercuric cyanide when it is washed with cold water, some, however, remaining attached to the cyanide of zinc. Previous experiments seemed to point to the conclusion that the mercuric cyanide thus retained is not combined, but in some manner mechanically entangled by the zinc cyanide. This view is, however, disposed of by further experiments, of which an account is now given.

The precipitate is in many respects a remarkable substance. The amount of mercuric cyanide "retained" is dependent on the amount of water present during precipitation, as well as on the proportion in which the salts interact; the maximum quantity retained is 38.5 per cent. Zinc cyanide having this percentage of mercuric cyanide attached to it in such a form that it cannot be removed by ordinary washing with cold water is precipitated when cold saturated solutions of the two salts are mixed in equimolecular proportions. The washed precipitate is amorphous. Prolonged contact with cold water leads to the gradual removal of mercuric cyanide. Boiling water dissolves the mercuric salt more rapidly. A cold solution of potassium iodide readily dissolves the mercuric cyanide with the formation of the soluble double salt $Hg(CN)_2 \cdot 2KI$.

A series of experiments in which the masses of the interacting salts were varied proved that a compound of the two cyanides is formed, and suffers decomposition to a greater or less extent, depending on the relative amount of water present. An examination of the curves plotted from these results leads to the inference that the composition of the double salt is expressed by the formula $Zn_2Hg(CN)_{10}$, that is to say, the two cyanides are present in it in the proportion $Zn(CN)_2, \frac{1}{2} Hg(CN)_2$. Such a salt contains 40.6 per cent. of mercuric cyanide. It cannot be obtained pure, since it is decomposed by water, and it can only be produced by precipitation of aqueous solutions. Under the most favourable circumstances, when the quantity of water present is reduced to a minimum, a substance containing 98 per cent. of the double cyanide is obtained; the remaining 2 per cent. consists of zinc cyanide, resulting from the decomposition of some of the double salt by water,

the mercuric cyanide being dissolved, whilst the insoluble zinc cyanide remains mixed with the double salt. All attempts to prepare the double cyanide by other methods than that of precipitation have failed. Fundamental molecules of zinc cyanide and mercuric cyanide must apparently be present, in order that combination may occur. The aggregates of fundamental molecules $[Zn(CN)_2]_n$ and $[Hg(CN)_2]_m$, which constitute the solid salts, show no tendency to combine. No evidence is forthcoming of the existence of any other compound of the two cyanides than that now described. No similar compound of zinc cyanide with other metallic cyanides than that of mercury could be obtained.

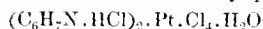
This tetrazincic monomercuridecyanide, mixed with more or less zinc cyanide, has been found by Sir Joseph Lister to be an admirable surgical antiseptic, and it is at his suggestion that the inquiry was undertaken.

A full account of the best method of preparing the salt is given in the author's previous paper (J. Chem. Soc. Abstr. 1890, 855).

In the discussion following, Sir Joseph Lister said that the great value of the salt arose from the circumstance that while equally effective as an antiseptic, it had none of the irritant qualities of mercuric cyanide; and its slight solubility was an advantage. When mercuric chloride was used, it was liable, on the one hand, to be washed away by the discharges, and, on the other, to accumulate until a solution was formed which was so concentrated that it caused great irritation.

β -Pyridine and Piperidine Bases. C. Stoehr. J. Prakt. Chem. 1892, 45, 20—47.

By heating a mixture of glycerol and ammonium phosphate, β -methyl pyridine results, as has been shown by the experiments of P. Schwarz (Ber. 1891, 24, 1676) and of L. Storch (Ber. 1886, 19, 2456). The reaction is a complex one, and a number of basic products result in addition to the β -methyl pyridine, including β -ethyl and perhaps β -propyl pyridine; also a considerable quantity of pyridine itself is formed and bases containing 2 atoms of nitrogen, which are to be regarded as homologues of the diazine $C_4H_4N_2$. Only traces of α -pyridine bases result, which is of interest since the bases obtained from animal oils, the formation of which is to be traced to the glycerol of the fats in the animal residues, consist essentially of these α -bases. The mixture of bases obtained by the distillation of glycerol and ammonium phosphate boil between 120° C. and 250° C. The most volatile portion of the oil (up to 120° C.) contains the pyridine, that from 120° — 149° C. a mixture of pyridine and β -methyl pyridine together with a small quantity of α -methyl pyridine, and that from 140° — 150° C. the bulk of the β -methyl pyridine, which was isolated by means of its mercuric double chloride. The free base boils at 143° — 143.2° C., and has the sp. gr. 0.9748 at 0° C. It is soluble in water in all proportions on gentle warming, combines with methyl iodide to a crystalline ammonium iodide, which is readily soluble in water and is carbonised when heated with bromine. The base obtained by the distillation of strychnine and of brucine with lime is identical with the above in every respect. The platinum double chloride of β -methyl pyridine—



forms monoclinic crystals, which lose their water of crystallisation over sulphuric acid and melt with decomposition at 201° — 202° C. When gently heated, the salt gives up hydrochloric acid to form the platino-salt, $(C_6H_7N)_2PtCl_4$, a pale yellow crystalline precipitate, almost insoluble in water. The mercuric chloride double salt, $C_6H_7N \cdot HCl \cdot HgCl_2$, crystallises in needles from solutions containing 2—3 per cent. of free hydrochloric acid, and melts at 146° C. The zinc chloride and silver nitrate double salts, $2(C_6H_7N) \cdot ZnCl_2$ and $3(C_6H_7N) \cdot AgNO_3$, are also characteristic. β -methyl pyridine does not condense with aldehydes, differing in this from the isomeric α - and γ -bases.

On reduction with sodium amalgam in alcoholic solution, β -methyl piperidine, $C_6H_{12}N$, is formed. This is a

colourless oil, boiling at 125° — 126° C., and having a specific gravity of 0.8635 at 0° C. Its salts with mineral acids are characterised by being readily soluble in water, whilst the double salts are also considerably more soluble than those of the corresponding pyridine base.

β -ethyl Pyridine, $C_5H_4(C_2H_5)N$, is contained in the portion of the mixture got by the distillation of glycerol and ammonium phosphate, boiling at 160° — 166° C., and is best isolated by means of its mercuric double salt, which closely resembles the corresponding β -methyl pyridine salt, and which melts without decomposition at 131° — 132° C. The free base boils at 165° C., and has the sp. gr. 0.9585 at 0° . It is a colourless, highly refractive liquid, considerably less soluble in water than the methyl base, and readily volatile with steam. Its salts with mineral acids are very hygroscopic, but the base forms well-defined double salts with mercuric chloride, platinum chloride, auric chloride, silver nitrate, and with picric acid. On oxidation with potassium permanganate, nicotinic acid results. The base obtained by distilling hucine with lime, together with β -methyl pyridine, is β -ethyl pyridine, which is identical with the product from glycerol in every respect. β -ethyl pyridine forms a crystalline ammonium iodide, the cadmium iodide double salt of which is characteristic. On reduction β -ethyl pyridine, $C_5H_4(C_2H_5)NH$, is formed, which boils at 154° — 155° and has a sp. gr. 0.8711 at 0° C., the hydrochloride of which is readily soluble both in water and in alcohol. Other salts of the base are described. The physiological action of β -methyl- and ethyl pyridine was tried on white mice by subcutaneous injection, the bases being employed in the form of their hydrochlorides. They both act similarly to conine. The breathing is gradually slowed after being first stimulated, and this action is then followed by flowing of saliva and clonic spasms, finally producing death. The fatal dose is greater in the case of the methyl base, the relative intensity of the action as compared with that of conine being 7.1 to 1 in the case of β -methyl pyridine and 6.2 to 1 in that of β -ethyl pyridine.

—C. A. K.

Synthesis of Oxygenated Pyrazole Derivatives. L. Lederer. J. Prakt. Chem. 1892, 45, 83—94.

The synthetical methods employed for the preparation of antipyrine have led the author to study the action of phenylhydrazine in β -halogen substituted fatty acids. Condensation takes place between the amidohydrogen of the phenylhydrazine and the halogen atom of the substituted acid, an asymmetric derivative of the fatty acid with phenylhydrazine being first formed, which readily condenses to a pyrazolone from which an isomer of antipyrine can be prepared.

β -bromobutyric acid in the form of its potassium salt was employed as the starting point, and this when treated with phenylhydrazine yields asymmetric phenylhydrazine butyric acid.

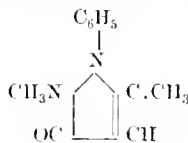
This acid forms glittering plates when crystallised from alcohol, which melt at 111° C. and when heated with concentrated sulphuric acid to 100° C. yielded phenyl-methyl-isohydro-pyrazolone which can be extracted with chloroform after neutralising the product of the reaction with ammonia.

It forms colourless crystals which melt at 127° C. when crystallised from alcohol; from benzene solution it sometimes separates in an unstable form consisting of colourless crystals which readily change into a stable pale red-coloured modification. With silver nitrate a blue colour resembling Pyrazole blue is formed. When methylated a readily soluble product results, which tastes something like antipyrine. This substance is under investigation. A mono-acetyl derivative melting at 79° is easily obtained in the normal way. When oxidised with a dilute aqueous solution of ferric chloride, phenyl-methyl-isopyrazolone is formed, which is best extracted with chloroform. It is readily soluble in benzene, chloroform, and alcohol, and like the hydro-base exists in two modifications, the unstable form melting at 157° C., the stable form at 167° C. When heated in methyl alcohol solution in a sealed tube to 100° with an excess of methyl iodide phenyl-dimethyl-iso-pyrazolone the isomer of

antipyrine is formed, which is also extracted from alkaline solution by chloroform. Iso-antipyrine is readily soluble in water and in alcohol, soluble in chloroform and in hot benzene, difficultly soluble in ether. From the last it separates in tables which melt at 113° . It is a strong base closely resembling antipyrine in its behaviour with reagents. The platinum double chloride is more soluble in water than that of antipyrine, but both melt at the same temperature— 192° C. The picrate is, like that of antipyrine, with difficulty soluble in water; it forms pale yellow needles which melt at 168° C.; antipyrine picrate melts at 187° C. Potassium ferrocyanide gives a white crystalline precipitate in slightly acid solution of the base, ferric chloride gives a dark red colouration and bromine is absorbed by a glacial acetic acid solution of iso-antipyrine, a crystalline product separating on standing.

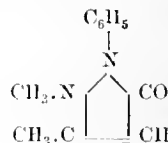
In all these reactions the base behaves just like antipyrine. The salicylate of iso-antipyrine is difficultly soluble in water and does not crystallise as readily as the corresponding salt of antipyrine. The dilute slightly acid solution is coloured emerald green by sodium nitrite, and in more concentrated solution a precipitate of the nitroso-body is formed which, when pure, consists of moss-green needles which decompose at 155° C. Like nitroso-antipyrine, this body gives Liebermann's nitroso reaction. Iso-antipyrine is less stable towards nitric acid than antipyrine; the nitro-compound formed melts at 210° C. Both antipyrine and iso-antipyrine melt at 113° and resemble one another exactly in their solubilities. They are both separated from their aqueous solutions on the addition of caustic soda as oils which are readily taken up by ether. Iso-antipyrine is also a powerful antipretic.

The constitutional formulæ for the two bases are:—



Iso-antipyrine.

(Phenyl-dimethyl-isopyrazolone.)



Antipyrine.

(Phenyl-dimethyl-pyrazolone.)

The reactions involved in this preparation have been patented in Germany, D. R. P. 53,834, October 1889.

—C. A. K.

Dextro-rotatory Terpene from the Leaves of the Siberian Cedar (Pinus sibirica). F. Hawitsky. J. Prakt. Chem. 1892, 45, 115—123.

The complete analogy in the properties and reactions of the dextro- and laevo-rotatory terpenes from both Russian and French turpentine oil render it highly probable that the rotatory powers of these two modifications of terpenes are equal and opposite although the laevo-rotatory terpene from French oil has a specific rotatory power $[\alpha]_D = -43.36^{\circ}$, and the dextro-rotatory terpene from Russian oil a rotatory power of only $+32.00^{\circ}$. The method of isolation of the terpenes from the two oils may explain this difference, but even when the latter was purified by distillation with steam and subsequent fractionation its specific rotatory power was only brought up to $+37.8^{\circ}$. The author has, therefore, examined the oil of the Siberian cedar with the view of obtaining a purer dextro-rotatory terpene. The purified terpene boils at 156° under 753 mm. pressure (corr.), and has a specific rotatory power $[\alpha]_D = +45.04$. It yields a crystalline hydrochloride $C_{10}H_{16}HCl$, which melts at 125° and a bromide, $C_{10}H_{16}Br$, which could not be obtained in a solid form. With alcoholic sulphuric acid a hydrate, $C_{10}H_{16}O$, boiling at 210° C. and possessing all the properties of the hydrate of dextro-rotatory terpene, results.

The chemical and optical properties of the above substances together with measurements of the latter are fully detailed in the paper, together with the method of isolation and purification of the oil.—C. A. K.

The Terpenes of the Oil from the Resin of the Pine (Pinus abies). B. Kuriloff. J. Prakt. Chem. 1892, **45**, 123—133.

The oil obtained from the resin of *Pinus abies* consists of an optically inactive terpene and a dextro-rotatory isoterpene. The former boils at 157° (corr.) under 760 mm. pressure and forms a hydrochloride, $C_{10}H_{16}.HCl$, melting at 126·5° C. The isoterpene, which forms about 2 per cent. of the oil, boils at 176·7° (corr.) under 772 mm. pressure and has a specific rotatory power $[\alpha]_D = -47·5^\circ$. Its hydrochloride, $C_{10}H_{16}.2 HCl$, crystallised from alcohol, melts at 48·5° C. The paper contains full details of the properties, densities and refractive powers of the two substances.

—C. A. K.

PATENTS.

Improvements relating to the Manufacture or Production of certain Phosphorus Compounds. P. G. W. Typke, New Malden. Eng. Pat. 2,252, February 7, 1891.

The phosphoretted hydrogen given off in the manufacture of the hypophosphites is recovered and converted into phosphorus according to the following process. The gases and steam evolved in the manufacture are first cooled and the greater portion of the steam thus condensed. The cooled gases are then led through tubes or retorts made of fireclay or of iron filled with pumice stone, coke, or other suitable material which will stand a high temperature and which will not combine either with phosphoretted hydrogen or with its decomposition products. The hydride of phosphorus is thus completely dissociated; the vapours of phosphorus are condensed in suitable receivers whilst the hydrogen is allowed to escape.—C. A. K.

Improvements in the Production and Separation of Methylamines, Ethylamines, Phenylamines, and Naphthylamines. R. Vidal, Paris, France. Eng. Pat. 3622, February 27, 1891.

See under IV., page 344.

Improvements in the Manufacture or Production of Orthoxydiphenyl-carbon Acid. B. Willeox, London. From F. von Heyden, Nachfolger, Radebeul, Germany. Eng. Pat. 5122, March 21, 1891.

See under IV., page 344.

Process for the Production of Mono- Bromo- and Di-bromo-para-ox-benzoic Acid, suitable for Conversion into Protocatechuic Acid, Pyrocatechin, and the like. J. Y. Johnson, London. From F. von Heyden, Nachfolger, Radebeul, Germany. Eng. Pat. 5184, March 23, 1891.

MONO-BROMOPARAHOXYBENZOIC acid is prepared by treating the free acid or its alkyl ester with one molecular proportion of bromine, in glacial acetic acid solution. The dibromo substitution product is obtained by the action of the calculated quantity of bromine on the alkyl esters of the acid dissolved in caustic soda. The free acid, when thus treated, yields tribromophenol.—C. A. K.

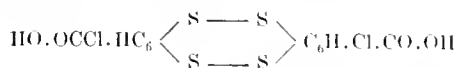
Improvements in the Formation of Ozone in presence of Air or Oxygen, and Apparatus therefor. A. Schneller and W. F. Wisse, The Hague, Holland. Eng. Pat. 5222, March 24, 1891.

See under XI., page 354.

Improvements in the Production of Salicylic-Acid Derivatives containing Chlorine and Sulphur. J. Y. Johnson, London. From F. von Heyden, Nachfolger, Radebeul, Germany. Eng. Pat. 5263, March 24, 1891.

DITHIO-SALICYLIC acid results when two molecular proportions of salicylic acid are treated with one molecular portion of chloride of sulphur ($S_2 Cl_2$) by the method

described in a previous patent (Eng. Pat. 14,443 of 1888). If double the above proportion of chloride of sulphur be employed, and the mixture heated to 100°—150° C. a mixture of derivatives of salicylic acid result more highly sulphurised than the dithio-salicylic acid, and which also contain a portion of the hydrogen substituted by chlorine. When not less than four molecular proportions of the chloride of sulphur to two of salicylic acid are used, a simple body results which from analysis appears to be a tetrathio-dichloro salicylic acid, having the following formula:—

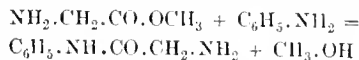


The free acid forms a clear yellow amorphous mass, insoluble in cold water, readily soluble in ether, alcohol, &c. The alkali salts and the magnesium salt are readily soluble in water, whilst the salts with the heavy metals and with the alkaline earths are yellow to grey-coloured precipitates.

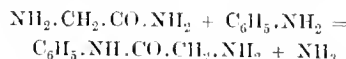
—C. A. K.

Improvements in the Manufacture of Aromatic Glycolol Derivatives. W. Majert, Berlin, Germany. Eng. Pat. 5269, March 24, 1891.

Two products have been shown to be formed by the action of ammonia on chloro- or bromo-acetanilide, viz.:—Glycolol anilide and di-glycolol anilide. These same bodies are formed when the esters of glycolol or glycolol amide are treated with a primary aromatic amine, according to the following equations:—



or—



The resulting products are readily soluble in water and alcohol, less soluble in ether, benzene or petroleum ether; the derivatives obtained from the di-alkylated primary amines are insoluble in water. They are all strong bases, which absorb carbonic acid readily from the air and combine with acids to form stable salts. The salts are decomposed by ammonia in the cold, but hot solutions of ammonium salts are decomposed by the free bases.

The di-glycolol derivatives are very weak bases and their salts dissociate in aqueous solution.

The products are best prepared by the action of alcoholic ammonia on bromacetanilide and its homologues, or by treating the methyl or ethyl ester or the amide of glycolol with the amine. In this way the following bodies have been obtained, the physical properties of which are described in the patent:—Glycololanilide, dimethyl glycololanilide, glycolol-toluide (ortho, meta, and para), glycololanisidine (ortho, meta, and para), glycolol-phenetidine (ortho, meta, and para), and glycolol-diphenylamine.—C. A. K.

Production of Basic Gallate of Bismuth. O. Imray, London. From the "Farbwerke vormals Meister, Lucius, and Brüning," Hoechst-am-Maine, Germany. Eng. Pat. 6231, April 11, 1891.

NEUTRAL bismuth nitrate in nitric acid solution is treated with gallic acid dissolved in 70 per cent. alcohol and caustic alkali or alkali carbonate added to the resulting mixture until the whole remains but slightly acid. On the addition of sodium acetate or on dilution with water a yellow precipitate of basic bismuth gallate is formed, having the composition $Bi(OH)_2CO.O_6C_6H_2(OH)_3$. It is insoluble in water and in dilute acids. Neutral soluble salts of gallic acid may be substituted for the free acid in the preparation.

—C. A. K.

Improvement in and Relating to the Production of a Solution of Myrrhic Resin. W. P. Thompson, Liverpool. From A. Flügge, Frankfurt-on-Maine, Germany. Eng. Pat. 6306, April 13, 1891.

MYRRH is a gum resin containing about 30–35 per cent. of resin, 3 per cent. of ethereal oil, and 65 per cent. of gum. Hitherto strong alcohol has been the only known solvent for the resin, but the patentee finds that a solution of four parts of castor oil to one part of alcohol dissolves the resin completely when digested with it in a closed vessel for eight days. The solution obtained is perfectly clear, of a light brown colour and of an agreeable aromatic smell. A similar solution can be got by treating the alcoholic extract of the resin with castor oil and then evaporating off the former solvent. The solution can be diluted with other oils or fats, and can be employed for embalming and preserving purposes, which is not the case with alcoholic solutions of the resin, the resin being separated from the latter immediately on contact with water.—C. A. K.

Improvements in and relating to the Manufacture of Hydrazine or Diamidogen and its Salts. J. Y. Johnson, London. From the Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. Eng. Pat. 6786, April 20, 1891. (Second Edition.)

THE preparation of hydrazine, $\text{NH}_2\text{—NH}_2$, starts from guanidine either in the form of thiocyanate or of carbonate which is converted into a nitro-compound by the action of nitric acid preferably in presence of sulphuric acid. The product of the reaction is poured into water, when the nitro-guanidine separates and may be purified by recrystallisation from water. Other salts of guanidine can be substituted for the above and nitrates can be employed in place of nitric acid. The nitro-compound is then reduced to the corresponding amido-guanidine, zinc-dust or iron filings in presence of dilute acid or else sodium amalgam being used. The solution of the resulting salt of amido-guanidine is then concentrated, and may be purified by converting it into the sulphate, which is difficultly soluble. By the action of alkalis, the hydrates of the alkaline earths, mineral acids or water under pressure, the amido-guanidine is decomposed with the liberation of ammonia and of carbon dioxide and the formation of hydrazine. This decomposition is effected in a vessel attached to an upright condenser. The hydrazine can be precipitated as sulphate by means of sulphuric acid, or it can be purified by other known means such as distillation and subsequent conversion into any desired salt.

Hydrazine is capable of use in the production of various chemical and pharmaceutical compounds.—C. A. K.

Improvements in the Manufacture of Iodine Substitution Products of Phenols and Cresols. B. Willeox, London. From the "Farbenfabriken vormals F. Bayer & Co.," Elberfeld, Germany. Eng. Pat. 7026, April 23, 1891.

By acting with iodine in presence of alkali on certain phenols the hydrogen atom of the hydroxyl group is replaced by iodine as already described in previous patents. (Eng. Pat. 5079, March 23, 1889, and Eng. Pat. 18,021, November 8, 1890; this Journal, 1890, 412.) The phenols previously employed were phenol, cresol, thymol, para-isobutylphenol, para-isobutylortho-cresol, and para-isobutylmeta-cresol. The present specification covers the preparation of similar products from ethyl, propyl, and amyl phenol, methyl, ethyl and amyl cresols and propyl cresols, isomeric with thymol and carvacrol. Amyl phenol is obtained by heating phenol amyl alcohol with zinc chloride and the other substituted phenols are similarly prepared by heating the phenol with the alcohol in presence of zinc chloride. The resulting phenol is separated by the addition of alkali and purified by fractional distillation after the addition of acid. The iodine derivatives are obtained by treating a solution of the phenol in alkali with a solution of iodine in potassium iodide, in the form of yellow amorphous precipitates. They give off

iodine in heating, are insoluble in water, but dissolve readily in olive oil, ether, and chloroform, somewhat less readily in alcohol, benzene and petroleum ether. Like the iodine derivatives previously described, these new products are used for medical purposes.—C. A. K.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

An Exact and Convenient Method for the Determination of Vapour Densities. C. Schall. J. Prakt. Chem. 1892, 45, 134–144.

THE method, which applies also to the determination of vapour densities under greatly reduced pressure, depends upon the measurement of the depression of a column of mercury placed in manometer produced by the vapour of the substance, this pressure being compared with that produced by the decomposition of a known weight of pure sodium carbonate when decomposed by dilute sulphuric acid. The apparatus consists of a three-bulbed vessel heated in a suitable bath and connected by a T-piece on the one hand to the manometer, and on the other hand to a tube leading to a pump. The substance is clamped between the two ends of a tube above the bulbed vessel previously to introducing it into the latter. The vessel for decomposing the sodium carbonate is attached to the tube leading to the manometer by a second T-piece. The whole apparatus is first exhausted, then the carbonate decomposed, and finally the substance introduced, measurements of the pressure exerted by the carbon dioxide in the first case, and by the vapour of the substance in the other being taken. The vapour density is then calculated according to the formula—

$$D = \frac{g \times h \times 106 \times 1.528}{h' \times G \times 44}$$

Where g = weight of substance.

G = weight of carbonate.

h = pressure due to carbon dioxide.

h' = pressure due to substance.

1.528 = specific gravity of CO_2 compared with air.

44 = molecular weight of CO_2 .

106 = molecular weight of Na_2CO_3 .

Full details of the method, together with a sketch of the apparatus, are given in the paper.—C. A. K.

INORGANIC CHEMISTRY.— QUANTITATIVE.

The Solubility of Sodium Carbonate and of Sodium Bicarbonate in Solutions of Sodium Chloride. K. Reich. Monatsh. 1891, 12, 464–473.

See under VII., pages 346–347.

The Quantitative Determination of Arsenic by the Berzelius-Marsh process, especially as applied to the Analysis of Wall Papers and Fabrics. C. A. Sanger. Amer. Chem. J. 1891, 13, 431–453.

THE object of the author was to obtain some method by which a very small amount of arsenic might be estimated without resorting to the usual quantitative methods which require too much time for ordinary use.

The author's method of obtaining an approximate estimate of the amount of arsenic present was suggested by H. B. Hill, and consists, briefly, in the comparison of the

mirror obtained from an aliquot part of the solution with a series of standard mirrors obtained from known weights of arsenious oxide.

A known quantity of the paper is taken, the quantity depending upon the probable quantity of arsenic present, and upon the character of the paper (*i.e.*, whether a plain colour, a small or large pattern). The paper is measured by means of thin glass plates cut to the required dimensions. The author has used the following sizes:—25 sq. cm. (5×5); 50 sq. cm. (5×10 , 4×12.5 , 2×25); 100 sq. cm. (10×10 , 5×20 , 4×25 , 8×12.5 , 2×50).

The paper is cut into small pieces and treated in a glazed porcelain dish with strong sulphuric acid (1 to 5 cc.), to which has been added about one-thirtieth of its volume of strong nitric acid. When the paper has absorbed the acid, the dish is heated over a low flame until the paper is thoroughly charred, the mixture being continuously stirred with a thick glass rod. In order to get rid of every trace of nitric acid it is best on cooling to add a few cc. of water, and heat again until sulphuric acid fumes appear. On again cooling the "char" is moistened with about 5 cc. of water, well triturated with the glass rod until all lumps are thoroughly broken up, heated to boiling to expel sulphur dioxide, and filtered hot, which is best done by means of a filter-pump. After filtering the "char" is washed with hot water, and after cooling the extract is ready for weighing and introduction into the apparatus.

Any form of hydrogen generator may be used, but the author prefers to use a modification of Bloxam's electrolytic method, in order to ensure a constant supply. To the delivery-tube is attached a two-way or a three-way distributing tube according to the number of reduction flasks to be used. The reduction flask is a wide-mouthed bottle of about 75 cc. capacity, fitted with an india-rubber cork pierced with three holes. Through one hole passes a right-angled tube reaching to the bottom of the flask, the other end being connected to the distribution tube of the generator. Through the second hole is inserted the right-angled delivery tube, reaching just below the cork, and the third hole serves for the introduction of acid and extract. A straight bulb drying-tube containing calcium chloride is attached to the delivery-tube of the reduction-flask, and to this drying-tube is attached the reduction-tube of hard Bohemian glass. At the place where the arsenic mirror is formed this tube is drawn out till the bore is from 1.5 mm. to 2 mm. This finely drawn part is bent slightly upward and sealed.

The reagents and materials employed must be strictly free from arsenic and the acid should be one part strong acid in eight parts of water. In the reduction-flask are placed not more than three grms. of zinc and about 20 cc. of acid. The hydrogen is now turned on from the generator, and lighted, the flame being not more than 1 to 2 mm. in height, the evolution of hydrogen being kept at this rate during the reduction. If the flask becomes heated it may be placed in a basin through which a current of cold water circulates. Before adding the extract the author allows the hydrogen to run for about 15 or 20 minutes to test for arsenic, a lamp being held under the heating place. If the apparatus is found free from arsenic a known portion of the extract is added. If no mirror appears in three or four minutes a further quantity is added, and the whole may be introduced if no mirror appears in another five minutes. When the size of the mirror formed in the first 15 minutes is not larger than that corresponding to 0.05 mgrm. of arsenious oxide, 25 minutes is sufficient for the deposition of all the arsenic.

To make the standard mirrors the author takes 1 gm. of pure arsenious oxide dissolved in water by means of sodium bicarbonate and acidulated with sulphuric acid. This is then made up to a litre and contains 1 mgrm. of As_2O_3 to 1 cc. Ten cc. of this solution are then made up to a litre forming a second solution containing 0.01 mgrm. to 1 cc. Of this, 1 cc., 2 cc., 3 cc., &c. are carefully measured into the reduction flask, giving mirrors corresponding to the same number of hundredth-milligrammes. Mirrors corresponding to half-hundredths may be made in order to get a complete set.

For the purpose of comparison the author uses a tin box shaped like a stereoscopic camera and painted black inside. The standard mirrors are mounted, in order, on a suitable slide, so that any pair of mirrors can be brought under the eye-holes. The mirrors to be compared are also mounted on a slide which can be inserted in the box above the first, thus allowing each mirror to be brought between a pair of the standard mirrors for comparison. The calculation of the amount of arsenic in the area taken follows from the determination of the amount in the aliquot part of the solution. From this can be found the number of milligrammes per square metre or of grains per square yard.

The following table shows a comparison of the results obtained by this method with those obtained by the volumetric method:—

Number of Paper.	Mgmm. As_2O_3 per Square Metre.	
	Barz-Marsh.	Volumetric.
363	8.8	9.1
359	24.0	29.5
392	43.8	40.5
39	64.9	67.5
405	72.8	71.9
111	110.4	108.7
395	133.0	210.4
42	178.8	121.8
194	842.0	832.7
155	1527.1	1478.5

This table shows that the method not only gives an approximation to the actual amount, but may be made with care to give results comparable with those of other quantitative methods.

The author thinks the process likely to be of great use in toxicological work, being the only means of rapidly estimating the amount of arsenic present when this is minute, the arsenic being extracted by distillation. The limit of arsenic that he has been able to detect by this method is 0.001 mgrm. As_2O_3 or 0.0007 As.—D. E. J.

The Volumetric Estimation of Mercury. Chapman Jones, Proc. Chem. Soc. 1892 [108], 46—47.

THE author has found the cyanide method of estimating mercury suggested by Hannay (J. Chem. Soc. 1873, 565) and modified by Tuson and Neison (J. Chem. Soc. 1877, 32, 673) to be unsatisfactory, the presence of carbon dioxide interfering with the titration. If, however, instead of adding the potassium cyanide solution until the turbidity produced by ammonia disappears, the titration be finished by adding, with certain precautions, a standard mercury solution until a definite and permanent turbidity is produced, concordant results are readily obtained. The method of working described is, if necessary, to separate the mercury as sulphide, and dissolve the washed precipitate in cold *aqua regia*, and to dilute and filter the solution. For the titration, litmus extract is added and neutralisation effected with solid potassium carbonate and hydrogen chloride, and finally with dilute ammonia. Excess of the cyanide solution is added, then a slight excess of ammonia, and, lastly, a standard solution of mercuric chloride, until a permanent turbidity is obtained, equal to that produced by 0.1 cc. of the mercury solution in water containing about the same amounts of litmus and ammonia as the solution which is being titrated.

ORGANIC CHEMISTRY.—QUANTITATIVE.

Sulphocyanogen in Coal-Gas. J. V. Esop. Chem. Ind. 1892, **15**, 6-10.

See under II., pages 337-338.

The Composition of Turkey-red Oil. P. Juillard. Bull. Soc. Chim. 1891, **6**, 638-656.

See under XII., pages 355-357.

Report Pharmaceutical Conference, Halle. Chem. Zeit. 1891, **15**, 1371-1376.

AMONG several papers read by Soltsien the following will no doubt be found very interesting:—

1. *Detection of Unsaponifiable Fats.*—The process recommended consists in treating with sulphuric acid and shaking out with petroleum spirit.

2. *Detection of Nitric Acid in Vinegar.*—The tests with brucine or diphenylamine should always be applied before giving an opinion.

3. *Cinnamon Powder.*—The author calls attention to the enormous dilution with sugar.

4. *Mace.*—This is still adulterated wholesale with the inferior Bombay article, and to improve it again a little of a small proportion of nutmeg is added. It is a pity that there exists as yet no reliable chemical test, so the expert must rely on the microscope.

5. *Cocoa.*—This is mixed to such a large extent with shells and starch that it is often undeserving of the name.

—L. de K.

On the Nitrogenous Bases present in the Cotton Seed. W. Maxwell. Amer. Chem. J. 1891, **13**, 469-471.

Owing to the known poisonous character of choline the author has endeavoured to find out whether choline and betaine are present in the cotton seed from which various cattle foods are prepared, both these alkaloidal principles having been shown to be present in the foods. 0.3 grm. of choline is sufficient to paralyse a strong cat and 0.5 grm. will produce immediate death. Betaine is generally believed to be non-poisonous, but is usually found admixed with choline. It is, therefore, very desirable to estimate the quantities of these bodies present in cotton seed.

About 5 lb of finely-ground cotton-seed cakes are extracted with 70 per cent. alcohol, the extract distilled and the residue taken up in water. On adding lead acetate to this solution, a lead precipitate is thrown down which is separated by filtration, and the filtrate is evaporated to a syrup after the excess of lead has been removed from it. The alkaloidal bodies are then taken up from this syrup in a mixture of 70 per cent. alcohol and 1 per cent. hydrochloric acid. This extract is treated with an alcoholic solution of mercuric chloride, and immediately an almost pure white double salt of the nitrogenous bases begins to separate out. After standing for 10 days the crystals are separated from the liquid, from which more crystals can be obtained after some weeks. After recrystallisation from water the salt is decomposed by means of hydrogen sulphide, the mercury sulphide being removed by filtration. The filtrate containing the hydrochlorides of the bases is slowly evaporated to a small volume, and then placed in a desiccator over sulphuric acid until crystallisation of the salts is complete. The crystals are free from colour and well-developed. After drying they are saturated with absolute alcohol in which the choline salt dissolves along with a small proportion of the betaine salt. 7.248 grms. of the crystals were treated with alcohol, and the extract evaporated to dryness and re-extracted three times to obtain the choline salt free from betaine. The following were the results:—

Choline hydrochloride = 1.08 grms.
Betaine " = 6.168 grms.

Choline and betaine appeared to be present in the sample of cattle food used by the author in the relative proportions of 17.5 per cent. choline to 82.5 per cent. betaine.

The alcoholic solution of the choline salt was treated with platinum chloride, and a platinum double salt of choline obtained. From this an aqueous solution of choline hydrochlorate was obtained by treatment with hydrogen sulphide, and the separation of the resulting sulphide by filtration. This aqueous solution gave the following reactions:—

- With (1.) Phospho-tungstic acid, white precipitate.
- (2.) Phospho-molybdic acid, yellow precipitate.
- (3.) Bismuth-potassium iodide, red precipitate.
- (4.) Cadmium-potassium iodide, grey precipitate.
- (5.) Iodine, brown precipitate.
- (6.) Platinum chloride, yellow precipitate soluble in water.

An aqueous solution of the betaine salt was treated with phospho-tungstic acid and a phospho-tungstate of the base obtained. This was broken up with calcium hydroxide and the resulting lime salt filtered off. The residue was extracted with strong alcohol from which free betaine was crystallised out.—D. E. J.

An Error in the Determination of Albuminoid Nitrogen by Kjeldahl's Method. H. Synder. J. Amer. Chem. Soc. 1891, **13**, 212-214.

In the determination of nitrogen by Kjeldahl's method, all the mercury should be precipitated by potassium sulphide in order to prevent the formation of mercurammonium compounds which resist the subsequent action of soda. The "official" modification of this process requires, however, for the determination of albuminoid nitrogen the use of 7-8 grms. of copper hydroxide, which is also precipitable by potassium sulphide; as the quantity of sulphide employed is never sufficient to precipitate the whole of the copper and mercury, a large and variable portion of the latter metal is left in the solution, and all the conditions are favourable for the formation of mercurammonium compounds. This was confirmed by experiment, lower results being obtained when an amount of potassium sulphide insufficient to precipitate the total copper and mercury was used, than when an excess was employed. The author recommends the following modification of the "official method":—7 grms. of the substance, a quantity of copper hydroxide and glycerin solution equivalent to 0.5-0.6 grms. of the hydroxide, and finally 30 cc. of potassium sulphide solution are used. In determining nitrates by the "official method" 2 grms. of zinc-dust are used, but to insure uniform results, the previous addition of 2 grms. of salicylic acid, to convert the zinc into an insoluble and crystalline form at the close of the digestion, is necessary.

—A. R. L.

The Specific Rotatory and Cupric Reducing Power of Invert Sugar and of Dextrose obtained from Cane Sugar by Means of Invertase. J. O'Sullivan. Proc. Chem. Soc. 1892 [109], 56.

AFTER referring to the various values assigned to the rotatory power of levulose and to the doubt thrown on Dubrunfaut's value by the statements of Herzfeld, Bornstein, and Winter, the author minutely describes experiments in which hydrolysis of cane sugar was effected by invertase instead of by means of acid. The conclusion finally arrived at is that, as the specific rotatory power of invert sugar obtained by means of invertase, which has no action on levulose, is $[\alpha]_D = -24.5^\circ$, and that of the dextrose prepared from such invert sugar is $[\alpha]_D = 57^\circ$, the apparent specific rotatory power of levulose calculated from these numbers must be $-24.5 \times 2 + 57^\circ = [\alpha]_D = 106$ or $[\alpha]_D = 93.8$, a value agreeing with that generally accepted.

New Books.

A TREATISE ON CHEMISTRY. By Sir H. ROSCOE, F.R.S. and C. SCHORLEMMER, F.R.S. Vol. III. The Chemistry of the Hydrocarbons and their Derivatives, or Organic Chemistry. Part VI. London and New York: Macmillan & Co. 1892.

This part of Roscoe and Schorlemmer's well known and classical Treatise on Organic Chemistry, contains a description of the derivatives of naphthalene and the allied hydrocarbons, as well as of the compounds consisting of two or more benzene nuclei directly connected. It forms a volume of 8vo. size, bound in cloth, containing Preface, List of Contractions, Table of Contents, and 561 pages of subject-matter. The Alphabetical Index, a most complete one, occupies 18 pages. The text throughout is profusely annotated with references to original sources of information. The groups treated of are the following:—Indene Group. Naphthalene Group; Methyl-naphthalene Group; Dimethyl-naphthalene Group; Ethyl-naphthalene Group; Naphthalene Derivatives containing more than 12 carbon atoms; Naphthindole derivatives; Acenaphthene Group; Pyrene Group; Diphenyl Group; Methyl-diphenyl Group; Dimethyl-diphenyl Group; Ethyl-diphenyl Group; Derivatives of Diphenyl containing more than 14 carbon atoms; Azo Dyes of the Diphenyl Group; Fluorene Group; Phenanthrene Group; Retene Group; Fluoranthene Group; Phenyl-naphthalene Group; Chrysene Group; Dinaphthyl Group; Diphenylbenzene Group; Triphenylbenzene Group. Special attention is throughout the work given to the organic colouring matters and dyestuffs and their effects in dyeing and printing; also to those organic substances which may be classed as "Fine Chemicals." With regard to the technological application of organic substances in the tinctorial arts and pharmacy, &c., this work on Organic Chemistry throughout holds a perfectly unique position amongst treatises on this branch of science.

The price of the volume is 21s.

LESSONS IN ELEMENTARY CHEMISTRY, INORGANIC AND ORGANIC. By Sir HENRY E. ROSCOE, LL.D., F.R.S. Late Professor of Chemistry in the Victoria University, The Owens College, Manchester. London and New York: Macmillan and Co. 1892.

This well-known little work in this its latest edition, is considerably improved and enlarged. Especially in the section dealing with Organic Chemistry are the extensions noticeable. The last edition was published in 1886. In the Inorganic Chemistry Section, as an example of the stage to which this branch of the elementary literature has been brought, may be mentioned the record of the striking discoveries of nickel carbon monoxide and iron carbon monoxide made by Mond, Langer, and Quincke, and Mond and Quincke, respectively. In the Organic Chemistry Section it is noticeable that on the subject of Indigo, the chemistry of which has been deeply studied in so many phases for the main purpose of commercial application, the literature is naturally expanded, though notice of the technical application so far as replacement of the natural product is concerned, is in this edition cut down to the remark that "none (of the synthetical methods) have yet been so successful as to compete to any extent with the natural product."

Among the alkaloids, a short description of Cocaine and its uses, and of Antipyrine, with the constitution of the latter, is noted as an additional feature. Moreover a chapter is added (Lesson XLIII.) on the "Synthetical Production of Organic Compounds," in which the outlines of the more typical cases of Organic Chemical Synthesis are given. The present edition thus contains 43 chapters, whilst that of 1886 contained 41. The other additional chapter was obtained by splitting up Chapter XL. of the 1886 edition, on Turpentine, Camphor, and the Alkaloids, into two

chapters for this the 1892 edition, so that here we have Chapter XL. devoted to Turpentine, Camphor, and the Glucosides, whilst in Chapter XLI. the Alkaloids are separately dealt with. In the edition for 1886 there are 439 pages; in this the 1892 edition 486 pages of subject-matter. The work is illustrated with 78 well-executed wood engravings, and a beautiful chromolithograph chart of the spectra of the metals of the alkalis and alkaline earths. The price of the book is 4s. 6d.

ANLEITUNG ZUR CHEMISCHEN ANALYSE ORGANISCHER STOFFE. Von Dr. G. VORTMANN, Privatdocent an der Technischen Hochschule in Aachen. Leipzig and Vienna: Franz Deuticke. London: H. Grevel and Co., 33, King Street, Covent Garden. 1891.

IN his preface the author points out that hitherto the term "Organic Analysis" has been made almost exclusively and with few exceptions to refer to certain restricted methods of elementary quantitative analysis, and that the behaviour of organic substances to reagents, and especially of chemically allied substances to one and the same reagent, has received but scanty attention of a systematised kind. But the means at disposal through lack of systematised matter, and by reason of many vacancies as to known reactions, were inadequate, and much special experimental investigation was necessary before the vacancies could be filled up and a definite system constructed. This work now contains a system of qualitative reactions. The author states that he has not given much prominence to the treatment of the alkaloids, as this subject is already so well handled in the text-books of analytical chemistry.

The present volume is of 8vo. size, with paper cover, and containing Title page, Preface, Table of Contents, subject-matter covering 403 pages, and an Alphabetical Index. Lastly follows a series of 18 elaborate tables of numerical data of which the principal comprise "Vapour Tensions of Potash Solution of 1.258 Specific Gravity;" "Melting and Boiling Points of the Hydrocarbons;" "Tables for Determining the Percentage Amounts of Alcohol in Spirituous Liquors;" "For Determining the Amounts of Alcohol by the Drop Test (Tranbe);" and "For the Specific Gravity and Index of Refraction of Aqueous Glycerol Solutions;" "Tables of Absorption Spectra;" "Specific Gravity of Mixtures of Ether and Alcohol (Squibb);" "Specific Gravity, Melting Points and Solidifying Points of Fats and Oils;" "Melting Points and Solidifying Points of Free Fatty Acids," &c., &c.

The text is illustrated by 27 wood-cuts representing apparatus necessary in the experiments.

The following excerpt of contents will sufficiently indicate the nature and scope of the work:—

I. *Detection, Discrimination and Quantitative Estimation of the Elements.*—A. Qualitative Analysis. Carbon. Hydrogen. Chlorine, Bromine, and Iodine. Oxygen. Sulphur. Nitrogen. Phosphorus. Metals. B. Quantitative Analysis. Estimation of Carbon and Hydrogen. Estimation of Chlorine, Bromine, and Iodine; of Oxygen; of Sulphur; of Nitrogen; of Phosphorus; of Metals. Methods for simultaneous Estimation of several Elements. Calculation of Analyses.

II. *Discrimination and Quantitative Estimation of Atomic Groups.*—Hydroxyl-, Methoxyl-, Ethoxyl-, Sulphohydryl-, Sulphomethyl-, and Ethyl-, Amido-, Imido-, Methyl-amido- or Ethylamido-, Hydrazine-, Diazo-, Nitro-, Nitroso-, Carbinol-, Aldehyde-, Carbonyl- (Ketone-), Carboxyl-, and Nitrile- Groups. Also Radicals of Hydroxy Acids.

III. *Discrimination and Quantitative Estimation of Compounds.*—Hydrocarbons. Halogen Substitution Products of the Hydrocarbons. Alcohols. Phenols. Ethers and Esters. Aldehydes. Ketones. Carbohydrates. Quinones. Glucosides. Acids. Sulphur Compounds. Primary Amines. Secondary Amines. Tertiary Amines. Acid Amides. Pyridine- and Quinoline- Bases. Alkaloids. Nitriles. Nitro Compounds. Albuminoids. The price of work is 10s.

HANDWÖRTERBUCH DER PHARMACIE. Praktisches Handbuch für Apotheker, Ärzte, Medicinalbeamte und Drogisten. Herausgegeben von A. BRESTOWSKI. Wien und Leipzig: Wilhelm Braumüller. K. U. K. Hof- und Universitäts-Buchhändler. London: H. Grevel and Co., 33, King Street, Covent Garden. 1892.

THIS, the second number of the new Dictionary of Pharmacology, edited and published by Brestowski, has just appeared. (See this Journal, 1892, 275, col. 1.) The price of each number issued is 2s. 5d. The Editor is assisted by 41 contributors of eminence. The first volume of the two which furnish the complete work will comprise about 24 numbers or parts.

Whilst due attention is given to the chemical relations and properties of the individual substances treated of in the text, the physiological and toxicological relations are specially dealt with, as also the best methods of preparation from the pharmaceutical point of view. Attention is also fully devoted to tests for purity and discrimination. The present number commences with *Amylacetate* and ends with *Aseptol* (*Orthophenolsulphonic acid*).

CHEMISCH-TECHNISCHES REPERTORIUM. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen, auf dem Gebiete der Technischen und Industriellen Chemie mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. EMIL JACOBSEN. Erstes Halbjahr. Erste Hälfte. Berlin: R. Gaertner's Verlagsbuchhandlung. Hermann Heyfelder, S.W., Schönebergerstr. 26. London: H. Grevel and Co., 33, King Street, Covent Garden. 1892.

THIS, the first issue of Jacobsen's Repertorium for 1891, and representing the first half of the opening half year, appears in a volume, the pages of which run from 1 to 152. The text is illustrated with 27 woodcuts. The subjects treated of are as follows:—Building Materials, Cements, Artificial Stone, Colouring Matters, Dyes and Calico Printing, Fats, Oils, Illuminating and Heating Materials, Fermented Liquors, Tanning, Leather, and Glue Manufacture, Textiles, Glass, and Earthenware, Wood and Horn, India-rubber, Cements, Gums, Pastes, and Adhesives, Lakes, Varnishes, and Paints. Metals.

A DICTIONARY OF THE COAL-TAR COLOURS. Compiled by GEORGE H. HURST, F.C.S. (member of the Society of Chemical Industry). London: Heywood and Co., Lim., 68, Fleet Street. 1892.

LARGE 8vo. volume, handsomely bound in blue cloth and gilt. It contains Preface, a Plan of the Work, Introduction, and Text covering 106 pages. The matter is arranged alphabetically according to the technical or trade names of the colours. After each colour or dye is given in brackets the name of the manufacturer or inventor. The English patents are also given, number and year being specified. Modes of application of the colours, specialities, and tests are also included. Where several names are applied to a colour, these names are indicated. The method of treatment of each colouring matter described in this Dictionary may be gleaned from the following plan followed in each case as nearly as possible. "No systematic account of the process of manufacture or chemical relationships of the colours is given, but as far as possible to obtain the information, the chemical composition, formula, method of preparation, date of introduction, literature relating to it, and the discoverer are given, whilst the properties and uses of the colours have had special attention paid to them." The price of the work is 10s. 6d.

SILK DYEING, PRINTING, AND FINISHING. By GEORGE H. HURST, F.C.S., Lecturer on Technology of Painters' Colours, Oils, and Varnishes at the Manchester Technical School, &c. London: George Bell and Sons, York Street, Covent Garden; also New York. 1892.

SMALL 8vo. volume, bound in cloth. It contains Title Page, Preface, Table of Contents, List of Coloured Patterns, and 220 pages of subject-matter. The work terminates with an Alphabetical Index. The text is illustrated with 21 woodcuts and 11 plates of dyed and printed silk specimens. The subject-matter is divided into chapters, as follows:—I. Origin, structure, composition, and properties of Mori, Tussah, and other wild Silks. II. Boiling off and bleaching of Silks. III. Dyeing Blacks on Silk, Logwood blacks, and Tannin blacks, Aniline and other Coal-Tar blacks. IV. Dyeing of Fancy Colours on Silk. Weighing of Silks. Reds, Oranges, Yellows, Blues, Greens, Browns, Violets, &c., on Silk. V. Dyeing mixed Silk Fabrics. VI. Silk Printing. VII. Silk Dyeing and Finishing Machinery, Yarn Dyeing, Piece Dyeing, Silk Finishing Machinery, Silk Finishing. VIII. Examination and Assaying of Raw and Dyed Silks.

Appendix of 170 recipes for Dyeing and Printing Silks and 66 patterns.

The price of the book is 7s. 6d.

This book forms one of the Technological Handbooks, edited by Sir H. Trueman Wood, Secretary of the Society of Arts.

ZEITSCHRIFT FÜR ANORGANISCHE CHEMIE. Unter Mitwirkung von Berthelot, Blomstrand, Brauner, Clarke, Classen, Clève, Cooke, Cossa, Crookes, Ditte, Friedheim, Gibbs, Hempel, Joergensen, Krant, Lunge, Mallet, Mauro, Mendelejeff, Meyer, Mond, Nilson, Piccini, Roscoe, Seubert, Spring, Thorpe, Winkler, und andere Fachgenossen. Herausgegeben von GERHARD KRÜSS. Band I. Heft 1, 1892. Hamburg and Leipzig: Verlag von Leopold Voss. London: H. Grevel & Co., 33, King Street, Covent Garden.

THIS new and important work on Inorganic Chemistry is to appear as a periodical, the parts of which can ultimately be bound to form volumes of 30 sheets each. A volume would be priced at 12s. As the above eminent names indicate, the contributors to this work are of various nationalities and of representative character.

The present, and opening number, is a pamphlet of 8vo. size, containing 82 pages of subject-matter. The articles contributed to this the first issue are as follows: On Phosphorus Oxy-sulphide (Thorpe and Tutton). The Double Acids of the Heptatomic Iodine (Blomstrand). Action of Hydrogen Peroxide on some Fluorides and Oxyfluorides (Piccini). Some Ammoniacal Platinum Compounds (Carlgren and Clève). Preparation of Tungstates free from Molybdenum (Friedheim and Meyer). A Lecture Experiment (Winkler).

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

(From the Board of Trade Journal.)

NEW SPANISH CUSTOMS TARIFF—Concluded.

Statement showing the Rates of Import Duty to be levied in Spain under the New Spanish Tariff, compared with the Rates of Duty hitherto leviable on Imports into that Country.

Note.—Up to the 30th June next, when the Anglo-Spanish Convention of 1886 expires, the Conventional rates of the Spanish Tariff will still be levied on British produce, including those of the Franco-Spanish and German-Spanish Treaties which are enumerated in Parliamentary Paper, Commercial No. 13 (1886). (C.—4779).

No.	CLASSIFICATION OF ARTICLES.	Rates leviable by New Tariff of 1st February 1892.		CLASSIFICATION OF ARTICLES.	Rates leviable hitherto on Imports from United Kingdom.
		General Tariff.	Special Tariff.		
	CLASS X.	Pes. cts.	Pes. cts.		Pes. cts.
	ANIMALS AND ANIMAL PRODUCTS EMPLOYED IN INDUSTRY.				
	Group 1.—Animals.				
	Group 2.—Hides, Skins, and Leather Worms.				
238	Skins and hides untanned (Note 45).....	Per 100 kilogs. 7 20	Per 100 kilogs. 6 00	.. .. .	Per 100 kilogs. 6 00
239	Varnished leather, calf skins, tanned and dressed.....	Per kilog. 3 25	Per kilog. 2 50	.. .. .	Per kilog. 3 25*
240	Other hides, tanned or dressed, including sole leather.....	1 63	1 25	.. .. .	1 85†
	Group 3.—Feathers.				
	Group 4.—Animal Products.				
250	Animal fats.....	1 39	1 00	.. .. .	1 00
251	Guano and other natural manures.....	0 05	0 05	.. .. .	0 04
252	Other artificial manures.....	0 30	0 25	.. .. .	0 04
253	Gut.....	25 35	19 50	.. .. .	21 90
254	Other animal products not specified, unmanufactured....	0 65	0 50	.. .. .	0 50
	CLASS XI.				
	INSTRUMENTS, MACHINERY, AND APPARATUS EMPLOYED IN AGRICULTURE, INDUSTRY, AND LOCOMOTION.				
	CLASS XIII.				
	VARIOUS.				
343	Horn, whalebone, meerschaum, bone, and paste, in imitation of the substances last above specified, manufactured.	3 25	2 50	.. .. .	2 50
346	Cartridges without projectile or ball, for fire-arms, not prohibited.	Per 100 kilogs. 90 00	Per 100 kilogs. 75 00	.. .. .	Per 100 kilogs. 45 85
347	Ditto, with projectile or ball, for fire-arms, not prohibited	72 00	60 00	.. .. .	22 90
348	Priming or percussion caps for ditto.....	Per kilog. 2 10	Per kilog. 1 75	.. .. .	Per kilog. 146 65
352	India-rubber and gutta-percha, unmanufactured.....	Per 100 kilogs. 60 00	Per 100 kilogs. 5 10	.. .. .	Per 100 kilogs. 3 00
353	Ditto, in sheets, threads, and tubes.....	Per kilog. 0 90	Per kilog. 0 75	India-rubber, in sheets or tubes. Ditto, in thread.....	Per kilog. 0 75 0 50
354	Ditto, manufactured in objects of any form.....	2 60	2 60	Ditto, manufactured in any form.	1 50
355	Oilcloths and tarpaulins for flooring or packing.....	Per 100 kilogs. 30 00	Per 100 kilogs. 32 50	.. .. .	Per 100 kilogs. 21 65
356	Ditto, of other kinds.....	Per kilog. 1 30	Per kilog. 1 00	.. .. .	Per kilog. 0 65
359	India-rubber elastic tissues with mixture of other materials (Note 70).	3 60	3 00	.. .. .	2 75

* Duty whilst the Commercial Treaties between Spain and Belgium and Spain and France remain in force, 2.50 pesetas per kilog.

†

1.25

EXPORT TARIFF.

No.	ARTICLES.	Rates leviable by New Tariff of 1st Feb. 1892.				Rates leviable hitherto under the Special Tariff.			
		Per 100 Kilogs. Pes. cts.				Per 100 Kilogs. Pes. cts.			
1	Cork, in lumps or sh. cts.	5	00	..	..	4	90	..	..
2	Linen, cotton, or hemp rags, and used wares of same materials.	4	00	..	..	4	00	..	..
3	Galena ores (Note 1)	1	25	..	..	1	25*	..	..
4	Argentiferous lead ores (Notes 1 and 2)	1	00	..	..	0	98*	..	..
5	Argentiferous litharæ (Notes 1 and 2)	1	50	..	..	1	45*	..	..
	All other articles	Free.	..	..	..	Free.	..	..	..

* Free of duty whilst the Commercial Treaty between Spain and France remained in force.

SPECIAL TARIFF, No. 4.

The following ARTICLES, when imported into Spain or the Balearic Isles, proceeding from or loaded at European ports, shall, in addition to the duty payable under this tariff, be subjected to the following surcharge:—

No.	Articles.	Per 100 Kilogs.	
		Pes. cts.	
1	Petroleum, crude or refined.....	0	50
2	Cocoa and palm oil	1	50
3	Indigo	20	00
4	Raw cotton.....	2	50
5	Alcacia, aloe, and jute, raw.....	1	00
6	Skins and hides, untanned.....	3	00
7	Cocoa.....	4	00
8	Coffee.....	4	50
9	Ceylon cinnamon.....	8	00
10	Chinese cinnamon	2	00
11	Cloves	3	50
12	Pepper	3	50
13	Tea.....	4	00

Notes.

(1.) Coal and coke shall be cleared in conformity with the weight of the quantity received on board, stated in a certificate to be given to the captain of the vessel by the Spanish Consul at the port of loading, in accordance with the cargo note and bills of lading, which the said Consul shall demand to see for the purpose. In doubtful cases the Custom houses may verify the weight of the coal or coke.

(2.) Crude shale oils shall be understood to be those obtained by a first distillation, and distinguished by their yellow colour and their density of 0.900 to 0.920, or 66 to 57½ of the centesimal areometer, equal to 21.69 to 21.48 Cartier.

Crude natural mineral oils shall be recognised by the following qualities:—

1. That when gradually and continuously distilled in a glass vessel at a temperature of 300 C., they shall leave a residue of more than 20 per cent. of the original weight.

2. That this residue shall afterwards leave a minimum of 1 per cent. of coke of the total weight of the mineral oils assayed.

3. That when assayed in the Granier apparatus they shall be inflammable at a temperature of less than 16° C.

All mineral oils which have not the above properties shall be considered refined oils.

The duties imposed on mineral oils, whether crude or refined, are appraised on the net weight of the liquid.

Bottles ("envases") containing the said oils shall pay separately; barrels as casks; tin boxes as tin worked up; and wooden boxes in which the latter are inclosed as common wood worked up.

In all cases where doubts arise regarding the application of Nos. 7, 8, and 9, the Custom houses shall consult the Central Custom House (Dirección General de Contribuciones Indirectas).

As regards crude mineral oils, it shall be indispensable in all cases to take samples in the following form:—

In all clearing of crude mineral oil, a sample of 200 cubic centimetres shall be taken from every 50 cases, and a like quantity from every 10 barrels of the total quantity declared, provided the quality is the same.

These samples shall be mixed together in a large bottle, and when the clearance of the whole cargo has been effected, two litres shall be taken of the samples filling two bottles, and when these bottles have been closed with sealing wax and stamped, the labels shall be signed by the Customs officers and the owner of the goods, and the samples shall be sent on to the Director-General of Customs to be assayed.

The declaration shall be proceeded with at once in accordance with No. 8, and the owner of the goods shall be bound by the result of the analysis, and the clearance shall not be deemed definitive until that result be known.

The samples shall be assayed within the space of one month, no extension of this period being permissible. The owners of the goods shall have the right to see the samples opened and assayed, and to appeal to the Ministry of Finance from the decision of the Custom house.

When the owners of the goods request in their appeals that fresh assays be made, they shall be liable for the expenses thereof, should no change be required to be made in the clearance dues decided on by the Custom house. Should the contrary be the case the expenses shall be borne by the Administration.

In order to secure their right to be present at the clearance, owners of goods must demand this in writing when signing the labels of the samples.

3. See Tariff No. 4 respecting arrivals from non-European ports.

4. Under this number shall be comprised bottles, demi-johns, and flasks for holding oils, wines, drugs, perfumery, and chemical products, provided they be not cut; also thick unpolished glass of more than 12 millimetres, for skylights and pavements.

5. Under this number shall be comprised bottles, tumblers, glasses, and other articles for table service or lighting purposes, whether of crystal or glass, plain or stained.

6. Only rough bricks, flagstones, and tiles of baked earth or clay, employed in the construction of walls, furnaces, &c., are to be included in this category.

7. No. 17 includes small bricks for flooring and for mosaic work, and also the objects comprised under No. 16, employed for building, when glazed, painted, enamelled, and made of washed and sifted earths.

8. The articles of fine earthenware included in this category are dinner services and kitchen utensils.

19. The number of threads comprised in the inch for the application of this duty are only those of the warp of the stuff.

20 and 21. To test gilt articles, they shall be rubbed with hot alcohol, and then touched with a drop of nitric acid. If they are varnished only, the varnish will come off with the alcohol and the nitric acid will act; if they are gilt the alcohol will cause no corrosion and the nitric acid will not have any effect upon them.

Silvered articles shall be filed until the superficial coating of silver gives way, and the colour of the metal of which they are principally composed becomes visible. Moreover, if a portion of the plated metal be dissolved in nitric acid, the silver (if there be any) will be precipitated with chloric acid, thus forming chloride of silver soluble in ammonia and possessing the characteristics of this substance.

In the case of nicked objects, the superficial part of the nickel which overlays them shall be filed so as to leave uncovered the brass or other metal which forms their chief component.

22 and 23. See Tariff No. 4 on arrivals from non-European countries.

24. The colours comprised in this number are compounds having a metallic basis, and are used mixed, with oil or turpentine, generally insoluble in water, alcohol, or ether, rarely crystallised, and almost always in powder or lumps. Among these are white lead, yellow chromate, vermilion, Prussian blue, Thenardite, English green and parrot green ("papagayo").

25. The colours comprised in this number are called artificial colours or organic products in which metallic substances are rarely found. They are generally crystallised, soluble in water, alcohol or ether, and are used more for dyeing and stamping than in painting, with or without goldsize ("mordiente"). Among these are picric acid, aldehyde green, English violet, rose aniline, and salts of the same colours of naphthaline, artificial alizarine, &c.

26. The products or substances comprised in Nos. 118 and 119 shall be examined by pharmaceutical inspectors, who shall sign the certificates in conjunction with the Customs officials in the following form:—

The products cleared are correctly stated in the declaration and are or are not—passed as imports, the formula thereof having been published (state where); and the composition thereof having been ascertained by means of an assay made by A. B.

39. In order to have the benefit of this number the pulp or paste must be perforated so that it cannot be used for any purpose except paper making. When the paste or pulp is presented for clearance without being perforated, the Customs officers shall, at the expense of the owner of the goods, break up the sheets in a manner that may render the stuff useless for any other purpose than paper making. Paste or pulp not perforated shall pay duty as if it were common pasteboard.

42. Boxes of pasteboard lined with paper more or less common, that may be used as packing for handkerchiefs, shirt fronts, buttons, pieces of tissues, or other similar articles, shall pay duty in accordance with this number.

45. See Tariff No. 4 on arrivals from non-European countries.

70. Under this number are comprissed all tissues, whether they have one or two coatings of rubber, and likewise those which are rubbered only between the two surfaces.

GENERAL TRADE NOTES.

NOTES AND HINTS ON THE VEGETABLE PRODUCTS OF TROPICAL AFRICA.

J. R. Jackson, *Journ. Soc. of Arts* 1891, 49, 110—111, and 122—123.

Rubber.—The various known kinds of African rubber come from climbing plants of the orders *Apocynaceæ* and *Urticaceæ*, mostly from the former. All plants of these orders should be examined for rubber. Liberian rubber from a tree named "Abba" has a considerable export capable of great development if systematic planting were undertaken.

Attention should be given to juices from any species of *Euphorbia* as they yield milky juices solidifying on exposure to air which may be useful for mixing with rubber and gutta-percha.

Gutta-percha plants of the order *Sapotaceæ* should be examined for the milky juices of their trunks and for the fats and oils which the seeds contain. The "butter-tree" is of this order, the seeds of which yields gutta-shea the product most nearly resembling true gutta-percha. It is at present used in making hard soaps.

Food products.—The cassava (*Manihot utillissima*) is cultivated in West Africa for the sake of its roots, from which tapioca is made. It is worth extended cultivation.

Drugs.—A large field is open in this department and any plants used by the natives for medicinal purposes should be sent to England for experiment or trial. Plants of the order *Rubiaceæ* should be tested for bitter tonic principles, the mallow family for demulcent properties, the *Euphorbiaceæ* for cathartic properties. The ordeal bean of Old Calabar is used in ophthalmic and other cases and might be worth cultivation. The downdaké (*Sarcocephalus Esculentus*) has attracted attention on account of its properties as a tonic and febrifuge. *Strophantus* (or Kombe) has valuable cordial properties. Several species are probably comprised under this name. The fruits and foliæes should not be gathered till they are ripe, as the immature seeds shrivel in drying and lose some of their active principle. *Vanilla*, which has never been cultivated to any great extent in British possessions, would no doubt flourish in Western Africa.

Oils and Fats.—A large number of new oil seeds have come into the English market from the West Coast of Africa during the last few years. The seeds of any unknown plant should be examined for oil, and if found specimens of the plant should be sent home for the determination of their botanical affinities. The following plants, the characters and value of which are at present not completely known, furnish seeds, the oil from which has found its way into the market in larger or smaller quantities: mutugo (from the *Telfaria occidentalis*), maluku, (from the *Polygala varifolia*), meni (from the *Lophira alata*), owala (from the *pentaclethra macrophylla*), and the M'paga nut from a species not yet identified.

Gums.—Any species of acacia may be expected to furnish a soluble gum.

Resins, or semi-fossil gums, commercially known as copal, are found buried at various depths in the neighbourhood of gum-yielding trees, or on the site of extinct forests. Amine found in Zanzibar is the most valuable variety. In hambane copal discovered in 1883 has fetched 80*l.* to 100*l.* a ton. Ogea gum was introduced from the Gold Coast in the same year.

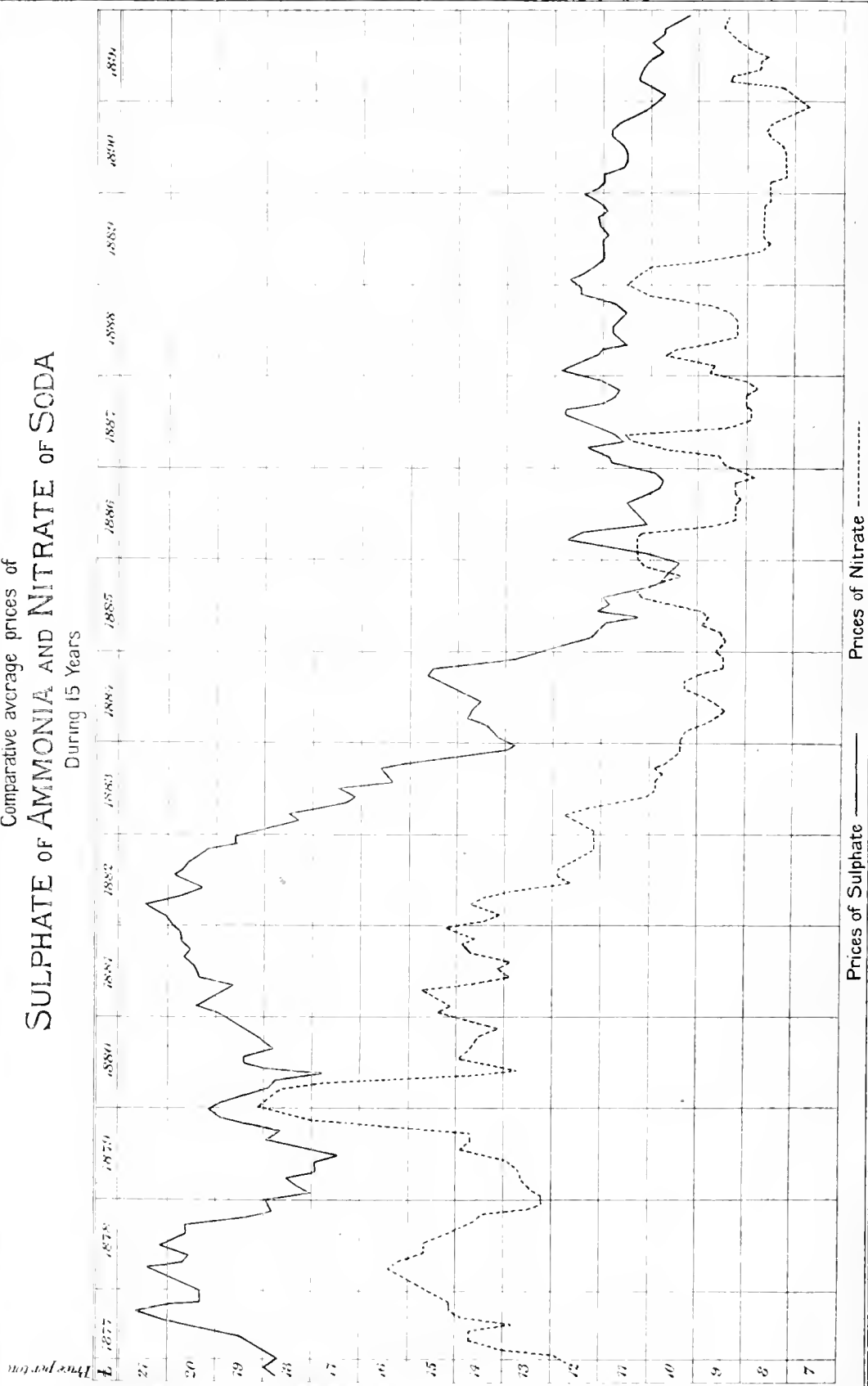
Dyes.—The Yoruba indigo, though used by the natives, has not found its way to England. Downdake, and the yellow dye plant of the Soudan (*Cochlospermum tinctoria*) are worth more attention than they have received.

Fibres.—There is a wide field for the utilisation of fibrous substances. The leaf stalks of the bamboo palm of West Africa seem likely to become important for brush making. The Bolobolo fibre brought to notice in 1889 seems likely to command a considerable price.

Perfumes.—In collecting specimens of fragrant plants for transmission to England for examination, care should be taken to dry the fragrant part of the plant thoroughly.

—V. C.

Comparative average prices of
SULPHATE OF AMMONIA AND NITRATE OF SODA
 During 15 Years



—Bradbury and Hirsch.

THE RESULTS OF IMPROVED COKE OVENS.

At the meeting of the Society of German Ironmasters, held on January 31st, in Düsseldorf, Herr F. W. Lürmann, of Osnabürek, read a paper on "Coke Oven Progress, with special regard to obtaining by-products," of which the following is an abstract: For obtaining by-products in coke oven working, which began some 35 years ago, and at first met with little acceptance, the Hoffmann-Otto oven takes first rank, there being at present in Germany 1,205 of these ovens. The installation of a group of 60 ovens costs 300,000 marks (the mark is equivalent to 23·8 cents.), and the necessary condensation apparatus 420,000 marks. Such a group treats in the course of a year from 57,000 to 70,000 tons of coal, with an average result of from 65 per cent. to 77 per cent. of coke, 2·5 per cent. to 4·5 per cent. of tar, and 0·8 to 1·25 per cent. of sulphate of ammonia. The Semet-Solvay oven, the construction of which permits of a stronger formation of the covering masonry, attains a very high temperature, and good coke can be obtained with an addition of from 23 per cent. to 27 per cent. of thin coal. From the same cause the yield is greater than, for example, that of the Coppée oven, which, however, is also a satisfactory oven, 1,000 being in use in Great Britain. For some three years benzine has been obtained direct from the coking-gases; the necessary apparatus, invented by Herr Franz Brunek, is a secret; it costs 5,000 marks per oven. From 3 to 7 kilos. of benzine are obtained from 1 ton of coal. The value of the by-products amounts, for a Hoffmann-Otto oven, irrespective of benzine, to from 3,400 to 5,000 marks, the average being 4,600 marks; for all the ovens of this system in Germany 5,600,000 marks. The old idea that in obtaining by-products the quality of the coke is prejudiced no longer appears to hold good. In the discussion which followed, Herr Hüssener mentioned that a certain water-contents, according to the quality of the coal from 10 per cent. to 17 per cent., is advantageous in coking, and that coal poor in gas are not suitable for obtaining by-products; the limit is about 80 per cent. to 82 per cent. coke-yield in the crucible.—*Engineering and Mining Journal*.

COMMERCIAL, &C., PROGRESS OF RUSSIA.

Taking the mining products of the country, we find first that the production of gold amounted in quantity to 720 cwt., and in value to 5,051,000*l.* in 1881, and in 1889 to 733 cwt. and 5,117,000*l.* The principal centre for this production is Eastern Siberia, where the auriferous sand of the Djalou river has lately increased the amount produced. In 1888 the production of Russian gold represented a proportion of 21·6 per cent. of that of the whole world, 30·7 per cent. falling to the United States, and 25·3 per cent. to Australia. Of platinum, 53 cwt. were produced in 1888, and the working of the metal is concentrated exclusively in the Ural, in the Government of Perm, at the mines of Nijnigul and Govoblagodat. There are two large establishments at St. Petersburg engaged in the purification of the metal. Of silver, 144 cwt. were exported in 1883 and 297 cwt. in 1888. This metal is obtained chiefly from the mines of Altaï and from the mines of the Kirghese steppes.

Lead is only produced in Russia as a secondary product of the treatment of argentiferous ores, and the production of this article falls very much below the requirements of the country, which imported 391,000 cwt. in 1889 and 423,000 cwt. in 1890.

There are 21 copper foundries which treated 2,224,000 cwt. of ore and produced 90,000 cwt. of bar copper in 1888. The principal centres of this production are the Ural and the Caucasus. There are 116 copper mines at present in working. The zinc industry is almost exclusively concentrated in Poland, the number of mines being 12, from which 900,000 cwt. of ore have been extracted. The product of the country has only furnished 74 per cent. of the quantity required for home consumption, the remainder being supplied by importation. Of tin almost the entire quantity comes from abroad. Mercury is worked at one place only, namely, Nikitooke, and 3,200 cwt. of pure mercury were produced in 1888 and 6,000 cwt. in 1890. Russia is now commencing to export mercury.

The iron industry is very important, 522 mines in the Ural supplying 15,750,000 cwt. in 1888, 20 mines in the South, 4,500,000 cwt., 63 mines in Poland, 3,857,000 cwt. The total product exceeds 27,960,000 cwt. The number of establishments producing iron was, according to the latest returns, 132, with 200 blast furnaces, which worked up over 26,357,000 cwt. of ore, and produced about 13,178,000 cwt. of iron, of which three-fourths were obtained by the charcoal blast furnace, and one-fifth by the coke furnace. The Ural holds the first place in the production of iron, and the establishments which show the largest out-turn are those of the Compagnie de la Nouvelle Russie, the Compagnie Huta Bankowa, and the Compagnie de Briansk. In those districts in which the blast furnaces work with charcoal, the metallurgical industries can only increase their production to a limited extent, by reason of the difficulty of obtaining an increased quantity of combustibles; in those in which coal is used (Southern Russia and Poland) the development is much more rapid. In 10 years the total product has increased 50 per cent.; in the provinces of the South and South-west it has quadrupled, and in Poland it has trebled. The proportion which the Russian production bore to the national consumption was established for 1888 in the following ratios: pig iron, 90 per cent.; finished iron, 85 per cent.; and steel, 96 per cent.

During the same year the number of coal mines working was 330, and they produced 5,078,550 tons of coal; of this quantity 2,346,400 tons were supplied by Poland, 1,700,000 tons by the Donetz basin, 257,140 tons by Moscow, and 192,850 tons by the Ural. The principal mines in the kingdom of Poland belong to M. de Krantsa, the Société Franco-Italienne, and the Société de la Nouvelle Russie. It is principally England and Germany which supply Russia with the greater part of the combustibles for which she is obliged to have recourse to foreign countries. In 1890 England supplied 1,354,800 tons, Germany 139,800 tons, and Austria 11,250 tons. The use of Russian coal on the various railways has increased by 50 per cent. during the last 10 years, and the consumption of foreign coal has decreased in the same proportions.

The production of naphtha is almost exclusively confined to the Caucasus in the peninsula of Apelérion and principally in the neighbourhood of Baku. Petroleum is also worked in the Crimea and in the Transcaucasian districts. After the annexation of Baku to Russia this industry was the object of a monopoly which from 1821 to 1872 yielded to the Treasury an annual revenue of about 89,000 roubles. In the Caucasus the production of naphtha amounted to 3,325,130 tons in 1889, and to 3,845,000 tons in 1890. The principal workings are those belonging to the following companies: Nobel, Baku, Caspienne, Caspienne et Mer Noire, Denho et Cohan, Schibakow, &c. The Nobel Company has 50 wells at work, and the factory belonging to the company is the most important one. It contains a refinery for petroleum and benzine, a factory for lubricating oils, and works for sulphuric acid and carbonate of soda. In this establishment, 707,140 tons of naphtha were treated in 1889, and from this quantity 257,140 tons of refined petroleum were obtained. The vessels belonging to this company are said to represent a value of six millions of roubles; its tank waggons, three millions of roubles.

In 1890 the quantity of petroleum, raw and refined, shipped from Baku, amounted to 2,839,520 tons, of which 765,000 tons were for foreign countries. About 74 per cent. of the product goes into the interior, 26 per cent. to foreign countries, principally to England, Turkey, Austria, Germany, Belgium, and Italy.—*Board of Trade Journal*.

THE NEW FRENCH CUSTOMS TARIFF.

The French Tariff Law of the 11th January 1892 has now been printed and issued to the public, and two translations of the law into English have also been published. The first of these is issued by the International Customs Tariffs Bureau, in Brussels, and forms No. 22 of the *International Customs Journal*. The second is issued by the Trade and Treaties Committee, and is attached to their Seventh Report which has been presented to Parliament (C.—6641).

This latter return gives the duties now leviable under the new French general and minimum tariffs of 1892 in a comparative form with those levied under the Conventional Tariff of 1882. It is scarcely necessary to say that the duties generally speaking have in the new tariff been raised all round. This, if any one glances at the comparative statement referred to, is at once evident. But another fact will also, at the same time, strike the most casual observer, this is, that so many articles now specially mentioned in the new tariff did not occur, or were not separately distinguished in the tariff of 1882, as not being at that time of sufficient importance, as articles of commerce to be so distinguished; further, that a large proportion of the articles now, for the first time, separately distinguished, are connected with recent inventions of art or science, or have come into demand in the last decade through being used in some recent invention.

It is now proposed shortly to give in review a list of such articles, together with the amount of import duty allotted to each article, and this may be premised by the statement that the duties on such articles are high in the majority of cases. It may also be here stated that the order of the articles according to the French tariff number has been strictly adhered to, and that the duties affixed are those of the minimum tariff as being those levied on articles of British manufacture. The first of these articles to which reference should be made is margarine, oleomargarine, and all other fatty substances to be used as food (No. 31 of the French tariff), such articles will pay 6s. per cwt., over $\frac{1}{2}$ d. per lb. The next is wood pavement (No. 129), which will pay very close on 8d. per cwt. Pâtes de cellulose (No. 158) wood pulped, will pay, if treated by mechanical pressure, dry, 5d., or if moist, 2½d. per cwt., the same article, if treated chemically, will pay 10d. Amongst builders' materials, tiles, machine-made (No. 181c) will pay 4d. per cwt., and squares of compressed cement (No. 186) will pay duties varying from 5d. to 1s. 8d. per cwt., according to state.

Mineral wax or ozokerite (No. 194) will pay when crude 4s. per cwt., and when refined 16s. Paraffin and vaseline (No. 199) will pay respectively 12s. and 11s. 2d. per cwt. Ether (No. 266a) will also pay 12s. per cwt., and chloroform (No. 266b), 30s. per cwt., collodion (No. 266c) being also taxed 12s. per cwt. Pyrolignite (No. 271a) of lead will pay 1s. 2½d. per cwt., while pyrolignite of lime will pay 9½d. Sulphate and other salts of quinine will pay 30l. per cwt., or 5s. 4d. per lb. Chemical manures, being chemical products to be used in agriculture (No. 281a), are to be imported free. Celluloid in lumps, cakes, or sheets (No. 281b) will pay 1l. 10s. per cwt. Charcoal specially prepared for electric lights (No. 302) will pay 1l. per cwt. Transparent soaps containing alcohol or sugar (No. 311) will pay 16s. per cwt. Dextrin and other products derived from fecula and starches (No. 319b) will pay 5s. 2d. per cwt. Electric incandescent lamps (No. 361), will pay, if with their mountings, 7l., and 14l. per cwt. if without the mountings.

Under tissues of silk there is also a fresh category, tissues of artificial silk of all sorts (No. 459); these, if unmixed with other tissues, will pay duty as chemical products which contain alcohol, while, if mixed with other material, the article will pay the duty on the most highly taxed material of which composed.

Turning to paper, there are also several new categories which attract attention: these are paper hangings (No. 461a) which will pay 4s. per cwt. Paper sulphurised (No. 461b) paying 8s. per cwt. Photographer's paper, albuminised (No. 461c), which will pay 2l. per cwt. when not sensitised, and double that duty when sensitised. Also blacked paper (tracing paper) so called "papier au charbon" will pay 1l. per cwt.

There are new categories under the head of cardboard made from cellulose or wood pulped (No. 465); these articles when moulded, compressed, or hardened will pay 6s. 4½d. per cwt. The same articles when lacquered or covered with a uniform varnish, 20s. per cwt., and when decorated with paintings or incrustations, 4l. per cwt.

Turning to leather we find a new category for imitation leather (*cuir factice*) (No. 477), which will pay 10s. per cwt.—*Ibid.*

NITRATE REVENUE IN CHILI.

The *Chilian Times* for February 3rd says that since Chili came into possession of Tarapacá and the other nitrate-producing territories she had received in duties on nitrate and iodine up to the end of 1889 the enormous sum of 110,127,783 dols., as under:—

1880, 1,336,881 dols.; 1881, 5,829,633; 1882, 8,317,712; 1883, 10,176,336; 1884, 10,855,330; 1885, 10,510,182; 1886, 10,599,419; 1887, 13,098,747; 1888, 17,917,858; 1889, 21,485,685 dols.

If to the above there be added the duties received in 1890 and 1891, we shall have a total not far short of 150 millions.

PAPER-MAKING AND RIVER POLLUTION.

At a meeting of the Joint Rivers Committee dealing with the watershed of the Ribble, Mr. W. Naylor, chief inspector for the watershed, submitted his report for the month, which stated—

During the past month the examination of the river Ribble has been continued, and the western section, extending from the Calder confluence to the estuary, inclusive of the Darwen and its affluents, completed. This area collects the drainage of 200 square miles, and bears a population of 311,500. Visits have been paid to, and entries made concerning 14 paper mills, one paper-staining mill, one chemical works, two dye works, one tar distillery, and numerous cotton factories.

Most of this month's work has been on the Darwen, where the paper trade is largely represented. One instance only was noted where dry solids were thrown into the Darwen from a paper mill, but the solids suspended, and very distinctly visible, in paper mill refuse, are serious. A large quantity of soda still finds its way into the river from paper mills, although it is a fact, known widely outside the paper trade, that it can easily be recovered, and, further, at each of the mills where evaporating plant has been erected, I am informed that it is a source of profit. The evaporation of soda has very important secondary effects in lessening pollution. (a) Soaps formed in the boilers from fatty matters on the raw material are burnt in the incinerator or cremator eventually; and (b) in washing the boiled raw material or half stuff for any soda retained in the interstices of the fibre, an amount of dirt and organic matter is always washed out, which also goes right along to the incinerator and is burnt. The annual consumption of soda ash on the Darwen is 3,300 tons. Evaporating plant is installed at the works having an aggregate consumption of 1,720 tons. Assuming half the remainder is used in the process of boiling, there is a residue of about 800 tons thrown into the river annually. But, granting that the whole of the soda has been eliminated from the paper mill refuse, there remains a thick coloured waste liquor from the washers, beating engines, and paper machines, bearing the dirt from the rags, Surat bagging, &c., according to the nature of the mill. From returns kindly supplied by paper-making firms on the Darwen, it is estimated that in this river alone the consumption of raw material is annually 10,300 tons rags; 12,400 tons straw and esparto; 4,700 tons ropes, Surat bagging, canvas, &c.; 3,000 tons waste paper, peat, &c.; giving a total of 30,400 tons to be washed. There are used in addition about 18,000 tons mechanical wood pulp, 950 tons chemical wood pulp, which, while requiring no washing, will lose some proportion as waste during manipulation. The filthy condition of some of this raw material is worthy of note, too, the albuminoid ammonia, being as high in an average of six representative samples of paper waste as in the average urban sewage, namely, 0.4 parts per 100,000. But the point calling for earliest attention is the quantity of solids in suspension, as these could be lessened to a great extent without plant or apparatus, coupled with maintaining cost, ignoring their importance as polluting agencies. The average suspended solids in white paper mills is 85.1; brown paper mills, 98.1; ditto dissolved solids, white paper mills, 80.1; ditto brown paper mills, 170.9. Quantity of water turned into river by white paper mills, 2½ millions galls. per day; ditto brown paper mills, ½ million galls. per day; total 3 millions galls. daily. A deduction, however, should here be made

for the brown paper mills, as they use, in most instances, river water directly, already contaminated by the white paper mills; but, allowing them the benefit of creating no more pollution than the white paper mills, we get a uniform waste bearing in suspension 85 grains per gallon, and holding in solution 80 grains per gallon, or 5,090 tons per annum of suspended solids, and 4,700 tons per annum of dissolved solids, at six days per week, and this amount, large as it appears (only 20 per cent. of the raw material used), is rather under than over the mark, allowing the river an initial burden of 20 grains per gallon dissolved solids. It was found upon experiment that a mixture of white mill refuse lost 98 per cent. of suspended solids by subsidence only, and a mixture of brown mill refuse lost 85 per cent. by subsidence only. If, therefore, this refuse could be turned into a receptacle allowing a subsidence before entering the river, much good would be done. But such receptacles must admit of absolute quiescence; continuous tanks are useless, as the fibre is extremely light and finely divided. The continuous tanks at Spring Vale paper mill, of 27,000 gallons capacity, brought about a reduction of 2 per cent. only in suspended solids, and the effect at Primrose Lodge, Clitheroe, is about the same, but at both places there is additional treatment. The great desiderata at paper mills are evaporating plant and receptacles in duplicate to hold six hours' refuse at the least, and the sooner steps are taken in this direction the better it will be for the river Darwen. In the discussion of these matters with gentlemen in the paper trade, inspectors are treated with every courtesy, and I am strongly of opinion that, on the whole, they are willing to meet the reasonable demands of this committee. Considerable expense would be incurred in providing plant for evaporation, and it depended entirely on the value of soda ash whether the outlay was remunerative or not. Speaking generally, however, he thought the inspector had received correct information when he said the provision of such plant would remunerate manufacturers in the end. He thought he might say, as far as the paper trade was concerned, they were prepared to carry out any reasonable requirement. In answer to Mr. Smith, the Chairman said the cost of providing the evaporating plant for a moderate-sized mill would be from 1,000*l.* to 3,000*l.*, and he believed the income would pay interest on the capital outlay.—*Chemical Trade Journal.*

DRUG IMPORTS INTO THE UNITED STATES.

The full official statistics of the foreign trade of the United States for 1891 are now to hand. They give the following results, so far as concerns the imports of some of the principal drugs:—

Duty-free.

	1891.	1890.
	Lb.	Lb.
Alizarine	1,123,632	2,667,103
Cinchona	2,861,421	3,274,117
Gum arabic	826,248	935,841
Camphor (crude)	1,982,083	1,400,483
Shellac	7,485,456	5,837,298
Liquorice root	82,539,923	45,360,615
Bleaching powder	108,880,381	105,090,046
Opium	451,129	Dutiable
Potash, chlorate	3,134,461	"
" muriate	78,144,810	63,775,938
Quinine	2,527,099	3,790,297
Sulphur	116,971	131,096
Vanilla	228,435	179,016
Nutmegs	1,382,900	1,289,312
Pepper, all kinds	12,675,906	15,923,819

Dutiable.

	1891.	1890.
	Lb.	Lb.
Glycerin	14,710,119	11,290,709
Dye-wood extracts	3,933,828	3,066,952
Opium (crude)	—	331,561
" (smoking)	63,189	77,578
Soda, bicarbonate	1,500,663	916,355
" caustic	68,154,226	88,345,462
" sub.	347,822,902	360,521,656
Whale oil	359,215	395,710
Olive oil	613,497	755,667
Salt	163,155,263	527,835,772
Linseed	758,756	2,576,281
Soap, toilet	733,987	752,256
Spices, ground	2,256,137	1,189,116

—*Chemist and Druggist.*

THE FRENCH DRUG TRADE.

The following figures show the imports into and exports from France of some of the most important drugs and chemicals (in kilos.) during the year 1891:

	Imports.	Exports.
Gums (from Europe)	13,378	45,993
Gums (exotic)	5,821,386	2,354,666
Tarperentine	9,066	178,097
Shellac	482,022	84,535
Copal and damar	1,215,395	399,121
Benzoin	158,837	100,629
Copaiba	35,320	"
Camphor (raw)	346,106	"
Camphor (refined)	152,077	63,205
Aloes	83,011	21,151
Opium	128,297	"
Rhubarb	7,029	1,161
Sarsaparilla	112,414	78,518
Jalap.	11,807	8,430
Cinchona	787,290	162,084
Senna	96,622	17,790
Medic. flowers	561,637	517,450
Iodine	24,910	16,779
Iodide pot.	1,320	17,465
Phosphorus, white	"	311,330
Phosphorus, red	"	28,698
Acid, citric	10,360	"
Concentr., juice	557,268	"
Acid, tartaric	110,175	118,777
Soda, bicarb.	627,288	86,190
Borax	95,057	702,810
Chlorate pot.	"	385,246
Glycerin	1,976,333	7,230,405
Sulp. copper	15,123,134	805,518
Quinine	7,038	11,853
Cream of tartar	25,974	15,759,521

—*Ibid.*

THE PRICE OF PLATINUM.

Platinum has fallen considerably in value lately, and now costs only about one-half of its price in September 1890, when it attained the highest quotation known. The following figures (in marks per kilo.) represent the fluctuations of the metal during the last five years:—

1887	July 1,925	Sept. 1,880	..	..	..	..
1888	Feb. 1,000	May 970	Aug. 950	Nov. 1,000	..	..
1889	Jan. 1,000	March 1,100	Aug. 1,070	Oct. 1,000	Nov. 1,075	Dec. 1,200
1890	Jan. 1,500	June 1,200	Sept. 2,500	Oct. 2,200	Nov. 2,100	..
1891	Jan. 1,750	July 1,550	Sept. 1,400	Oct. 1,500	Dec. 1,275	..
1892	Feb. 1,250	March 1,200	..	..	..	..

—*Ibid.*

THE SUPPLY OF TUNGSTEN.

The use of tungsten in the manufacture of tungsten steel has created a very considerable demand for wolfram, the principal ore of that metal and the supply being limited its market price has risen to a higher figure than has been obtained for many years. It would appear from recent experiments, of which we have been informed, that the advantages of tungsten steel will prove so important that this alloy will come into quite general use, perhaps taking the place of nickel steel. In view of the high value of tungsten at the present time it is worth the while of prospectors to look for its ores.—*Engineering and Mining Journal.*

ALKALI, &c. WORKS.

A Bill to amend the Alkali, &c. Works Regulation Act, 1881.

Be it enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:

1. The works specified in the schedule hereto shall be added to those specified in the schedule to the Alkali, &c. Works Regulation Act, 1881, and shall be scheduled works for the purposes of that Act.

Provided that if the process used in any work specified in Part I. of the schedule hereto shall be such that no sulphuretted hydrogen is evolved therein, the work shall not be deemed to be included in the schedule.

2. Works in which salt is produced by refining rock-salt, other than those where the rock-salt is dissolved at the place of deposit, shall not be within the provisions of the Alkali, &c. Works Regulation Act, 1881, in regard to works in which the extraction of salt from brine is carried on, or of any order made or to be made under section ten of that Act.

3. This Act shall come into operation on the first day of April in the year one thousand eight hundred and ninety-three, but certificates of registration may be applied for and issued at any time after the first day of January in that year.

4. This Act may be cited as the Alkali, &c. Works Regulation Act, 1892.

SCHEDULE.

Part I.

(1.) Alkali waste works, that is to say, works for the recovery of sulphur from alkali waste or for utilising the sulphur or any other constituent of such waste.

(2.) Barium works, that is to say, works for the manufacture of barium compounds from barium sulphide.

(3.) Strontium works, that is to say, works for the manufacture of strontium compounds from strontium sulphide.

(4.) Antimony sulphide works, that is to say, works for the manufacture of antimony sulphide.

(5.) Bisulphide of carbon works, that is to say, works for the manufacture of bisulphide of carbon.

Part II.

(6.) Venetian red works, that is to say, works for the manufacture of Venetian red, crocus, or polishing powder by heating sulphate or some other salt of iron.

(7.) Lead deposit works, that is to say, works where the sulphate of lead deposit from sulphuric acid chambers is smelted.

(8.) Arsenic works, that is to say, works for the preparation of arsenious acid, or where nitric acid or a nitrate is used in the manufacture of arsenic acid or an arseniate.

(9.) Nitrate and chloride of iron works, that is to say, works in which nitric acid or a nitrate is used in the manufacture of nitrate or chloride of iron.

(10.) Muriatic acid works, that is to say, works, not being alkali works as defined in the Alkali, &c. Works Regulation Act, 1881, where muriatic acid is made.

(11.) Fibre separation works, that is to say, works where muriatic acid gas is used for the separation of silk or woollen fibre from vegetable fibre.

(12.) Tar works, that is to say, works where gas tar is distilled or is heated in any manufacturing process.

(13.) Zinc works or works in which zinc is extracted from the ore.

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

	Month ending 31st March	
	1891.	1892.
	£	£
Metals.....	1,831,153	1,850,188
Chemicals and dyestuffs.....	706,735	764,052
Oils.....	534,674	537,820
Raw materials for non-textile industries.	2,591,726	2,593,041
Total value of all imports	35,253,050	36,704,177

SUMMARY OF EXPORTS.

	Month ending 31st March	
	1891.	1892.
	£	£
Metals (other than machinery)	3,780,663	2,842,986
Chemicals and medicines	846,273	839,111
Miscellaneous articles.....	2,954,560	2,616,475
Total value of all exports.....	21,663,378	19,665,382

IMPORTS OF METALS FOR MONTH ENDING 31ST MARCH.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Copper:—			£	£
Ore..... Tons	6,226	6,516	57,673	48,937
Regulus..... "	6,373	10,614	198,286	276,959
Unwrought "	3,160	2,378	170,125	114,014
Iron:—				
Ore..... "	257,884	407,920	230,232	297,733
Bolt, bar, &c.... "	3,126	3,025	33,079	29,977
Steel, unwrought.. "	553	181	6,757	5,019
Lead, pig and sheet "	10,536	15,722	133,767	172,754
Pyrites..... "	51,811	46,948	98,766	82,534
Quicksilver..... Lb.	822,556	815,315	92,305	77,374
Tin..... Cwt.	65,483	57,290	294,572	255,127
Zinc..... Tons	4,924	3,365	114,768	73,557
Other articles... Value £	..	..	398,823	416,212
Total value of metals	..	..	1,831,153	1,850,188

IMPORTS OF OILS FOR MONTH ENDING 31ST MARCH.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Cocoa-nut..... Cwt.	1,985	1,170	£ 2,850	£ 1,332
Olive..... Tons	1,529	1,831	62,089	71,026
Palm..... Cwt.	50,955	96,823	59,352	113,824
Petroleum..... Gall.	10,993,410	9,659,528	230,854	192,126
Seed..... Tons	2,594	1,838	66,160	49,863
Train, &c..... Tons	735	1,532	15,658	29,551
Turpentine..... Cwt.	15,947	5,204	21,334	5,718
Other articles .. Value £	..	..	76,368	70,690
Total value of oils ...	..	..	534,674	537,820

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 31ST MARCH.

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST MARCH.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Bark, Peruvian .. Cwt.	16,329	9,850	£ 38,771	£ 20,328
Bristles..... Lb.	275,796	220,395	43,265	31,189
Caoutchouc..... Cwt.	22,245	27,184	286,843	296,900
Gum:—				
Arabic..... "	5,506	3,863	15,368	12,906
Lac, &c..... "	13,879	11,739	54,889	45,988
Gutta-percha "	5,831	2,828	83,429	33,788
Hides, raw:—				
Dry..... "	47,697	48,805	119,032	113,487
Wet..... "	38,221	30,990	83,268	67,990
Ivory..... "	1,057	1,164	53,262	56,951
Manure:—				
Guano..... Tons	1,871	3,026	10,492	34,294
Bones..... "	7,903	8,226	47,002	37,495
Paraffin..... Cwt.	51,651	51,387	76,743	86,568
Linen rags..... Tons	2,656	2,864	24,783	28,658
Esparto..... "	19,383	22,096	95,805	104,531
Pulp of wood "	10,044	13,690	59,565	64,808
Rosin..... Cwt.	137,343	92,985	30,596	19,512
Tallow and stearin .. "	135,260	94,548	172,633	122,028
Tar..... Barrels	2,027	2,118	1,099	1,208
Wood:—				
Hewn..... Leads	138,927	138,627	227,834	254,489
Sawn..... "	92,837	107,916	216,155	254,508
Staves..... "	3,724	7,387	22,276	47,073
Mahogany..... Tons	3,887	4,965	37,709	42,934
Other articles.... Value £	..	..	789,807	815,498
Total value.....	..	..	2,591,726	2,593,941

Besides the above, drugs to the value of 78,618*l.* were imported as against 66,093*l.* in March 1891.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Alkali..... Cwt.	6,736	3,663	£ 3,818	£ 2,193
Bark (tanners, &c.) .. "	31,160	29,728	9,519	11,801
Brimstone..... "	38,754	27,751	11,517	8,059
Chemicals..... Value £	..	..	119,716	118,317
Cochineal..... Cwt.	266	211	1,592	1,275
Cutch and gambier Tons	1,373	2,375	33,378	56,591
Dyes:—				
Aniline..... Value £	..	..	22,317	16,485
Alizarine..... "	..	..	32,780	30,661
Other..... "	..	..	1,196	1,088
Indigo..... Cwt.	7,499	9,916	150,622	173,341
Nitrate of soda.... "	231,035	219,885	96,501	99,504
Nitrate of potash, .. "	32,351	25,666	28,858	22,374
Valonia..... Tons	1,513	4,756	31,617	62,121
Other articles... Value £	..	..	163,274	160,236
Total value of chemicals	..	..	706,735	764,052

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 31ST MARCH.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Alkali..... Cwt.	532,988	527,850	£ 206,126	£ 195,629
Bleaching materials .. "	114,552	114,505	38,446	46,201
Chemical manures. Tons	35,136	35,517	252,771	249,970
Medicines..... Value £	..	..	90,070	100,448
Other articles.... "	..	..	258,860	246,773
Total value.....	..	..	546,273	539,111

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR
MONTH ENDING 31ST MARCH.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Brass..... Cwt.	8,718	9,623	£ 49,077	£ 42,695
Copper:—				
Unwrought..... "	81,265	80,877	240,023	193,190
Wrought..... "	24,136	34,337	80,500	104,329
Mixed metal.... "	23,851	25,413	72,121	64,935
Hardware..... Value £	..	..	215,793	197,478
Implements..... "	..	..	110,597	115,287
Iron and steel..... Tons	250,439	218,980	2,400,729	1,860,382
Lead..... "	3,517	5,080	51,873	72,960
Plated wares... Value £	..	..	26,834	26,508
Telegraph wires, &c. "	..	..	392,552	18,827
Tin..... Cwt.	8,212	10,317	38,913	47,820
Zinc..... "	12,969	17,676	13,743	16,489
Other articles.. Value £	..	..	96,908	82,586
Total value.....	..	..	3,780,663	2,842,986

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH
ENDING 31ST MARCH.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Gunpowder..... Lb.	756,800	713,800	£ 17,616	£ 18,881
Military stores.. Value £	..	..	69,027	93,361
Candles..... Lb.	1,424,800	1,871,500	£ 8,132	36,249
Caoutchouc..... Value £	..	..	103,446	103,855
Cement..... Tons	65,644	41,194	141,245	79,275
Products of coal Value £	..	..	174,218	143,612
Earthenware... "	..	..	165,343	164,942
Stoneware..... "	..	..	18,902	15,828
Glass:—				
Plate..... Sq. Ft.	267,032	147,029	17,739	8,776
Flint..... Cwt.	8,435	9,556	20,167	21,006
Bottles..... "	67,184	71,714	31,544	33,909
Other kinds.... "	19,480	17,041	16,713	14,654
Leather:—				
Unwrought.... "	14,306	11,398	129,139	107,454
Wrought..... Value £	..	..	32,979	27,270
Seed oil..... Tons	7,968	7,703	167,260	152,243
Floorcloth..... Sq. Yds.	1,731,700	1,525,200	70,479	65,712
Painters' materials Val. £	..	..	136,330	137,769
Paper..... Cwt.	89,284	85,817	154,973	145,183
Rags..... Tons	3,754	5,351	25,703	36,558
Soap..... Cwt.	40,231	49,160	51,742	55,338
Total value.....	..	..	2,954,560	2,616,475

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND
MACHINERY.

APPLICATIONS.

5108. R. Fish and W. Smith. Improvements in apparatus for regulating liquid seals in gas washers and the like. March 15.

5125. F. H. Rowlett. *See Class II.*

5214. A. Desgoffe. Improvements in machinery for manufacturing fuel blocks and other articles from plastic material. March 16.

5238. J. A. Yeadon and W. Adgie. *See Class III.*

5239. J. A. Yeadon and W. Adgie. Improvements in apparatus for revivifying gas, lime (sulphide of calcium), and other analogous materials. March 16.

5281. C. Fery. *See Class XXIII.*

5325. H. H. Lake.—From T. Craney, United States. Improvements in evaporating apparatus. March 17.

5377. S. H. Johnson and C. C. Hutchinson. Improvements in apparatus for mixing liquids with liquids and solids. Complete Specification. March 18.

5538. O. W. Ketchum. Improvements in gas generating furnaces or gas producers. March 21.

5558. P. Lucas. Improvements in and relating to the fireplaces of brewers' pans, salt pans, iron and steel furnaces, and other like furnaces. March 22.

5619. J. A. Fisher. Improvements in the construction of non-conducting coverings to prevent the radiation of heat. Complete Specification. March 22.

5659. R. L. Newman. Improvements in evaporators for the distillation of liquids. March 22.

6134. D. Stewart. An improved vacuum pan. March 30.

6354. T. Thornley. Improvements in kilns or furnaces applicable for the drying and incineration of spent soda solutions. April 1.

6478. F. W. Scott, E. G. Scott, and F. W. Scott, jun. Improvements in evaporating apparatus. April 4.

6535. W. Birch. Improved means and apparatus for separating solid or semi-solid substances from sludge or other fluid or semi-fluid matters. April 5.

6700. C. D. Abel.—From E. Theisen, Germany. Improvements in surface condensing and refrigerating apparatus. April 7.

6898. R. S. Brownlow. Improvements in apparatus for heating feed-water, applicable also for evaporating and for cooling or condensing. April 11.

COMPLETE SPECIFICATIONS ACCEPTED.*

1891.

6887. J. Peake. Kilns for various purposes. March 23.

8177. F. Smith and W. Travis. Apparatus for drawing off liquids. March 23.

8546. J. C. Mewburn.—From The Maschinenfabrik Grevenbroich. *See Class XVI.*

9181. J. Dawson and J. W. Hampson. An improved construction of refrigerator or cooling pan for chemical and other purposes. April 6.

9310. A. J. Boulton.—From A. Kionne and F. Bredel. Setting and heating retorts. April 6.

1892.

1210. B. Zeitschel. Apparatus for rapidly heating liquids. April 6.

2117. C. F. Betting. Assay or chemical balances. March 23.

3013. N. Hunting. Apparatus for distilling water in the presence of air, and for communicating heat thereto, and for supplying water and air thereto and delivering water therefrom. March 23.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

4982. G. Angel. Improvements in the manufacture of peat fuel. March 14.

4991. C. Heath. Improvements in apparatus or means for utilising small or waste coal or other fuel for steam boiler and other fires and furnaces. March 14.

5031. R. E. P. Craven. An improved apparatus for washing smoke and separating carbon and other matters therefrom. March 15.

5125. F. H. Rowlett. Improvements in the construction of "saturators" used in the manufacture of gas, applicable also for dye-vats and other purposes. March 15.

5173. M. Lauchlan. Carbon diamond fire-lighters. March 16.

5198. J. Laycock and S. B. Clapham. Improvements in apparatus for use in the purification of coal-gas. March 16.

5575. T. O. Dixon. Improvements in the manufacture of perforated fuel. March 22.

5620. F. A. Tagliaferro, A. A. Moore, and R. Campion. Improvements in the manufacture of fire-lighters and artificial fuel. March 22.

5698. J. Tattersall. Fire-lighters. March 23.

5755. A. Mortimer. An improved fire-lighter. March 24.

5994. J. Rudd. Improved apparatus and means for increasing the illuminating power of gas. Complete Specification. March 28.

6000. C. Hunt. Improvements in gas-washing apparatus. March 28.

6020. C. Herzog. An improved method of and means for the regulation of the quality of an artificial gas. March 29.

6062. W. Belton, G. E. Davis, and A. R. Davis. Improvements in the purification of coal-gas. March 29.

6362. C. Bougourd de Lamarre. A new process of and apparatus for the manufacture of illuminating gas. Complete Specification. April 1.

6697. J. Morley. The treatment of ingredients and the manufacture of compound block for use as fire-lighters. Complete Specification. April 7.

6733. D. Rylands. An improved means of utilising gas for warming or heating purposes. April 8.

6819. W. D. Scott - Moncreiff. Improvements in or relating to the treatment of fuel. April 9.

6908. H. Collet and M. Merichenski. Improved mixture intended for use in carburetting air or enriching combustible gas. April 11.

6909. H. Collet and M. Merichenski. Improvements in carburettors. April 11.

7079. C. R. Collins. Improvements in gas-making apparatus. Complete Specification. April 12.

7202. J. N. Mörath and F. S. de Straznicki. Improvements in the manufacture of artificial fuel. Complete Specification. April 14.

7243. C. Fink. Improvements in method of and apparatus for purifying smoke and precipitating the products of combustion thereof. Complete Specification. April 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

7092. A. A. Lister. Apparatus for extracting tar and ammonia from gas. March 23.

7648. E. Stauber. Process and appliances for producing peat-coke cakes. March 23.

8479. J. Ruscoe. Apparatus for charging and drawing gas retorts. April 6.

9180. B. H. Thwaite. Methods of storing inflammable spirits or highly volatile hydrocarbons. April 6.

9366. B. Gibbons and W. P. Gibbons. Apparatus for charging inclined gas retorts. April 13.

9398. P. van Gelder. Separating smoke or soot from air or other gases and utilising the air or gases so purified. April 13.

9457. J. H. Parkinson. Apparatus for obtaining or separating oxygen from atmospheric air. April 13.

10,918. J. C. Chandler. Apparatus for washing or scrubbing gas. April 6.

11,416. J. Bromilow. Gas producers. April 13.

1892.

2367. L. Sepulchre. Gas generator for the distillation of mineral oils and the combustion at a distance of a part or the whole of the products of the distillation, applicable to apparatus for lighting and heating. March 23.

3026. J. A. Dubbs. Manufacture of asphaltum. March 23.

3355. E. W. Harding. Apparatus for the manufacture into blocks or moulded forms of carbonaceous matter for use as fuel. March 30.

3959. J. Johnson.—From H. Kennedy. Coke ovens. April 6.

3995. A. J. Boulton.—From The Chicago Heat Storage Co. Manufacture of fuel-gas. April 6.

4032. T. R. Osbourn. Apparatus for quenching coke. April 6.

4033. T. R. Osbourn. Apparatus for the manufacture of coke. April 6.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

5238. J. A. Yeadon and W. Adgie. Improvements in apparatus for distilling mineral or other tars, hydrocarbons, or other analogous liquids. March 16.

5539. B. Willecox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in purifying anthracene and anthraquinone. March 21.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

9052. W. P. Thompson.—From P. Kuntze. Manufacture of ammonia and tar from nitrogenous organic substances, and apparatus relating thereto. March 23.

1892.

2367. L. Sepulchre. See Class II.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

5112. B. Willecox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture of new colouring matters. March 15.

5540. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture of the red basic naphthalene colouring matter which yields azocarmine on sulphonation. March 21.

5761. The Clayton Aniline Co., Limited, J. Hall, and F. Moore. Improvements in the manufacture and preparation of a yellow colouring matter. March 24.

5811. C. D. Abel.—From C. F. Boehringer and Söhne and Co., Germany. Manufacture of derivatives of amidocrotonic acid. March 24.

5815. B. Willecox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the production of fast colours on the fibre for printing and dyeing purposes. March 24.

6252. R. Holliday and Sons, Limited, and L. G. Paul. Improvements in treating nitroso compounds for use in dyeing animal fibres. March 31.

6630. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Germany. Improvements in the manufacture of colouring matters. April 6.

7120. W. Marekwald and J. F. Holtz. Manufacture or production of aromatic disulpho-ethylenediamides, aromatic disulphopiperazides, and piperazine. April 13.

7298. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture of dyestuffs. April 16.

7337. B. Willecox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of colouring matters and new materials therefor. April 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

8497. S. Pitt.—From L. Cassella and Co. Production of blue dyestuffs. March 30.

8702. B. Willecox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture and production of colouring matters derived from anthraquinone and alizarine blue. March 30.

9943. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Production of blue colouring matter. April 20.

10,619. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture and production of new basic dyestuffs. April 20.

11,298. E. Schweich and E. Bucher. Colouring matter or dye and methods of extracting and utilising the same. April 6.

1892.

960. A. Bang.—From G. A. Dahl. The production of fast yellow mordant dyeing azo-dyestuffs. March 23.

1231. H. H. Lake.—From Wirth and Co., Agents for A. Leonhardt and Co. Manufacture of colouring matters. April 6.

2718. S. Pitt.—From L. Cassella and Co. Production of black dyes suitable for dyeing wool. April 20.

4677. P. Monnet. Manufacture of new colouring matters or dyes. April 20.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

5297. P. Temming. A new fabric suitable as a substitute for cotton waste for cleaning parts of machinery, and process for making the same. Complete Specification. March 17.

5462. E. Knowles. Manufacture of mixed silk and cotton yarn. March 19.

6550. B. J. B. Mills.—From G. Bergier, France. Improvements in the spinning and treatment of silk in the manufacture of various classes of silk thread. Complete Specification. April 5.

7321. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Germany. Process for the preservation of textile fabrics and fibres. April 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

3960. W. H. Hughes. Cleaning, restoring, and bleaching damaged cotton, or other products from cotton seed, sponges, and all textile material. April 13.

10,556. A. M. Clark.—From La Société La Ramen. Process of ungumming and decorticating textile materials. April 13.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

4984. E. Zillesen, sen. An improved process for dyeing piece-goods. March 14.

5197. R. H. Pickles. Improvement in the composition of compounds of aluminium, iron, and chromium, to be used as mordants. March 16.

5204. W. Crippin and B. Burrell. Improvements in the process of dyeing with indigo cotton, and other fibrous materials, in the raw or manufactured, or partly manufactured state. March 16.

5408. G. Jagenburg. Process for dyeing loose cotton, cotton thread, and woven fabrics. March 18.

6162. E. Hermite, E. J. Paterson, and C. F. Cooper. An improvement in the bleaching of textile and pulping materials in vacuo. March 30.

6304. T. Hoyle and Sons, Limited, and W. N. Neild. Improvements in dyeing cotton and other textile fabrics. April 1.

7339. B. Willecox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the production of fast colours on fibres. April 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

4928. G. Young and W. Crippin. Apparatus for dyeing and bleaching and otherwise treating cotton, wool, silk, and other fibrous materials in the raw and manufactured or partly manufactured state. March 23.

19,113. W. Ward. Colouring cork used in the manufacture of floor coverings, and apparatus used in colouring the same. March 30.

1892.

2939. A. Ophoven. Art or process for colouring pictures or textile fabrics. March 23.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

5127. J. E. Campbell. Improvements in the utilisation of galvanisers' waste pickle and the like, and in apparatus therefor. March 15.

5195. A. G. Haddock. Improvements in the manufacture of carbonate of soda with recovery of sulphur. March 16.

5225. A. Allhusen, G. E. Edgell, and W. Russell. Improvements in the recovery of sulphur from the waste gases from Claus kilns or similar gases, and apparatus therefor. March 16.

5296. C. J. Bayer. Improvements in the treatment of bauxite or similar minerals for the purpose of obtaining alkali-aluminates or alumina hydrate. March 17.

5388. H. C. Bull. An improved method or process of and means for concentrating and purifying sulphuric acid. March 18.

5425. J. C. Ody. Method for making caustic soda (sodium hydrate). Complete Specification. March 19.

6139. J. C. Ody. New method for manufacturing carbonate of soda. March 30.

6288. H. C. Bull. See Class XI.

6931. H. H. Lake.—From J. H. C. Behnke and the chemische Fabrik in Billwarder vorm. Hell and Staamer, Germany. Improvements relating to the production of pure carbonic acid from the products of combustion of furnaces, kilns, and the like, and to apparatus therefor. April 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

5354. J. J. Hood and A. G. Salamon. Manufacture of cyanogen compounds, and the treatment of substances used therein. March 30.

5801. M. Royon. Apparatus to produce sulphuretted hydrogen. March 23.

9332. Comte T. S. de D. Brochocki. Manufacture or production of chlorine compounds for bleaching. April 6.

9575. D. Rylands. Process or arrangements for the manufacture of carbonic acid gas. April 13.

1892.

1032. P. R. de Lambilly. Method or process for the production of alkaline cyanides. April 13.

4527. C. G. Collins. Process for the purification of brine. April 13.

VIII.—GLASS, POTTERY, AND EARthenWARE.

APPLICATIONS.

5249. J. Slater. Improvements in treating vitreous substances for joining the same or for attaching metals thereto. March 17.

5527. O. Imray.—From The Actiengesellschaft für Glasindustrie vormals F. Siemens, Germany. Manufacture of blown hollow glass with metal insertions. March 21.

7024. R. Cresswell. The treatment of ingredients for the manufacture of compounds specially adapted for coating glass for reflective purposes; also in means for increasing the reflective power of glass so treated. April 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

7040. W. A. Kerr. See Class IX.

7547. J. Morton. Kilns for burning retorts, pipes, quarries, and other refractory substances. March 23.

7988. T. C. J. Thomas. Manufacture of glass. April 13.

9960. D. Rylands. Furnaces for glass melting and for similar purposes. April 20.

18,281. C. D. d'Enghein, A. D. d'Engchien, and S. D. d'Engchien. Kilns or ovens for firing terra-cotta and other like materials. March 30.

1892.

1974. W. Leuder. Process of marking glass by acids. March 23.

3586. C. Armstrong. Kilns or ovens for burning and glazing sanitary ware and the like. March 30.

4525. H. D. Fitzpatrick. From M. Schreiber and L. Oettinger. Manufacturing glass bricks. April 13.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

5683. T. D. Harries. An improved artificial stone. March 23.

5746. A. T. Morse. An improved distemper for walls, ceilings, and the like. Complete Specification. March 23.

6608. T. Potter. Improvements in the construction of fire-proof floors. April 6.

6745. V. F. L. Smidth. Improvements in the manufacture of hydraulic cement for building purposes. Complete Specification. April 8.

7034. F. H. Willis and R. Astley. An improved form and method of constructing and fixing fire-proof floors. April 12.

7270. R. Huppertsberg. Improvements in the manufacture of artificial bituminous stone. April 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

5709. O. Clausen. Manufacture of fire-clay and magnesian bricks, and kilns for firing same. April 13.

6532. J. Jackson. Manufacture or production of decorative material, more especially intended for application to walls, ceilings, or like surfaces. March 30.

7040. W. A. Kerr. Composition designed to serve as a substitute for wood, and also applicable for the manufacture of bricks and crucibles, retorts, and other articles of earthenware. April 13.

8567. O. Imray.—From W. Schlening. Manufacture of artificial stone. March 23.

9319. W. P. Thompson.—From J. P. von Balgooy. See Class XIII.

20,743. J. T. Abell. Paving. March 23.

1892.

2957. H. Hartmann. Manufacture of a resistible material, chiefly designed for building purposes. April 13.

3539. H. Brunson and E. W. Gillett. Building or paving blocks. March 30.

4496. J. S. Holiday. Artificial stones. April 13.

4540. G. M. Graham. Building or paving blocks. April 13.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

4997. J. de Coppet. Improvements in the treatment of minerals, mattes, speiss, and other substances containing nickel for the separation of copper, nickel, and cobalt. March 14.

5026. T. H. Mallaband. Improvements in melting furnaces. March 15.

5255. J. G. H. Batchelor and C. T. Batchelor. Improved means for the recovery of tin and iron from tin plate scrap or other waste material from tinned goods. March 17.

5258. R. Henderson. Improvements in machinery or apparatus for separating and concentrating auriferous and argentiferous ores and extracting gold and silver therefrom by amalgamation. March 17.

5560. R. Heaton. A solder for aluminium. March 22.

5651. H. H. Lake.—From H. F. Brown, United States. Improvements in ore-roasting furnaces. March 22.

6038. G. Wegner. Improved solder for joining together aluminium pieces or pieces of aluminium with other metals. Complete Specification. March 29.

6235. W. H. D. Cleminson. Improvements in casting or founding. March 31.

6399. J. C. Bull. Improvements in the treatment or refining of copper and other metals. April 2.

6454. F. Ryland. An improvement or improvements in tinning cast-iron hollow-ware. April 4.

6567. H. R. Lewis and C. Gelstharp. Improvements relating to the treatment of ores and other compounds containing metals and sulphur, and to apparatus therefor. April 5.

6612. T. Twynam. Improvements in the manufacture of iron and steel. April 6.

6704. S. H. Brown. Improvements in a compound for carburising metals. Complete Specification. April 7.

6814. W. D. Parr and E. H. Crapper. An improved process of surface hardening and annealing steel and iron plates. April 9.

6927. A. Gentzsch. Improved process for winning gold without using mercury. April 11.

7027. C. Raleigh. A combination of matter adapted for use in the process of chlorination and means for producing the same. April 12.

7064. C. T. J. Vautin. An improved process for the separation of lead from ores containing galena and blende. April 12.

7067. A. E. Butler, B. F. Butler, and H. M. Butler. Improvements in furnaces for heating and melting metals. April 12.

7069. G. J. Atkins. Improvements in means and apparatus for separating gold, silver, and other metals from their ores. Complete Specification. April 12.

7151. J. F. Duke and F. Bedman. Improvements in separating or recovering tin from tin plate, and apparatus for the purpose. April 13.

7152. J. F. Duke and F. Bedman. Improvements in producing metal or other castings. April 13.

7159. J. B. Chamberlain. An improved alloy. April 13.

7160. J. B. Chamberlain and A. Gutensohn. An improved process for coating metal with a vitrifying material for the removal of scale. April 13.

7302. A. Turner and M. B. Baird. Improvements in the manufacture of iron and steel. April 16.

7332. G. Retterer. Improvements in galvanising iron, and apparatus therefor. April 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

213. D. Edwards. Apparatus used in the manufacture of tin, terne, and other coated metal plates. April 13.

214. D. Edwards. Apparatus used in the manufacture of tin, terne, and other coated metal plates. April 13.

215. D. Edwards. Apparatus used in the manufacture of tin, terne, and other coated metal plates. April 13.

795. J. E. Bott. Manufacture of ferro-bronze and other alloys. April 20.

6179. W. T. Rickard. Mechanical and chemico-metal-lurgical treatment of copper, the precious, and other metallic ores. March 30.

7625. A. Tropenas. Manufacture of steel, steel castings, or ingot iron, and apparatus and appliances employed therein. April 6.

8122. B. Krantz and H. Zeissler. Decorating metal articles with other metals deposited thereon. April 13.

8137. S. Pearson and J. H. Pratt. Metallic alloys. March 23.

8529. D. C. Bateman. Apparatus for hardening and tempering steel wire. March 23.

10,144. P. H. Bertrand. Method of forming magnetic oxide (Fe_3O_4) upon the surface of wrought or cast iron. April 20.

15,444. T. H. J. Eskuchen and H. A. Haarmann. Burning of pressed blocks of purple ore, and apparatus or kilns therefor. April 20.

1892.

1565. H. H. Lake.—From J. Gould, jun. Coating of metal plates, and apparatus therefor. March 23.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

4949. A. F. Willman. The generation of electricity for electric lighting and other purposes. March 14.

5245. J. Pedder. Improvements in the production of caustic soda and carbonate of soda by electrolysis, and in apparatus therefor. March 17.

5311. J. C. Richardson. Improvements relating to the construction of electrodes for electrolytic purposes. March 17.

5409. G. E. B. Pritchett and T. W. Pritchett. Improvements in secondary batteries. March 18.

5412. J. F. Bennett and F. A. Colley. Improvements in galvanic batteries. March 19.

5546. J. W. Swan. Improvements in or connected with the electrolytic deposition of copper or other metals. March 21.

5645. L. Pyke and E. S. Harris. Improvements in or connected with electric batteries. March 22.

6006. T. Parker and A. E. Robinson. Improvements in the treatment of electro deposits of metals. March 28.

6007. T. Parker and A. E. Robinson. Improvements in or connected with cells for electrolysing chloride solutions. March 28.

6058. W. F. Taylor. Improvements in machinery for the purpose of hardening and tempering metals by electricity. March 29.

6112. H. H. Lake.—From W. Sleicher, jun., and G. A. Mosher, United States. Improvements in and relating to secondary batteries or accumulators. Complete Specification. March 29.

6288. H. C. Bull. Improvements in or connected with the manufacture of alkalis, chlorine, and hydrogen by electrolysis. April 1.

6289. J. C. Graham. Improvements in the deposition of metals by electrolysis, and in apparatus therefor. April 1.

6405. D. Urquhart and J. M. Small. An improvement in secondary voltaic batteries. April 2.

6428. E. Hancock and A. J. Marquand. Improvements in the manufacture of elements for electric or secondary batteries. April 2.

6465. G. E. Heyl. Improvements in electrical secondary or storage batteries. April 4.

6467. E. Hermite and A. Dubose. Manufacture of the alkaline carbonates or bicarbonates by the electrolytic decomposition of alkaline chlorides in the presence of gelatinous alumina or chloride or other salt of aluminium. April 4.

6637. G. E. Heyl. Improvements in electrodes for storage batteries. April 6.

6722. W. W. Donaldson and R. Macrae. Improvements in battery plates or secondary batteries. Complete Specification. April 7.

6949. J. Marx. Improvements in and apparatus for the electrolysis of solutions of salts or compounds of the alkalis, more especially intended for the manufacture or production of alkalis and chlorine and for bleaching. April 11.

7088. A. W. Wetherelt. An improved dry battery. April 13.

7144. G. H. Cutting. Improvements in secondary batteries. April 13.

7170. T. E. Weatherall. An improvement in primary batteries. April 14.

7220. F. B. Stone. An improved primary battery. April 14.

7226. C. H. A. Hoho and E. A. C. Lagrange. Improvements in or relating to the electric treatment of metal or other bodies. April 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

7960. R. D. Sanders. Apparatus for use in the manufacture of metal tube cylinders, or other articles by electro-deposition. April 13.

8126. G. J. Philpott. Compound dynamo-electric generators. March 30.

9079. C. Hoepfner. Electrolytic extraction of metals and the electrolysis of other substances. March 30.

9628. D. G. Fitzgerald. Negative elements (positive electrodes in charging secondary cells) of voltaic batteries. April 13.

9629. D. G. Fitzgerald. Negative elements (positive electrodes in charging secondary cells) of voltaic batteries. April 13.

9689. V. Jeanty. Apparatus for supplying depolarising or other liquids to a series of electric batteries. April 13.

9734. W. Aldred. Dynamo-electric machines. April 20.

9803. W. J. Engledue. Galvanic batteries. April 13.

10,082. P. Jablochkoff. Voltaic batteries. April 20.

10,090. L. Grabau. Process for the electrolytic production of aluminium. April 13.

13,460. The London Metallurgical Company, Limited, and S. O. Cowper-Coles. Coating articles with a new metallic alloy by electro-deposition. April 20.

16,270. W. P. Thompson.—From E. Correns. Accumulators for the storage of electric currents. March 30.

17,655. G. D. Burton, A. H. Eddy, and G. T. Briggs. Heating metals by electricity and machines therefor. March 30.

1892.

2225. G. Nahnsen. Method of purifying electrolytes containing zinc, relating to or connected with the electro-metallurgical production of zinc. April 6.

2329. O. Imray.—From T. J. Montgomery. Process and apparatus for bleaching by electrolysis. March 23.

2913. G. Nahnsen. Electro-metallurgical extraction of zinc. March 23.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

5794. G. H. Ilikins. Improved washing compounds. March 24.

5938. R. Bell and G. H. Barber. Improvements in the manufacture of soap. March 26.

6953. E. J. J. B. Benoit and J. S. y Vila. Improvements in the method of extracting stearine and oleine from tallow, and in apparatus therefor. Complete Specification. April 11.

COMPLETE SPECIFICATION ACCEPTED.

1891.

9431. H. H. Lake.—From La Société Anonyme des Parfums Naturels de Cannes. Purification of fatty substances. March 30.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

5120. H. W. Pieton and S. E. Linder. Improved manufacture of vermilion. March 15.

5287. J. W. H. James. Improvements in the manufacture of white lead, and in apparatus therefor. Complete Specification. Filed March 17. Date applied for October 1, 1891, being date of application in France.

5862. J. R. Carnthers. Improvements in colour cakes, blocks, or sticks for marking or colouring purposes. March 25.

6009. S. Z. de Ferranti and J. H. Noad. Improvements in the production of white lead and chrome pigments. March 28.

6516. G. W. Scollay. Improvements in the manufacture of pigments. Complete Specification. April 5.

6542. J. S. Fairfax.—From F. Crane, United States. Improvements in the manufacture of pyroxyline solutions and compounds for varnishes and coatings. April 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

3832. J. H. Noad. Manufacture of white lead. April 6.

6683. R. J. White. Manufacture of white lead. April 20.

8296. A. MacLean, jun. Transparent coloured materials for decorative purposes. March 23.

9193. R. Jacks.—From G. Sharp. Composition for coating ships' plates and the like. March 30.

9267. W. B. Lawson and H. Schofield. Manufacture of black-lead blocks. April 6.

9319. W. P. Thompson.—From J. P. von Balgooy. Process and compositions for coating walls and similar surfaces to prevent the penetration of damp. March 30.

1892.

2253. C. H. Bigland. Paints or protective coverings for ships' bottoms and other structures. March 23.

3142. H. Taylor. Manufacture of paints and varnishes, and in the treatment of materials in connexion therewith. April 13.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

5689. F. Riegert. A process for waterproofing all kinds of skins and rendering them more durable. Complete Specification. March 23.

5704. J. T. Hardy. An improved method or process of furnishing moroccos, goat skins, and other leathers. March 23.

5828. C. K. Falkenstein and K. K. Falkenstein. An improved method of rapid tanning with the aid of electricity. March 25.

6104. C. W. Luther. The production of a cement or glue for joining wood. March 29.

6416. W. P. Thompson.—From F. A. Wolff, Germany. Improvements in and in apparatus for the treatment of liquid gelatin or glue for the ultimate production of plates or sheets of such. Complete Specification. April 2.

7150. C. J. Sanders. A process for treating the entrails or intestines of animals to render them waterproof and useful for industrial purposes. April 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

7106. A. Huillard. Process of decolourising and clarifying tanning liquors or tannic extracts. April 6.

9624. W. Crowther and J. Crowther. Preserving a solution of tannin and keeping it from fermenting or changing into gallic acid. April 13.

10,871. B. Whiteley. Manufacture of mats, rags, and and similar articles from the skins of animals such as sheep and the like. March 30.

18,003. F. J. Bugg. Manufacture of an improved composition leather fabric. March 30.

19,397. I. Goldschmidt. Process of dyeing, tanning, and mordanting leather, teased fabrics, or other porous materials, and apparatus employed therefor. April 6.

1892.

2429. H. E. Howe. Method of rendering leather used for the outer soles of boots and shoes flexible or pliable. March 23.

XV.—AGRICULTURE AND MANURES.

APPLICATION.

5411. F. W. Saubmann. Improvements in the manufacture of superphosphates. March 18.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

5357. H. H. Lake.—From A. Briart and P. Jacquemin. Method for enriching calcareous phosphates, and for manufacturing superphosphates and various by-products. March 30.

1892.

3029. H. H. Lake.—From The Biolytic Gypse Co. Insecticide and fertiliser. March 23.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

5719. T. Drost. Improvements in and relating to the manufacture of refined sugar from raw sugar. March 23.

6160. R. Brockhoff. Improvements in apparatus for manufacturing sugar. Complete Specification. March 30.

7254. G. E. Delory. Improvements in the treatment of fecula and other amylaceous matters, and in apparatus therefor. April 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

8545. J. C. Mewburn. From The Maschinenfabrik Grevenbroich. Crystallisation of saccharine and other solutions. March 23.

8546. J. C. Mewburn. From The Maschinenfabrik Grevenbroich. Treatment of solutions which have been boiled to the granular state. March 23.

21,370. L. Kern. Production of adhesive substances soluble in water, from the gum exuded from almond, cherry, peach, and other trees. April 6.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

5059. G. Sobotka and A. Kliemetschek. Method of and apparatus for producing clear wort. Complete Specification. March 15.

5227. R. Rozenbaum. A process for the treatment of wine. March 16.

6075. G. Sobotka. Method of and apparatus for separating yeast. Complete Specification. March 29.

6286. W. G. Davidson. Davidson's precipitating and hot blast process for treating and cooling distillers' dreg. April 1.

6531. J. F. Wittemann. An improved process of finishing beer. Complete Specification. April 5.

6555. G. M. Johnson and E. de Cock. Improved method of or means for treating beer for improving its qualities and colour. Complete Specification. April 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

9763. W. P. Thompson.—From J. F. Theurer. Process and apparatus for effecting the extraction of hops, with the simultaneous production of a fine extract. April 13.

10,135. P. M. Justice.—From A. W. Billings. Method and means for manufacturing beer and ale.

18,511. A. Umbeck. Brewing. March 23.

1892.

3010. W. P. Thompson.—From C. F. Lawton. Process of manufacturing beer, ale, wine, cider, or the like. March 23.

3011. W. P. Thompson.—From C. F. Lawton. Method and apparatus for manufacturing beer, ale, wine, cider, or the like. March 23.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

4948. H. J. Allison.—From J. Miner, United States. Process of making food compounds. March 14.

5589. S. L. West. Improvements in apparatus for purifying, sterilising, and filtering water, and rendering the same fit for potable purposes. Complete Specification. March 22.

5725. J. Falcimagne. Improvements in or relating to the preservation of meat and fatty matters. Complete Specification. March 23.

6570. G. J. Epstein. Improvements in the manufacture of a substitute for egg. April 5.

6808. G. Tall. The manufacture of an improved substitute for butter. April 8.

6841. W. Crawford. An improvement in the manufacture of malt bread, biscuits, confectionery, and other articles of diet. Complete Specification. April 9.

7043. C. Saville. A new or improved food product, and process of producing the same. Complete Specification. April 12.

B.—Sanitary Chemistry.

5077. D. Harwood. Improved means for preventing the pollution of the atmosphere in large cities and towns. March 15.

6211. J. Price. Improvements in the treatment of sewage. March 31.

6396. F. W. Lacey. Improvements in apparatus for the treatment of noxious gases. April 2.

6731. H. Grimshaw. A new and improved method for the purification of sewage and waste water from manufacturing processes. April 8.

6882. H. C. W. Baldwin. Improvements in the construction and arrangements of purifying and disinfecting apparatus. April 9.

C.—Disinfectants.

5036. J. B. Dewhurst. An improved compound for disinfecting and other purposes. March 15.

5979. F. W. A. Hille. Improvements in disinfectants. March 28.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1891.

7345. R. Riek and O. Dahm. Manufacture of artificial "human milk" and other easily digestible foods. March 23.

1892.

3470. G. F. Redfern.—From G. H. Neuhauss, J. F. H. Gronwald, and E. H. C. Oehlmann. Apparatus for sterilising milk and other fluids. April 20.

C.—Disinfectants.

1891.

8827. R. Armstrong. Manufacture of detergent powder. March 30.

9491. T. H. Williams. Manufacture of disinfecting powder. April 13.

9492. T. H. Williams. Manufacture of disinfecting powder. April 13.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATION.

5981. J. E. Hollidge. A treatment of paper or other material whereby writings become unalterable by the action of time or exposure. March 28.

COMPLETE SPECIFICATION ACCEPTED.

1891.

20,225. C. Kellner. Treatment of short fibres, particularly paper pulp, forming therefrom rovings and other goods. March 23.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

5745. J. Pfeiffer and W. Krauth. An improved process for the production of oxygenated pyrrazol derivatives. March 23.

7269. W. P. Thompson.—From W. C. Tiffany, United States. Improvements in extracts and distillates of ruine, hymenosepalum, torr, and their by-products, and the processes of producing the same. April 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

8584. L. F. Riedel. Manufacture of an iodine derivative of phenacetin. March 23.

9431. H. H. Lake.—From La Société Anonyme des Parfums Naturels de Cannes. See Class XII.

9450. J. Y. Johnson.—From F. von Heyden. Manufacture of iso-eugenol and poly-iso-eugenol. March 30.

9763. W. P. Thompson.—From J. F. Theurer. See Class XVII.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

5597. J. W. McDonough. Improvements in the art of producing coloured photographs. Complete Specification. March 22.

6342. V. Mathieu. Process for producing coloured photographs. Complete Specification. April 1.

6543. J. S. Fairfax.—From F. Crane, United States. Improvements in the manufacture of pyroxyline solutions and compounds for photographic or other films or coatings, and for solid or massive articles. April 5.

COMPLETE SPECIFICATION ACCEPTED.

1891.

7785. B. Krantz and H. Zeissler. Method and apparatus for reproducing photographs. April 13.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

5499. E. Davies. Improvements connected with explosive and non-explosive projectiles, and in an explosive compound to be used with the explosive projectile. March 21.

6258. O. Imray.—From MM. Rotten and Co., Germany. Improved manufacture of explosives. March 31.

6448. C. O. Lundholm and J. Sayers. Improvements in the manufacture of explosives. April 4.

6470. R. H. Courtenay. Improvements in and means for discharging highly explosive substances or fluids for war and mining and other purposes. April 4.

6548. D. Morrison and J. Somerville. Improvements in and relating to matches for lighting purposes. April 5.

7238. J. K. von Falkenstein and A. M. Bohn. New or improved manufacture of smokeless powder and high explosives. April 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

9503. H. T. Ashton. Percussion fuses. April 20.
10,747. J. Selwig and B. Lange. Apparatus for nitrating cotton, cellulose, straw, &c. April 20.
12,474. J. Heath and W. Frost. A safety fuse lighter. April 20.

XXIII.—ANALYTICAL CHEMISTRY.

APPLICATIONS.

5211. E. E. Duller. An improvement in fractional distillation. March 16.
5281. C. Ferý. A new instrument for the measurement of the refractive index of light in liquids. March 17.



THE JOURNAL OF THE Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 5.—VOL. XI.]

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[Non-Members 30/- per annum; Members 21/- per Set of extra or back numbers; Single Copies (Members only) 2/6.]

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NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list will retire from their respective offices at the forthcoming Annual General Meeting.

Sir John Evans, K.C.B., F.R.S., has been nominated to the office of President; and Professor J. Emerson Reynolds, F.R.S., has been nominated Vice-President under Rule 11.

Dr. F. Hurter, Dr. W. H. Perkin, F.R.S., Mr. John Spiller, and Professor T. E. Thorpe, F.R.S., have been nominated Vice-Presidents under Rule 8; and Mr. Thos. Tyrer has been nominated an Ordinary Member of Council under Rule 17, in the place of Mr. John Spiller, nominated a Vice-President.

Mr. Ludwig Mond, F.R.S., has been nominated Foreign Secretary; and the Treasurer has been nominated for re-election.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

Extract from Rule 18:—"No such nomination shall be valid unless it be signed by at least ten Members of the Society who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's Office, at least one month before the date of the commencement of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

ANNUAL GENERAL MEETING.

The Annual General Meeting will be held in London on the 20th, 21st, and 22nd July next. A detailed programme appears in this issue. Books of Coupon Tickets will be provided upon application to the Hon. Local Secretary, and will be wanted as vouchers for visits to works and excursions.

Post Office Orders should be made payable at the General Post Office, London, to the Honorary Treasurer, E. Rider Cook, and should be forwarded to him at Bow, unless it be desired to notify a change of address.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is prepared to offer 5s. apiece for copies of the Society's Journals for January 1883 in saleable condition.

LIST OF MEMBERS ELECTED, 23rd MAY 1892.

Allen, Walter W., c/o the Pueblo Smelting and Refining Co., Pueblo, Colorado, U.S.A., manager.

Bower, W. Ackroyd, Carnbroe Chemical Works, Coatbridge, N.B., chemical engineer.

Brooke, Wilton, Ashville, Stairfoot, Barnsley, Works, manufacturing chemist.

Clarke, Chas., MacLoutsie, Bechnanaland, South Africa, analyst and assayer.

Dodd, Archelaus, 135, Coleman Street, Whitmoreeans, Wolverhampton, electro chemist.

Gilmonr, Jas. D., 138, Aitkenhead Road, Glasgow, chemist.

Hamilton, Robt., Leeds Steel Works, Limited, Leeds, analytical chemist.

Moore, Dr. G. Dunning, 25, Catharine Street, Worcester, Mass., U.S.A., professor of chemistry.

Paine, Angustus G., The New York and Pennsylvania Company, Times Building, New York City, U.S.A., paper manufacturer.

Pope, Wm. J., 43, Hartismere Road, Walham Green, S.W., chemist.

Seutter, Dr. Erhard von, Via Treere 4, Görz, Austria, works manager.

Smithson, Saml., Ravensthorpe, near Dewsbury, Yorks, dyer and drysalter.

Taylor, Ernest H., Teinturie "Le Phœnix," Borgerhout, Antwerp, chemist.

Thorp, G. H., Clowes Villa, Lower Broughton, Manchester, engineer.

Wing, Jno. D., Box 59, New York City, U.S.A., merchant.

CHANGES OF ADDRESS.

Archbold, Dr. G., 10 Washington; 121—123, Front Street, New York City, U.S.A.

Barrett, A. A., 10 Liverpool; Isola Perroni, Piazza del Collegio Militare, Messina, Sicily.

Barrow, Jos., 10 Failsforth; 65, Bromboro' Road, Lower Bebington, Birkenhead.

Bartlett, F. C., Journals to c/o American Zinc Lead Co., Cañon City, Colorado, U.S.A.

Beckett, G. H., 10 London; c/o Alfred Nobel, San Remo, Italy.

Benjamin, Dr. M., 10 West 121st Street; 77, West 50th Street, New York City, U.S.A.

Berenger, J. J., 10 Treon Road; Basset Road, Camborne, Cornwall.

Boothby, Chas., 10 Westminster; The Hollies, Mile End, Stockport.

Cargey, W. E., 10 Newcastle; dalla Signora Poccardi, 51, Via alla Ponte Mosca, Torino, Italy.

Colwell, W. E., 10 London; c/o B. P. Clapp Ammonia Co., Cincinnati, Ohio, U.S.A.

Conroy, Jas. T., 10 Montpellier Crescent; Hunstanton, Hamilton Road, New Brighton, Cheshire.

Crichton, D. G., 10 Broken Hill; Nundle, viâ Tamworth, New South Wales. (Journals.)

Davis, Chas., 10 Oakfield Road; 3, Leitrim Terrace, High Street, East Ham, E.

Fleck, Hermann, 10 Philadelphia; F'hland Strasse 14, Tübingen, Germany.

Fletcher, R. J., 10 London; 50, Maitland Street, Halifax, Nova Scotia.

Gowland, Wm., 10 London; Buena Vista, Frodsham, Cheshire.

Gray, John, 10 Johnstone; Pentland Oilworks, Loanhead, N.B.

Gregory, Wm., 10 Ashford; Steam Brewery, Dartford, Kent.

Haller, G., Journals to 86a, Leadenhall Street, E.C.

Hamilton, Oswald, 10 London; c/o The Northfleet White Lead Co., Northfleet, Kent.

Heron, John, 10 Worple Road; Ellerdale, Cottenham Park, Wimbledon.

Holloman, F. R., 1/o Rawcliffe Bridge; 3, Laxton Terrace, Sedgwick Road, Leyton, E.

Johnstone, L., 1/o Newcastle; 1, Leadenhall Street, E.C.

Longshaw, Jas., 1/o Manchester; 3, Church Road, Seaforth, near Liverpool.

Lowe, Jas. S., Journals to c/o Oriental Bank Estates Co., Ltd., Port Louis, Mauritius.

Lowman, Dr. Oscar, 1/o Jefferson Avenue; 424, Brush Street, Detroit, Mich., U.S.A.

Mallalieu, T. C., 1/o Manchester; Anlage 24 C., Heidelberg, Baden.

Mond, L., Journals to 20, Avenue Road, Regent's Park, N.W.

Moult, John, 1/o Gladstone Terrace; Underhill, Low Fell, Gateshead.

Panton, J. A., 1/o Abbots Langley; 7, Penbridge Villas, Bayswater, W.

Preston, E. S., Journals to 30, Percy Street, Liverpool.

Richardson, C. T., Journals to 3A, Portman Mansions, Baker Street, W.

Riddell, Robt., 1/o Leicester; c/o S. Allsopp and Sons, Limited, The Brewery, Barton-on-Trent.

Scott, Ernest, 1/o Hampstead; 67, Lord Street, Liverpool.

Sendder, F., 1/o Clapham Common; 146, Earl's Court Road, South Kensington, S.W.

Sewell, Parker, 1/o Alice Street; 194, South Eldon Street, South Shields.

Smith, A. J., 1/o Fir Vale; 103, Rock Street, Pitsmoor, Sheffield.

Weldon, Ernest, 1/o Noel Street; 300, Radford Road, New Basford, Nottingham.

Westmoreland, J. W., 1/o Leeds; 2, City Road, Finsbury Square, E.C.

White, H., 1/o Rotherham; 80, London Road, Carlisle.

Wigg, G. L., 1/o Runcorn; Brow Head, Windermere.

Williams, R. Greville, 1/o Heywood; Greenfield House, Hopwood, near Manchester.

Williamson, Robt., 1/o Middlesbrough; c/o Jos. Williamson, Camp Terrace, North Shields.

Wilson, J. Millar, 1/o Ridley Park; Eddystone, Delaware Co., Pa., U.S.A.

CHANGES OF ADDRESS REQUIRED.

Graham, J. A., 1/o Dunmow, Essex.

Leeming, T. H., 1/o Burneston House, Plaistow, E.

Lees, Asa, 1/o 76, Duncombe Road, Upper Holloway, N.

Milne, G. A., 1/o Norton, Malton, Yorks.

Reay, T. B., 1/o Herrington Street, Sunderland.

Whelan, E. J., 1/o Star Chemical Co., Wandsworth Bridge Road, Fulham, S.W.

MEMBER OMITTED FROM JANUARY LIST.

Lee, J. W. Richmond; 70, St. Helen's Gardens, North Kensington, W.

Deaths.

Hofmann, Prof. A. W., F.R.S., 10, Doratheen Strasse, Berlin.

Shaw, D., Clayton, near Manchester.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

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C. W. Heaton.	F. Nanier Sutton.
D. Howard.	Wm. Thorp.
W. Kellner.	T. E. Thorpe.

Hon. Local Secretary: John Heron,
Ellerdale, Cottenham Park, Wimbledon.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies, and will take office in July next:—*Chairman:* Wm. Thorp. *Secretary:* John Heron. *Committee:* C. C. Hutchinson, B. E. R. Newlands, F. G. Adair Roberts, A. Gordon Salmon, T. Tyrer, and Frank Wilson.

SESSION 1891-92.

1892:—

May 30th:—

Dr. C. R. Alder Wright, F.R.S. "On some Aluminium Alloys."

Mr. J. A. Nettleton. "Vinegar."

June 13th:—

Professor V. B. Lewes. "Oil Gas."

Mr. Watson Smith. "The soluble Bituminous Constituents of certain Japanese Coals."—*cont.*

Meeting held Monday, 2nd May 1892.

MR. THOS. TYRER IN THE CHAIR.

ON THE DESTRUCTIVE DISTILLATION OF WOOD.

BY JOHN C. CHORLEY AND WILLIAM RAMSAY, PH.D., F.R.S.

THE destructive distillation of wood has been the subject of numerous researches. Some investigators have carried out experiments on a large scale, using different kinds of wood, and in a rough way, different temperatures; others have investigated more particularly the nature of the distillate and the composition of the gases evolved.

It may not be out of place here to give a brief summary of the previous investigations on the subject, before proceeding to describe our own experiments in detail; but we shall confine our remarks to those woods generally used in practice, viz.: oak, beech, and alder, as it is with these that our experiments have been carried out.

E. Fischer (Dingl. Polyt. J. **238**, 55) gives the results of experiments on beech on the manufacturing scale. Beech yielded, per cent.:—

Vinegar...45, equivalent to 4 per cent. $C_2H_4O_2$ and 1.1 per cent. CH_3O .

Charcoal...23

Gas.....28 (CO_2 , 20; CO , 7; CH_4 , 0.5; H , 0.05).

M. Senff (Ber. **18**, 60) distilled in an iron retort from four to six kilos. of wood; slow distillation (a) was achieved by packing the retort with air-dried wood and heating by means of a small fire; quick distillation (b) by heating the retort to bright redness, introducing the wood into the red-hot retort, closing, and continuing the process

at as high a temperature as possible. He experimented with a number of woods, but to quote his results for oak will serve our purpose.

	Total Distillate.	Tar.	Vinegar.	$C_2H_4O_2$	Charcoal.	Gas.
(a.)	18.15	3.7	41.48	1.03	34.68	17.17
(b.)	15.31	3.2	42.04	3.11	27.73	27.03

His conclusions are that quick distillation causes the formation of more gas, with less distillate and less carbon; that the vinegar is poorer in acid, and that the charcoal is more hygroscopic. He remarks incidentally that the yield of methyl alcohol follows that of acetic acid, being high or low, according as the yield of acid is high or low.

Similar experiments are recorded by C. A. Fawsitt (this Journal, 4, 319). He gives as the most suitable temperature, 350—400°; and for oak his numbers are:—

Vinegar, 47.6 per cent. containing 5.4 per cent. $C_2H_4O_2$; and charcoal, 24.9 per cent.

Lastly, W. Rudners (Dingl. Polyt. J. 264, 88 and 128) distilled small amounts of wood (20—47 grains) in the state of sawdust from glass retorts, using a bath of Wood's alloy as a source of heat. The temperature was made to rise slowly from 150° to 300°, and above. Oak yielded 7.92 and 8.21 per cent. $C_2H_4O_2$, and birch, 9.52 per cent. Comparisons are also given of the yield from other woods, and from cellulose prepared from birch.

A comparative table of yields is also quoted in "Chemistry as applied to Arts and Manufactures" (Mackenzie), but without particulars as to temperature.

The main products of the distillation of wood are water, acetic acid, methyl alcohol, aromatic oils, and charcoal. But the following subsidiary products have been detected:—formic, propionic, butyric, crotonic, iso-crotonic, and angelic acids (Grodski and Krämer, Ber. 11, 1356); acetone, methyl acetate, allyl alcohol, mestyl oxide, phorone (*ibid.*, 7, 1492); aldehyde, methyl formate (C. F. Mabery, Amer. Chem. J. 5, 256); methyl ethyl ketone, and two bodies of the formula $C_8H_{12}O$ and $C_{10}H_{16}O$, supposed to result from the mutual action of acetone on aldehyde, and of acetone on ethyl methyl ketone, and yielding on further dehydration

xylene and lymene; methylal (Fawsitt, *loc. cit.*); and at a low temperature, furfural (Heill, Ber. 10, 936). The tar contains guaiacol and creosol, together with numerous allied bodies; and the pitch, retene in considerable amount.

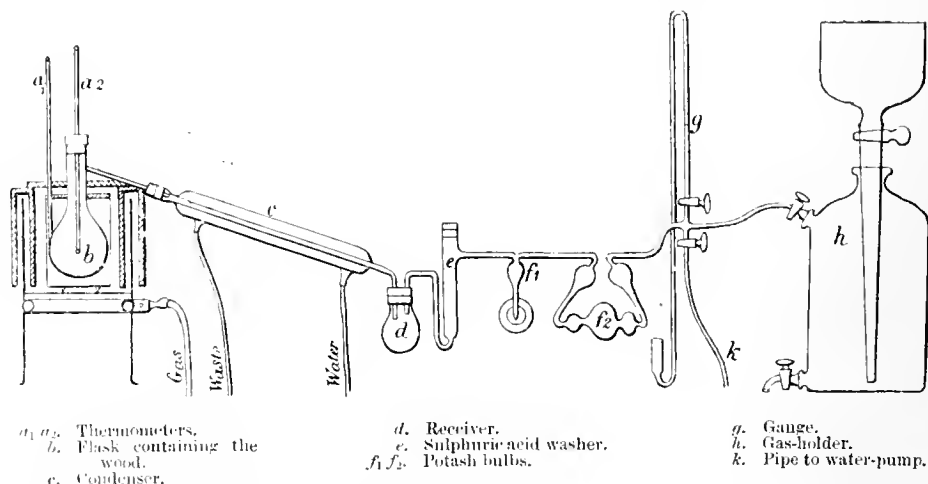
Analyses of the gas evolved at different stages of the distillation are also given by Fischer (*loc. cit.*). It consists mainly of carbon dioxide (55.6 to 64.7) and monoxide (30.1 to 35.1) together with methane (first three hours, 3.94; 8th hour, 4.67; 11th hour, 5.12; 12th hour, 2.43); traces of ethylene (0.05 to 0.69) and from 1.2 to 4 per cent. of hydrogen.

There appeared to be still room for a careful investigation of the operation of wood-distillation, regard being paid to temperature of the air-bath used to heat the still; to the temperature of the contents of the still; to the yield of acid and wood-spirit at different stages of the distillation; and to the composition of the gas evolved. Much still remains to be done; but the experiments carried out form a contribution to our knowledge of the whole subject.

Description of Apparatus.

The distillations were conducted in glass; the temperature of the still was raised by means of an air-bath with triple walls, an admirable device for securing constant known temperatures; such air-baths are made by L. Buhler, of Tübingen, from a design by Prof. Lothar Meyer. The products of distillation passed through a Liebig's condenser into a receiver; the gases escaping were washed with strong sulphuric acid, for the purpose of retaining methyl alcohol, the vapour pressure of which is so considerable at ordinary temperatures (54.2 mm. at 10°) as to cause considerable loss, provided no means had been taken to arrest its progress. Assuming the escaping gas to have been saturated with methyl alcohol at 15°, the amount retained by 4.5 litres of gas—an average yield—would have been 0.45 gram. It is not certain that no alcohol passed the scrubber of sulphuric acid, but the loss of wood-spirit must have thus been greatly lessened. After passing the scrubber the gases were made to bubble through two large sets of Liebig's bulbs full of potash, to retain carbon dioxide; they then entered a gas-holder of glass, roughly graduated, so that their volume was measured.

The accompanying woodcut shows the arrangement of the apparatus:—



a1 a2. Thermometers.
b. Flask containing the wood.
c. Condenser.

d. Receiver.
e. Sulphuric acid washer.
f1 f2. Potash bulbs.

g. Gauge.
h. Gas-holder.
k. Pipe to water-pump.

To ensure at least partial absence of air in the gases, the still and appurtenances were exhausted by a good water-pump before commencing distillation. The vacuum produced was about 740 mm. at an atmospheric pressure of 760 mm., hence the amount of air remaining in the whole apparatus and ultimately reaching the gas-holder did not exceed as a rule 100 cubic centimetres. To have made a perfect vacuum would have scarcely been possible, because it was necessary to employ an ordinary cork for the distilling-flask, owing to the high temperature of the issuing vapours.

The temperature of the air-bath and the temperature of the wood were read frequently during each distillation. They are illustrated by curves. Thermometers containing nitrogen were employed; in some cases, however, the temperature was too high to be thus registered, and the readings are therefore omitted.

The wood (oak, beech, or alder) was cut into small chips and placed in the flask, a thermometer being inserted so that its bulb occupied the centre of the space, and served to show the progress of the distillation. The temperature of the

bath was then raised, the whole apparatus having been rendered vacuum. As soon as the gas from the still raised the internal pressure, the entrance to the gas-holder was opened, and the gas passed. Distillation was continued until gas ceased to be evolved. But this must be taken only as a general description of the method of conducting experiments, for in many cases it was altered more or less in order to obtain special information.

After the distillation was over the weights of the charcoal, the distillate, and the carbon dioxide bulbs were ascertained, and the total volume of the gas was read. The distillate was re-distilled, and the insoluble oils were weighed. The second distillate, containing chiefly acetic acid and methyl alcohol, was titrated for total acid; and the methyl alcohol was distilled off, after neutralisation of the acid. It was united with the distillate from the sulphuric acid scrubber, diluted with much water. The total carbon dioxide, produced by oxidising the methyl alcohol, &c. with chromic acid was ascertained, and it was assumed for the sake of comparison to be all due to methyl alcohol. This is obviously an incorrect assumption, for the distillate is known to contain a considerable percentage of acetone, which also yields carbon dioxide as one of its oxidation products, besides other substances in smaller amount, many of which would also be oxidised to carbon dioxide; the total amount, however, of all these products was so small that it was thought better to submit them as a whole to some such rough test, rather than attempt a separation which would

have been difficult, and which would in all probability have involved considerable loss.

To gain an idea of the possibility of thus estimating methyl alcohol the following experiments were performed:—

Pure methyl alcohol in about 7 per cent. solution was boiled with a solution of chromic anhydride, and the carbon dioxide evolved was led through a second flask containing a boiling solution of the same oxidising agent. The vapours escaping were caused to return to the second flask by means of an inverted condenser. To the open end of the condenser was attached a flask containing a known volume of a solution of barium hydroxide, $\frac{1}{25}$ normal. The resulting barium carbonate was removed by filtration, and the residual alkalinity determined by titration.

Two experiments conducted on pure methyl alcohol gave 94.8 and 95.6 per cent.; but in estimating the amount of methyl alcohol in the crude products of distillation, no correction was introduced for the deficiency, for the method was regarded as merely a comparative one. The yield of methyl alcohol in the distillate from wood must therefore be understood to be calculated on the basis of CO_2 obtained when it was treated in the manner described above.

It will be best to exhibit the general results in a tabular form first, showing the results at high and at low temperatures. The methods of securing these temperatures will be afterwards described, together with the thermal changes which occur in the woods during distillation.

TABLE I.

Oak.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.
Weight of wood taken in grams.....	158.0	160.0	160.0	160.0	181.5	181.0	180.0	167.0
Per cent. of charcoal.....	32.9	30.0	29.69	31.25	30.58	33.7	25.00	24.55
Per cent. of distillate.....	55.7	58.1	60.56	58.75	59.87	56.35	59.44	58.09
Per cent. of CO_2 absorbed.....	6.43	3.93*	6.75	7.50	6.50	6.40	8.05	9.58
Per cent. of gas to make up 100 by difference.....	4.97	8.05	3.00	2.50	3.05	3.49	7.51	7.18
Volume of gas after absorbing the CO_2	4,910	6,000	4,350	4,650	4,300	4,000	7,500	7,502
CO.....	61.35	76.2	83.03	81.79	91.82	92.25	71.01	70.77
O.....	5.5	1.5	2.91	1.72	..	..	..	..
Per cent. by volume of the above gas	C ₂ H ₆.....	..	..	..	..	..	17.44	1.11
CH ₄	29.15	22.3	6.67	2.61	1.73	2.96	11.90	11.90
N by difference.....	..	..	13.39	13.88	6.25	1.89	11.55	13.32
Per cent. of pitch from distillate on the wood.....	7.72	8.12	7.93	8.12	8.00	7.60	10.00	9.58
Per cent. of acetic acid distillate on the wood.....	5.6	5.95	5.58	5.58	5.58	5.58	5.76	6.13
Per cent. of methyl alcohol on the wood.....	2.02	1.5	1.78	1.4	1.22	1.32	0.86	1.36
Maximum temperature about.....	345°	369°	356.5°	334	345°	341°	500°	500°

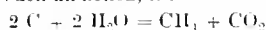
* CO_2 not all absorbed by the bulbs.

Confining our attention first to Table I., in which the results with oak-wood are stated, the chief feature to be noticed is that the percentage of charcoal obtained with a maximum temperature of 334° — 360° varies from 29.69 to 33.7 per cent. The air-bath in these experiments was slowly raised till distillation commenced; and the whole distillation from beginning to end took from 2 to 3 hours. For high temperatures the air-bath was on one occasion raised to the highest temperature obtainable with the burner we possessed, and when the temperature had attained its maximum, the distilling flask was introduced. This made no appreciable difference. The whole distillation in No. 7 lasted only three-quarters of an hour; and in No. 8 about the same time. The table shows the effect of

such rapid distillation very clearly. The charcoal, instead of amounting to 31 per cent. of the wood, drops to 25 per cent. The total weight of distillate is not greatly changed; but the carbon dioxide has increased, and the total amount of gas is more than doubled.* Analysis of the gas shows that a considerable amount of methane has been formed chiefly, apparently at the expense of the water, and perhaps to some extent of the methyl alcohol, for the acetic acid shows a yield a little above the average. It may be conjectured that the carbon and water react giving carbon dioxide and

* It is curious to note that Priestley in 1772 records the observation that a much larger amount of inflammable gas is liberated from wood by rapid distillation.

methane for the most part. It must be remembered that the water of the distillate is not all due to mechanical retention in the wood, which was in all cases seasoned and air-dried; but that we have here the action of nascent carbon on water, partly present as such, partly in course of formation. It is easy to construct an equation which shall represent such an action, it is—



It is true that such an action does not take place between ordinary charcoal and water-gas; but it presents a certain analogy to the action of carbon disulphide on hydrogen sulphide, in presence of copper, when nascent carbon is liberated from the disulphide. We notice also the production of a small quantity of olefines, due, no doubt, to the decomposition of the methane, for some carbon was deposited on the walls of the flask.

TABLE II.

Beech.	No. 1.	No. 2.	No. 3.	No. 4.
Weight of wood in grms.	187	180	180	180
Per cent. of charcoal.....	34.22	33.33	27.77	26.66
Per cent. of distillate.....	53.47	58.33	59.44	59.33
Per cent. of CO ₂ absorbed.....	7.49	6.66	8.88	9.23
Per cent. of gas to make 100 per cent.	4.82	4.68	3.99	4.78
Vol. of gas after absorbing CO ₂	5,000	4,500	6,000	7,200
CO.....	87.36	88.88	79.13	73.14
O.....	1.11	1.24	0.43	1.02
Per cent. by vol. of the above gas.	..	None	..	1.49
C ₂ H ₄	1.15	3.39	10.96	18.71
N by difference	7.38	6.49	9.51	5.64
Per cent. of pitch from distillate on wood.	7.49	7.22	..	11.11
Per cent. of acetic acid from distillate on wood.	6.02	5.37	6.05	6.74
Per cent. of methyl alcohol from distillate on wood.	5.31	5.42	5.9	6.08
Maximum temperature.....	380°	330°	about 500° slow.	about 500° fast.

An analysis of gas produced during distillation of oak on the manufacturing scale by the late Professor Dittmar, kindly furnished to us by Messrs. Turnbull, of Camlachie, gave the numbers:—

CO₂..... 53.3 per cent. of total gas.

The residue consisted of:—

CO..... 82.15
 CH₄..... 13.83
 C₂H₄..... 9.75
 N..... 3.25

The total weight of gas per 100 parts of wood on the large scale amounted to 16 to 18. It will be noticed that the total percentage at 500° found by us was 15 to 16 per cent.; but at lower temperatures 9 to 10 per cent. The percentage of pitch also increases at high temperatures from 8 to about 10 per cent. This probably arises from the formation of acetylene groupings between carbon and hydrogen, and the condensation to aromatic products, the chief of which are known to be creosol and guaiacol. The formation of such aromatic compounds which contain methyl groups does not appear to influence the percentage of methyl alcohol to any great extent.

If we survey the results of distilling beech-wood the same general features appear; but contrasting columns 1 and 2 with 4 and 5, it is to be noticed that the percentage of charcoal falls from 33—34 per cent. to 26—28 per cent., with rise of maximum temperature from 350°—380° to 500°.

There is again a rise, although a smaller one, in the percentage of carbon dioxide, and again an increase in the total gas. Ethylene and marsh-gas again appear, the former in quantity; and the yield of tar is increased. Yet the yield of acetic acid and of methyl alcohol do not appear to suffer. And Table III. giving the results of distilling alder-wood shows the same general features.

TABLE III.

Alder.	No. 1.	No. 2.	No. 3.	No. 4.
Weight of wood in grms.....	150	150	150	134
Per cent. of charcoal.....	34.66	34.66	25.33	25.37
Per cent. of distillate.....	54.66	51.00	60.00	59.70
Per cent. of CO ₂ absorbed.....	7.33	8.00	10.66	9.70
Per cent. of gas to make 100 per cent.	3.35	3.34	4.01	5.23
Vol. of gas after absorbing CO ₂	4,500	4,000	7,500	6,000
CO.....	77.35	84.61	64.01	73.47
O.....	2.87	1.65	2.15	1.52
Per cent. by vol. of the above gas.	..	None	..	1.59
C ₂ H ₄	4.77	1.32	8.72	20.11
N by difference	15.01	9.42	25.12	4.31
Per cent. of pitch from distillate on wood.	12.63	11.33	13.33	15.67
Per cent. of acetic acid from distillate on wood.	5.71	5.76	6.29	5.90
Per cent. of methyl alcohol from distillate on wood.	11.13	10.75	10.19	11.17
Maximum temperature.....	367°	343°	500°	509°

Comparing next the three woods with each other, it is to be remarked (see Table IV., where typical cases are selected for high and for low temperatures) that the total yield of charcoal, both at high and low temperatures, the total distillate and the total carbon dioxide do not appreciably differ for the different woods. The composition and amount of the other gases are also fairly comparable. But alder gives a higher yield of tar than the other woods, and, although the acetic acid is nearly the same for all, the percentage yield of methyl alcohol differs enormously. It is least with oak, very much increased with beech, and greatly higher with alder. In fact about five times as much methyl alcohol (or to be guarded, light spirit yielding CO₂ on oxidation) is produced from alder as from oak. And here also we can see that the influence of a high temperature is not to decrease the yield of methyl alcohol. Attention will be drawn to this fact later.

We come next to consider the temperature of the wood during distillation. It will be remembered that a thermometer was placed so that its bulb occupied the centre of the still containing the wood; hence the temperature of the wood could be compared directly with that of the air-bath.

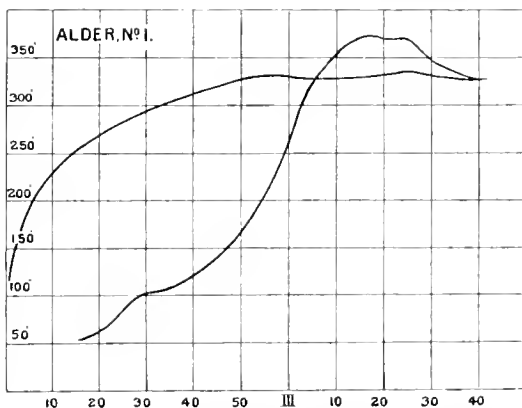
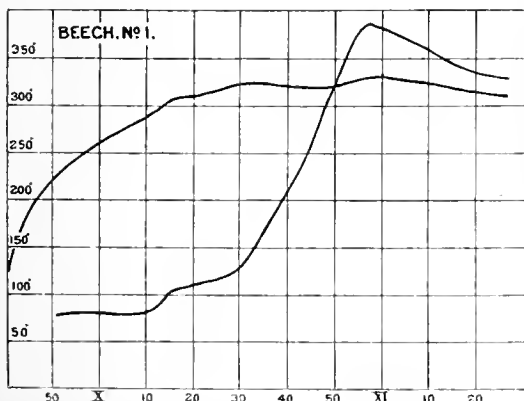
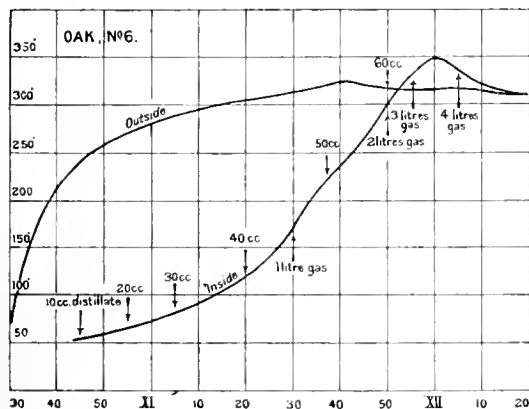
It is not too much to say that the results obtained are very remarkable. The conclusion may be shortly stated. The change of wood into products of distillation is an exothermic change; wood is of the nature of an explosive. The diagrams of temperature-curves inserted in this paper will amply prove this statement.

Of these three have been selected, which are fair average samples. The ordinates are time in minutes the abscissae temperatures of the thermometers outside and inside the still. While the temperature outside shows a gradual rise, fast at first, and slow afterwards, when the radiation from the air-bath begins to affect the rate of rise of temperature due to the source of heat, and gradually becoming horizontal, when radiation and supply of heat balance, the opposite is noticeable with the inside temperature-curve. There the form of the curve shows that as soon as water has distilled

TABLE IV.

	Oak.	Beech.	Alder.		Oak.	Beech.	Alder.
Weight of wood taken in grms.....	167	180	134	Weight of wood taken in grms.....	181	187	150
Per cent. of charcoal	24.55	26.66	25.37	Per cent. of charcoal	33.7	34.22	34.66
Per cent. of distillate	58.69	50.33	39.70	Per cent. of distillate.....	56.35	53.47	54.00
Per cent. of CO ₂ absorbed by KOH..	9.58	9.23	9.70	Per cent. of CO ₂ absorbed by KOH..	6.40	7.49	8.00
Difference to make up 100 per cent. .	7.18	4.78	5.23	Difference to make up 100 per cent.	3.49	4.82	3.34
Volume of gas after absorbing CO ₂ ..	7,000 cc.	7,200 cc.	6,000 cc.	Volume of gas after absorbing CO ₂ ..	4,000 cc.	5,000 cc.	4,000 cc.
Per cent. composition of this gas.	CO	79.77	73.14	Per cent. composition of this gas.	CO.....	92.25	87.36
	O .....	..	1.02		O .....	..	1.11
	Olefines.....	1.11	1.49		CH ₄	2.96	4.15
	CH ₄	14.50	18.71		N by difference	4.89	7.38
	N by difference	13.32	5.61				
Per cent. of pitch from distillate on the wood.	9.58	11.11	15.67	Per cent. of pitch from distillate....	7.49	7.49	11.33
Per cent. of acetic acid.....	6.13	6.51	5.90	Per cent. of acetic acid	5.58	6.02	5.76
Per cent. of methyl alcohol.....	1.36	6.08	11.17	Per cent. of methyl alcohol.....	1.32	5.31	10.75
Maximum temperature in each case about 500°.				Maximum temperature	344°	380°	313°

over, the reaction is exothermic, and as temperature rises, the evolution of heat is more and more marked. Indeed, in all cases it will be noticed that the temperature inside rises considerably higher than the outside temperature; with oak, 30°, with beech, 55°, and with alder 40°.



It is now possible to suggest a reason for the constancy of the yield of acetic acid and methyl alcohol, even when the temperature of the still is greatly raised. It is because the *acetic acid and alcohol are the products of the exothermic reaction*. A supply of heat from without is necessary to start the reaction, as it is in setting fire to gunpowder; the exothermal change continues the distillation independently of any external source of heat.

And yet when we contrast cellulose with acetic acid, methyl alcohol, carbon monoxide, dioxide, and water, we cannot be surprised, for these are among the compounds formed with the greatest evolution of heat from their elements. And it is indeed to be expected that such bodies should be formed from cellulose with considerable evolution of heat.

Next, as regards the progress of the distillations.

Oak.—No. 1. The inside temperature was not determined. Fifty cubic centimetres of distillate were collected before any considerable amount of gas was evolved. There was then a sudden rush of gas, and in 25 minutes the distillation was over.

No. 2. After 45 minutes the inside temperature had risen to 100°, the outside temperature being 275°; about 30 cubic centimetres of distillate had come over, and about 1

litre of gas was collected. Thirty-five minutes later gas was coming off quickly, and the inside temperature had risen to 310°. The outside temperature was kept constant. The inside temperature quickly rose to 360°, and then fell to the temperature of the air-bath.

No. 3. This experiment was conducted as before. The air-bath was slowly heated up. When it had a temperature of 254°, the inside temperature was 90°, and 30 cc. of distillate were collected. Ten minutes later the outside temperature was 270°, the inside temperature 143°, and 40 cc. of liquid had condensed. Gas came off suddenly as before.

No. 4. Both temperatures slowly rose. After 90 minutes the outside temperature was 271°, the inside temperature 261°, and 40 cc. distillate had condensed. Gas then came off quickly. In 20 minutes other 10 cc. had condensed, the outside temperature was 308°, and the inside temperature 299°, while 2 litres of gas were collected. Within the next 15 minutes, the amount of gas had risen to 4 litres, but little more distillate was formed.

No. 5. In this experiment the air-bath was heated up to 315° before introducing the flask, but this does not appear to have affected the results.

No. 6. The temperature of the air-bath was kept as low as possible. The results are shown in the curve, and it is evident that this accounts for the high percentage of charcoal and low percentage of distillate.

No. 7. The air-bath was at 500°; the flask was introduced and its temperature rapidly rose to 115°, when the thermometer had to be removed. No. 8 was treated in the same way.

Beech.—No. 1. The distillation occupied two hours. After 1½ hours the external temperature was 318°, the internal temperature 250°; and a little over two litres of gas had been evolved. In five minutes more the inside temperature had risen to 318°, and three litres of gas were collected. Five minutes later the outside temperature was still only 320·5°, but the inside temperature had reached 368°, and over four litres of gas had passed, and after other five minutes, the gas had reached five litres, but was stopping; the outside temperature was 325°, but the inside temperature had risen to 380·5°. The rise of temperature due to the exothermic decomposition of the wood accounts for the slight rise of external temperature. The temperature of both bath and bulk sank, till the distillation had stopped with outside temperature 315° and inside temperature 332°, and rapidly falling.

No. 2. Practically a repetition of the same phenomena.

Nos. 3 and 4 were distilled at about 500°, or somewhat over, with the same result as with oak.

Alder.—No. 1. The same general behaviour as oak and beech at low temperatures. After one hour the outside temperature was 326°, the inside temperature 250°. Ten minutes later the outside temperature was still 326°, but the inside temperature had risen to 350°. The rise continued, the highest temperature attained being 367°.

No. 2 showed nearly the same results, and Nos. 3 and 4 the same as the beech and oak at high temperatures.

Special experiments were made with beech and with oak in order to ascertain the rate at which acetic acid and methyl alcohol were evolved. The temperature of the air-bath was raised very slowly, and the distillate collected in 10 fractions. The outside temperatures and the percentages of methyl alcohol, calculated on the original weight of wood, are given in the following table:—

	Per Cent. MeOH.
No. 1. Below 135°	0·07
No. 2. 135°—165°	0·07
No. 3. 165°—215°	0·22
No. 4. 215°—275°	0·57
No. 5. 275°—285°	0·60
No. 6. 285°—295°	0·57
No. 7. 295°—305°	0·55
No. 8. 305°—320°	0·41
No. 9. 320°—325°	0·33
No. 10. 325° and above	0·18

The total amounts to 3·57 per cent., but the exposure of the distillates doubtless caused loss. The numbers may be taken as comparative, and it would appear that the alcohol comes over chiefly above 165°, and continues to be formed up to 325°.

Experiments with oak to ascertain the rate of yield of acetic acid at different temperatures were made with 183 grms. of oak. The gases were neglected, and the temperature was raised slowly as in the experiments Nos. 1 to 6 of Table I. The distillates were re-distilled when necessary, and were titrated with sodium hydroxide solution. The following table reproduces the results:—

No.	—	Yield.	Containing Acetic Acid.
1	Up to 120°	cc.	Grms.
2	120°—180°	10	0·1756
3	180°—240°	10	0·7320
4	240°—290°	10	1·0218
5	290°—300°	10	1·4610
6	300°—310°	10	1·5372
7	310°—322°	10	1·0980
8	322°—350°	15	2·3424
9	350°—450°	About 10	1·6104
Total			9·9844

Equal to 5·44 per cent. of acetic acid. There was doubtless some loss on re-distilling; but the results may be taken as comparative, and they show that the acetic acid rises in amount up to 350°, and then falls slightly. Comparing these results with those for methyl alcohol, it would seem that the alcohol is the first product of decomposition, when the exothermic reaction sets in, and that the acetic group is next separated from the wood. The chief evolution of heat appears to be due to the last separation. But it must be noted that the initial form of the temperature curve may be due not perhaps entirely to the commencement of an exothermic reaction, but possibly to some extent to the better conducting power of the dried and partially charred wood. As we do not know the relative conductivities for heat of wet and dry wood, we are of course unable to apportion the relative amounts. Still it is well to bear this in mind. If this be neglected, it would appear that the evolution of methyl alcohol is itself accompanied by evolution of heat, and that the formation of acetic acid causes a still larger evolution. A similar distillation was carried out with alder.

It was deemed of interest in this experiment to obtain some idea of the amount of furfural produced. That furfural is formed during the distillation of wood at low temperatures was noticed by Heill (*loc. cit.*). The actual yield, so far as we know, has never been made the subject of experiment. Furfural is easily estimated by means of phenylhydrazine. A solution of that substance was standardised against a 1 per cent. solution of pure furfural in dilute methyl alcohol, using as indicator aniline hydrochloride, which gives a crimson colour with furfural. The reaction is a neat one, and permits of an accurate quantitative examination.

A quantity of alder, amounting to 148 grms., was distilled very slowly; in two hours the temperature of the bath was steady. The distillate was collected in portions. Gas began to come off slowly at 280°, and increased in rate up to 340°. The external temperature was then 324°, the inside temperature overtaking the outside temperature at about 300°. At 500° (for the temperature of the bath was subsequently raised) about 5 cc. of an almost colourless distillate was obtained.

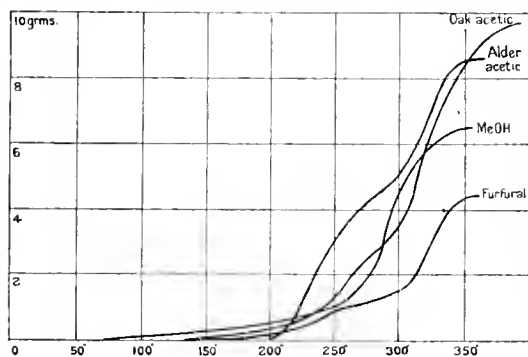
The results are given in the following table :—

No.	Temperature.	Time.	Quantity of Distillate.	Furfural.	Acetic Acid.
		Hours.	Less than 1 cc.	Grms.	Grms.
1	200°	2	1.5	0.05	0.0
2	200°-230	2	1.5	0.00	1.28
3	230°-250	1 Min.	6.0	0.006	1.95
4	250°-270°	25	1.5	0.05	0.88
5	270°-290°	25	1.5	0.064	0.83
6	290°-310°	15	3.5	0.086	0.80
7	310°-320°	10	5.0	0.142	0.79
8	320°-330°	10	5.0	0.170	0.78
9	330°-340°	15	1.5	0.237	0.87
Totals.....				0.985	8.18

It is again evident that the yield of acetic acid increases towards the end of the distillation, bearing out the remarks which were made before.

Contrary to expectation, the furfural appears to be produced in larger quantity at the end than at the beginning of the distillation, and it amounts to the not inconsiderable quantity of 0.62 per cent. of the weight of the wood. The acetic acid forms 5.45 per cent. of the weight of the wood. This furfural does not appear in operations on the large scale, because it is destroyed in "liming" the methyl alcohol. When heated with an alkali, it is converted into pyromucate of the alkali metal, and furfuryl alcohol, a non-volatile syrup. Hence it remains in the residues as a tarry mass. It is however possible to obtain furfural in quantity by allowing the weak alcohol to deposit it as an oil, before rectifying over lime. In the course of some days a layer settles, which can be drawn off. Of course much still remains dissolved, which must be removed by "liming."

A matter of some interest is the amount of water contained in the wood. This water cannot be estimated by drying at 100°, for at that temperature the wood is partially



decomposed, and the escaping vapours do not consist wholly of water. Experiments were therefore made of drying the wood over sulphuric acid *in vacuo* for a month. The results are as follows :—

	Per Cent.
Oak.....	13.58 H ₂ O
Beech.....	11.60 ..
Alder.....	11.64 ..

Alder, when hought, is usually very wet, and dries very rapidly after it is sacked. It is interesting to note that after such drying it contains nearly the same percentage of hygroscopic water as oak or beech.

Such are the results of the first part of this research. To summarise them briefly :—

1. The distillation of oak, beech, and alder is accompanied by an exothermic reaction, having for its products charcoal,

carbon monoxide and dioxide, and methane, acetic acid, methyl alcohol, acetone, and furfural, together with certain methoxy-benzene compounds.

2. These substances appear to be formed from beginning to end of the distillation; their appearance at first is doubtless due to the rise of temperature at the exterior of the wood; but they are formed in largest quantity when the exothermic reaction sets in.

3. The proportions of charcoal and gas relative to the other products depends on the temperature of distillation; but a high temperature does not appear to diminish the proportion of acetic acid and methyl alcohol.

4. Different woods, while nearly constant in their yield of acetic acid, differ greatly in their yield of methyl alcohol, or at least of some product which yields carbon dioxide on oxidation with potassium dichromate and sulphuric acid.

The direction of further investigation is obvious. It is known that wood which has been stored for long, and has rotted more or less completely, gives much poorer yields of acid and spirit than seasoned dry wood; and we are now proceeding with the study of cellulose (cotton-wool) and of jute in order to ascertain the effects of such changes.

DISCUSSION.

Mr. BERTRAM BLOUNT asked whether it was customary, when working on a large scale, to carry out the distillation *in vacuo*. It appeared from the sketch illustrating the apparatus that the author of the paper had made his experiments *in vacuo*; and it seemed to him that the results would be considerably influenced by the absence of pressure. He would also like to know why Professor Ramsay classified wood as an explosive. Wood might be a substance which, on distillation, gave an exothermic reaction, but he did not think that it could legitimately be called an explosive on that account.

Mr. OSWALD HAMILTON said the authors' experiments indicated considerable differences between the amounts of methane produced at high and low temperatures respectively. He thought that the differences, observed by the authors between the amount of charcoal produced at high and low temperatures, were more apparent than real, for the charcoal produced at low temperatures probably contained some pitch. This was borne out by the authors' tables, where the sums of the charcoal and pitch, at high and low temperatures respectively, were practically the same. With regard to the sudden rise of temperature about 300° C. a similar phenomenon was observed in the distillation of coal-tar, during which process the mercury in the thermometer suddenly rose from 300° C. to over 360° C. Whether this was due to an exothermic reaction or not, he could not say.

Mr. C. F. CROSS thought that in describing wood as an "explosive" substance, Professor Ramsay had given particular point to a most important result. This property was a fair inference from the general physiological consideration of substances composing living tissues. In recent chemical literature the correlative term "chemical tension" had been much used, and the conception expressed by it had been identified as a necessary condition of substances which had to adapt themselves to a long series of intrinsic changes. The light which had now been thrown on the subject from an altogether unexpected source gave the question new emphasis; and with the term explosive the authors of the paper had given definite expression to a phenomenon which he (Mr. Cross) and others had recognised rather on *a priori* grounds. He would venture to quote from a review written by himself some years ago.

"The study of the chemistry of lignification and of the fate of moribund vegetable matter therefore proves the possession of a high degree of intrinsic energy by plant substances, and the tendency to retain this energy in the form of derived compounds in which the carbon is proportionately accumulated (*Nature*, 1885, p. 606)."

He would not refer at length to what Professor Ramsay had promised later on, namely, the further consideration of the results he had brought before the meeting; but he would emphasise one point. The authors had obtained no acetic

acid in the dry distillation of the jute fibre; whereas this acid was easily obtained by the action of hydrolytic agents. It appeared to be formed, together with furfural, from the cellulose β of the fibre—a "penta"-cellulose. It was premature to attempt to explain this negative result; but the hypothesis that lignification was a continuous process of conversion of the wood cellulose into this cellulose β and semi-aromatic products, might be taken into account by the authors in the prosecution of their investigations.

Mr. DAVID HOWARD would like to say a word in praise of the strong language used by Professor Ramsay. From a manufacturer's point of view, wherever there was a possibility of a spontaneous rise in temperature, a practical expression for an exothermic reaction, there was a danger of explosion. He had no personal experience in the distillation of wood, but certainly if he had to carry out the process described by the authors, he would look very carefully to his outlets before he began.

Mr. WILLIAM FOSTER referred to some notes of his own experiments on the destructive distillation of the carbohydrates, selecting those referring to dry sawdust from the wood of the coniferæ. The temperatures used in his observations were much higher than those employed by the authors, and were similar to those found in coal and shale distilling industries. One point had been made pretty clear, namely, that the amount of carbonaceous residue (coke) was practically constant when a substance was destructively distilled at temperatures called "high" and "low" by gas engineers. Great variations, however, occurred in the amounts of condensibles (tar and water) and gas. The quantity of gas both as to volume and weight was increased by augmented temperature, the quantity of tar and water being proportionately diminished. The quantities of charcoal (coke) from oak at high and low temperatures given in the authors' tables as 24 per cent and 33 per cent, respectively, showed differences greater than he had observed in destructive distillation proper. The following figures were obtained in three independent experiments with sawdust (dried):—

Charcoal (coke).....	21.97	21.17	21.05
Tar and water.....	32.29	31.69	27.52
Gas.....	43.81	46.64	50.93
	98.07	99.50	99.50
Gas obtained per pound (measured at 62° F. and 30 in.) in cubic feet.....	6.44	6.89	7.83

Each of the gases, marsh-gas and hydrogen, was present to the extent of about 18 per cent.; and the carbonic oxide and anhydride jointly measured more than 50 per cent. The free nitrogen was in no case more than 3 per cent. These figures were obtained after some considerable experience with an apparatus which had been devised for the purpose of accurately ascertaining the amount of each factor when the raw material operated on weighed 2 lb. or even more.

Furfural was abundantly produced in the distillation of the carbohydrates at high temperatures, the tar from such bodies being probably as convenient a source of supply as any given in the text books. Acrolein and allyl alcohol were also, he believed, to be found under such circumstances, although he had not separated them from the other products as he had done in the case of furfural.

Mr. WARREN SMITH had listened with much interest to the paper, although he had had the privilege of seeing the experiments made in University College. He would like to add his word of support in favour of the word "explosion," as signifying an exothermic development, and he would like also to point out the very considerable difference between that action and the so called "break" in coal-tar distilla-

tion. No exothermic phenomenon was concerned in that "break," for when the distillate reached a certain degree of temperature there was a cessation of the distilling process until the temperature of about 110° C., at which the break commenced, had been increased by extra firing to about 180° C., when distillation recommenced. In 1871 he had the management of both a coal-tar and a wood distillery, so that he could look upon himself, to some extent, as an old wood distiller. In that year he communicated a paper to the Chemical Society on the subject of the distillation of wood (J. Chem. Soc. 1871, 1101—1108.) He had demonstrated, by the testing of samples taken at different stages of the process, that the amount of acetic acid gradually increased in a 12 hours' distillation, up to the seventh hour after the commencement, and that thereafter a gradual fall took place. During the first six hours, the specific gravity gradually increased from 1.01 to 1.017, and then in one hour rose to 1.03. At this point the specific gravity remained constant during the remainder of the distillation. After reaching the stage at which the specific gravity had increased to 1.03 the amount of tar distilling over was found to have reached the highest proportion so far attained. After the eighth hour the proportion of tar increased steadily. Professor Ramsay and Mr. Chorley had also found that the proportion of tar became increased if the temperature of distillation was raised. Towards the end of the distillation the temperature would naturally be higher, and for that reason he would expect, *a priori*, that the quantity of tar furnished at the latter stage would be higher. In working wood retorts on a large scale, he had never noticed sudden rises in temperature. There was no outward manifestation such as would strike a workman; and he did not think that it was considered necessary to draw the fires, or to open the fire-doors. This was his experience, and he had since learnt it was the experience during 40 years of his friends Messrs. Robt. Rummy and Co., of Manchester. But it was only fair to add that in these cases oak crop wood and timber in fairly large pieces were carbonised, whereas the authors used their wood cut up very small, and, moreover, it seemed well dried. In the first case there would be small surface and slow action, in the latter, large surface and rapid developments. He did, according to his own experience, recollect that a few hours after commencing, at the period, probably, at which most of the water as moisture in the wood was driven off, there was a much larger flow of gas than had previously been the case. With regard to wood charcoal, he believed that it was never absolutely charred. The charcoal, when transferred from the ovens to the cooling vaults, generally had a quantity of water thrown in after it in order to choke out any possible combustion. Being saturated in this way with aqueous vapour and moisture, and having cooled, the vault doors were opened, and the charcoal conveyed in iron wheel-barrows to the shed. This charcoal was exceedingly liable to burst spontaneously into ignition in the shed, and for this reason great caution had to be exercised. In this connexion he would remind the meeting that in a recent communication to the Society of Arts Journal with regard to coal, Professor Vivian Lewes had stated that it was found that coal caught fire spontaneously even in the absence of pressure, when, for example, a quantity of coal powder in a biscuit tin was maintained at a temperature of 100° C. for some little time. These were simple cases of exothermic action, or "explosion," and doubtless that of the charcoal described was quite analogous to that of the wood at a less advanced stage of decomposition, as described by the authors. It was, for the most part at least, the "explosion" breaking out anew, albeit under slightly modified conditions.

As to the utilisation of wood creosote, an American member, Dr. Franklin S. Clark, distilled forest-wood very largely in Wilmington, N.C., principally to obtain wood-creosote for the antiseptic treatment of wood for railway sleepers, and for especially resisting the attack of the sea-worm (*teredo navalis*). (This Journal, 1890, 1005).

He would like to point out that the late Mr. E. T. Chapman found hydrogen in wood-gas (Chemical News, 1871, 105. See also *ibid*, pages 91—93).

Mr. A. G. GREEN inquired whether Professor Ramsay's numbers for the methyl alcohol were obtained by oxidation of the total alcoholic mixture or whether this was submitted to a preliminary fractionation. He thought if this was done the acetone might be determined by conversion into iodoform, and the difference would give the methyl alcohol. He gathered that the authors had not as yet determined the acetone.

Mr. B. BRIGGS remarked that in this country, chiefly South Wales and Scotland, an important quantity of wood spirit was turned out; but the great difficulty in England was that manufacturers were hampered by the Government from treating the products of wood distillation in the way in which the Germans dealt with them. If methyl alcohol were made in England, the duty upon it would be 17s. or 18s. a gallon, and with that burden placed upon its manufacture, it was impossible to make it a paying industry, or to compete with German manufacturers in producing the colour for which it was employed. He had endeavoured to get the authorities to amend that state of affairs, but he was sorry to say that he had not been successful. The question of wood distillation was a very interesting one, but he was afraid that in this country, till some change was brought about, it must be considered as a dying industry.

Professor RAMSAY, in reply, said that there had been some misunderstanding, perhaps, because he had not made himself quite clear. The apparatus explained itself. After the air had been pumped out of the apparatus, the distillation commenced, and the gases produced soon raised the pressure again. When pressure had become normal, the gases were allowed to enter the gas-holder. Mr. Hamilton was quite right in his remarks about charcoal. The authors of the paper had found, after further research, that undoubtedly the resulting charcoal contained a large quantity of gas. Distillation on the large scale usually lasted about 12 hours, and on the small scale from $2\frac{1}{2}$ to 3 hours, so that six hours on the large scale would correspond to three on the small. It had been noticed on the large scale that there was an exothermic reaction. One manufacturer he knew of had been in the habit of burning the gas, but this course was not of much use, because the gas came at the wrong time, and it was not wanted at the end. With reference to the question of creosote, he would like to ask Mr. Watson Smith whether it was utilised in this country.

Mr. WATSON SMITH replied that it was only utilised in the United States.

Professor RAMSAY, continuing, said that he would like to add one point, namely, with regard to the temperature of distillation on the large scale. It was a mere matter of guesswork. It was somewhere between 400° and 500° , probably about 425° . A fairly accurate conclusion could be arrived at by comparing the yields of charcoal and gas on the large with those on the low scale.

NOTES ON SOME INDIAN GUM SAMPLES OF KNOWN ORIGIN.

BY DR. S. RIDEAL.

DURING an investigation by Mr. Youle and myself on the relative value, for commercial purposes, of some modern substitutes for gum arabic (this Journal, 1891, 610) our attention was naturally drawn to the characteristic properties of those Indian gums which are brought to the London market.

The favourable results obtained from the samples which were then examined for a variety of purposes led us to devote considerable attention to this class of gum, and we found that, as a rule, a good mucilage could be reasonably expected from them, as seldom did the insoluble portions reach a very high percentage.

We advocated the use of Ghatti gum for pharmaceutical purposes at the British Pharmaceutical Conference at Cardiff during the autumn of last year (Year Book of Pharmacy, 1892, 405, *et seq.*) and have since found that many manufacturers have been induced to give these gums a further trial. Quite recently the Bombay correspondent of the "Chemist and Druggist" (March 19th issue) has again drawn the attention of English consumers to this article: he says, in speaking of Ghatti gum (finest sort), "This gum is exclusively used in India by pharmacists. The English druggist has apparently not yet found out the value of this drug, which can be had in all qualities, and is (in the best grades) double the strength of Turkish gum acacia." These remarks, whilst confirming the favourable opinion already formed, naturally lead one to imagine that in India we have gums which are very suitable for many classes of work in this country. Unfortunately the gathering of gum in India is not yet carried out with any system and little is known as to which gums would yield the best price in England. That which is at present exported is named "ghatti," "anrad," &c. from inspection, and sorting the gums when once they are mixed is a laborious and expensive operation. We thought that it would be interesting if gums of known origin from India could be sent in small quantities to this country for the purpose of examination, and that by so doing light would be thrown on the best localities for the finest sorts of gum.

Through the kindness of Professor Pedler, of Calcutta, I have had placed at my disposal a series of gums which have been collected by the Government department, from trees of known botanical origin, and in most cases from known localities, and it is the purpose of this note to briefly describe the physical and chemical properties of these gums. Amongst these the most important is the—

Acacia Arabica Gum.—In India the tree is known as the Bahul tree and abounds all over Northern India, where it is prized more for its wood, which is used for fuel and timber, and its bark, which is of value for tanning purposes, than for its gum. The yield of gum too, is very small as compared with the yield from the same tree in other parts of the world, *e.g.*, in Arabia and Egypt. This small yield is probably due to the climatic difference of India, as the production of gum requires a dry atmosphere like that which abounds in the deserts of Arabia and Africa, the true home of the gum arabic.

Where such a climate exists as in Rajputana and Sind, the tree yields quantities of gum, but not sufficiently large to form an important item in the export trade. The indigenous product is merely used for home consumption in the interior of the country. The requirements of the seaport districts being met by the imported gum, very little of it finds its way to the seaport for export. The gum exported from Bombay to Europe is chiefly obtained from the Red Sea ports, and it is more or less adulterated with the Indian product. The Indian gum is inferior in quality to that obtained from Arabia and Africa. The colour is usually dark and it is frequently mixed with gums of other trees, and often these admixtures contain fragments of gums which are insoluble in water. In India, acacia gum is used for medicinal purposes as well as in the preparation of sweetmeats. The true Indian gum sells at 15 to 25 rupees per hundredweight, according to quality. It is reported that barren trees can be made to yield gum by inoculating it with gum from another tree, but, as far as I have been able to ascertain, no systematic experiments in this direction have as yet been tried. The samples of gum acacia sent from India consists of very hard, light, brown, irregular masses, without any marked taste or smell. They swell up in water to a pale-brown jelly and finally are completely soluble. They give a mucilage which is fairly adhesive, and with most reagents give characteristic reactions, while Ghatti gums gave negative results.

On analysis the sample gave 16.38 per cent. moisture and a fairly high ash (4.46). Its solution was very viscous, and it contained the smallest quantity of nitrogen of any of the samples examined. O'Sullivan, in a recent paper, has drawn attention to the presence of some nitrogenous substance in samples of Gedda gum, but apparently it exists in too small a quantity for isolation. On the other hand,

it may be that the gum acid is itself sometimes partially converted into an amido compound. The quantity of nitrogen present in all these Indian samples is recorded in the table, but it is difficult to draw any conclusions from the numbers obtained.

Acacia Catechu.—From this tree the catechu of commerce is obtained. It yields a gum of a pale yellow colour, and like the gum obtained from the Babul tree, is usually completely soluble in water. Some of the specimens are almost white, and apparently in India the gum from these trees is usually of better quality than that obtained from the tree *Acacia Arabica* when grown in the same place. It is, however, not procurable in large quantities. In point of fact, none of the Indian gums at present can be obtained pure in such quantities as to form a trade article by itself; hence Indian gums imported to this country are usually of the mixed character already referred to. The sample of a case of catechu examined came from Surat, Bombay, and occurred in light brown translucent angular masses. It left a slight residue insoluble in water. The specimens at my disposal were slightly musty, so that the mucilage obtained from it had not a very good adhesive value. Its viscosity was also small, and it had a fairly low ash. The complete figures of this and the other gums are given in the table at the end of these notes.

Acacia Farnesiana.—This tree yields a large quantity of gum, and is also found in the mixed gums imported to this country. The tree grows very freely in Sind. The sample examined was furnished by the Forest Department of the North-West Provinces, and had a pale red colour. Mr. Baden Powell has described the gum as occurring in "dark conchoidal masses translucent and transparent at the edges. Some of the pieces are much whiter." Our samples came from Bahraich and Oudh, and were mixed with bark. It dissolved completely in water, forming a deep brown mucilage which had very poor adhesive property. It did not darken on warming with normal soda, gave a slight brown precipitate with ferric chloride, and threw down a copious precipitate with alcohol. It contained 15.45 per cent. of moisture; ash, 2.08 per cent., and nitrogen, 0.061 per cent.

Acacia Ferruginea.—This gum occurs in brown irregular masses very similar to the former sample (*A. Farnesiana*). It is entirely soluble in water and is fairly adhesive. It differed from *A. Farnesiana*, in darkening with normal soda, but in other respects was very similar in character. Its moisture was high, 17.09, its ash 3.22, and it contained the highest quantity of nitrogen, 0.082, of any of the samples. Our sample came from Panchmahals, Bombay.

Acacia Leucophloea.—This tree is generally found in Central and South India. It yields a gum which is usually as white as the true gum arabic. It was exhibited at the Colonial and Indian Exhibition and was described by Dr. Fre as "gum bassora." The sample examined came from Saltara, Bombay. It consisted of light brown irregular masses with a slight marked taste and a peculiar aromatic odour. It dissolved entirely in water to a light brown liquid, and gave a fairly adhesive mucilage. In this respect therefore our sample differed from the sample described by Dr. Fre, but it contained a certain amount of metarabin arabin, as it gave a gelatinous precipitate with ferric chloride. Normal soda darkened the solution faintly. It yielded a white ash, gave a very viscous solution, and contained 14.65 per cent. of moisture.

Acacia Modesta.—This tree yields beautiful, clear, transparent lumps of reddish gum. I learn that it is largely used by calico printers in India. The sample examined came from the Punjab. It had an aromatic odour, dissolved completely to a pale yellow liquid, and gave a fairly adhesive mucilage. It turned yellow with normal soda, became solid on the addition of ferric chloride, and gave a thick white precipitate on the addition of alcohol. Basic acetate of lead also gave a thick white precipitate with the mucilage, and the contents of the tube became a solid mass. The sample had a fairly low ash, 2.91, contained 16.70 of moisture, and yielded a solution of medium viscosity. These were the only true acacias of which samples were sent, but in addition there are other gums

yielding trees, of which several samples were submitted, of which the following is a short account:—

Albizia Amara.—This tree is found in South India and yields a red coloured gum very much like the best kind of Indian acacia gums. The sample examined came from Cernbatorea, North Madras. It had a fragrant smell, was entirely soluble in water yielding a yellowish brown liquid, and was a very good adhesive gum. The liquid became thick on standing with ferric chloride, turns bright yellow when warmed with normal soda, and gave a slight precipitate with stannous chloride. The viscosity of the solution was high, being 19.28 times that of water. It contained 11.22 per cent. of moisture, 3.20 per cent. of ash, and had a very small percentage of nitrogen.

Anogeissus latifolia.—This tree is found all over India, and yields very large quantities of gum, which is also extensively used in calico printing. It is whiter than most acacia gums, but seems to possess far less adhesive power. The samples examined came from Secunderabad, near Hyderabad, and occurred in large spherical nodules. These lumps swell up to a great amount on the addition of water, consisting almost entirely of metarabin, very little liquid being strained off. It is useless as an adhesive gum. Mercuric chloride gave a white precipitate; with borax the solution became thicker. Ferric chloride darkened the liquid, showing the presence of tannin. It turned yellow with normal soda, and gave a thick white precipitate with alcohol. The gum yielded a very small ash, 1.28. The solution was very feebly viscous, viscosity Z equal to 320. It was certainly the poorest of any of the gums examined.

Banhinia retusa.—This gum is obtained from the North-West Provinces and Oudh. It resembles Indian gum acacia in colour and is soluble in water to a light-brown liquid. The sample sent was in too small a quantity for many experiments. It yielded 3.28 per cent. ash and 10.49 per cent. moisture.

Banhinia variegata.—This gum resembles the former, but the sample examined from Garhwal seemed to be a mixture, as amongst the dark brown masses were lighter coloured particles. It dissolved, however, entirely in water, forming a reddish-brown liquid. It had a slight aromatic smell, turned brown with the addition of normal soda, gave a thick flesh-colour precipitate with basic lead acetate, and turned solid on the addition of ferric chloride. Alcohol also threw down a thick flesh-colour precipitate. It yielded a solution which was of very poor viscosity, and is useless as an adhesive gum. It had a low ash, 2.51 per cent., and contained 13.63 per cent. of moisture.

Buchanania latifolia.—This is described as a clear resinous gum, but it resembles the true gum acacia in appearance, being nodular and covered over with fissures. It dissolves readily in water, forming a pale yellow liquid, but this solution is only very slightly adhesive. It has a sweet taste, a faint aromatic smell, and gives, with ferric chloride, a dark brown jelly immediately; basic lead acetate gives a thick white precipitate; mercuric chloride converts it into a jelly, and it turns bright yellow on warming with normal soda. It yielded 4.65 per cent. ash, which contained a trace of iron, contained not less than 20.73 per cent. moisture, and had a viscosity value Z equal to 0.694. The sample came from Betut, Central Provinces.

Odina Wadler.—This tree yields a large quantity of gum during the rainy season. This is white when it hangs on the tree, but becomes dark when it falls on the ground. The gum is not much valued in India, but is sometimes used in calico printing. A sample from Secunderabad, near Hyderabad, was examined. It occurred in dark brown lumps, had undergone slight fermentation, having a sour taste and smell. It partly dissolved in water, the remainder swelling up. With ferric chloride it gelatinised at once. It turned very dark on warming with normal soda; gave a thick white precipitate with basic lead acetate, and borax thickened the mucilage. It contained 18.09 moisture, and 3.52 ash. The solution was of very feeble viscosity.

Terminalia Tomentosa.—Our sample of gum of this tree also came from Secunderabad. The tree is stated to yield gum only in small quantities. The specimen examined was

very pale yellow in colour, the lumps being very glossy and transparent. Although in appearance so good, it only partly dissolved in water. The soluble portion formed a fairly adhesive mucilage, but it gelatinised and darkened in colour on the addition of ferric chloride. It was thickened

with borax, and turned pale yellow on warming with normal soda. This gum was further characterised by an exceptionally low ash, 0.66 per cent. Its solution was of very feeble viscosity, and the solid had a high specific gravity 1.904.

TABLE I.

	Moisture.	Ash.	Viscosity.		Specific Gravity.		Nitrogen.
			η .	z.	10 per Cent. Solution.	Of Solid.	
<i>Acacia leucophloea</i>	14.65	4.12	0.1371	1.106	1.020	1.599	0.054
<i>Acacia catechu</i>	15.22	2.14	0.0424	3.42	1.017	1.713	0.065
<i>Acacia ferruginea</i>	17.09	3.22	0.1132	913	1.017	1.622	0.082
<i>Acacia farnesiana</i>	15.45	2.08	0.1325	1.071	..	1.623	0.061
<i>Acacia modesta</i>	16.70	2.91	0.09006	726	..	1.611	0.053
<i>Acacia arabica</i>	16.38	1.46	0.11470	1.167	1.004	1.623	0.031
<i>Acacia ?</i>	21.29	1.88	0.3039	2.451	1.017	1.636	0.035
<i>Albizzia amara</i>	11.22	3.26	0.2397	1.328	1.017	1.794	0.036
<i>Anogeissus latifolia</i>	12.40	1.28	0.0397	320	1.002	1.696	0.039
<i>Bauhinia retusa</i>	10.13	3.28	..	..	1.015	1.759	0.038
<i>Bauhinia variegata</i>	13.63	2.51	0.06947	560	1.019	1.696	0.055
<i>Olinia wadiei</i>	18.09	3.52	0.04415	356	1.013	..	0.054
<i>Terminalia tomentosa</i>	17.59	0.66	0.03510	525	1.017	1.904	0.039
<i>Buchanania latifolia</i>	20.73	4.65	0.0849	694	1.018	1.640	0.039

TABLE II.

Gum.	Colour.	Taste.	Smell.	Solubility.	Adhesiveness.
<i>Acacia leucophloea</i>	Light brown, irregular	Marked	Peculiar odour	Entirely soluble to light brown liquid.	Fair.
<i>Acacia catechu</i>	Light brown, translucent, angular.	Slightly sour	Sour	Partly soluble to colourless liquid.	Very slight.
<i>Acacia ferruginea</i>	Brown, granular, containing bark.	Nil	Faintly sour	Entirely soluble to brown liquid.	Fair.
<i>Acacia farnesiana</i>	Brown, irregular, not all the same colour.	Slightly sweet	Nil	Entirely soluble to brown liquid.	Very slight.
<i>Acacia modesta</i>	Light brown, irregular	Nil	Peculiar odour	Dissolves completely to yellow liquid.	Fair.
<i>Acacia arabica</i>	Very hard light brown, irregular.	Nil	Slight mouldy smell.	Swells up to pale brown jelly.	....
<i>Acacia ?</i>	Brown, irregular	Nil	Very faint odour.	Partly soluble to light brown liquid.	Slight.
<i>Albizzia amara</i>	Light brown	Nil	Sweet odour	Entirely soluble to yellowish brown liquid.	Very good.
<i>Anogeissus latifolia</i>	Light brown, partly spherical.	Nil	Nil	Swells up to grey mass. Little liquid strained off.	Useless.
<i>Bauhinia variegata</i>	Dark brown, containing lighter particles.	Nil	Very faint	Entirely dissolves to reddish-brown liquid.	....
<i>Buchanania latifolia</i>	Yellowish brown; bark adhering to it.	Sweet	Faint	Entirely soluble to pale yellow liquid.	Slight.
<i>Olinia wadiei</i>	Dark brown	Sour	Sour	Partly dissolves.	....
<i>Terminalia tomentosa</i>	Translucent yellow	Nil	Smell like leather.	Partly dissolves; soluble portion pale yellow.	Fair.

The more important physical and chemical properties of the gums examined are tabulated above, but, in addition, the following summary of the behaviour of a 10 per cent. solution of the gums towards the following reagents may be of interest:—

1. When warmed with an equal bulk of normal soda, *A. farnesiana* and *A. arabica* did not darken in colour;

A. modesta, *Albizzia amara*, *Anogeissus latifolia*, *Buchanania variegata*, and *Terminalia tomentosa* turned yellow; whilst the other gums darkened considerably.

2. A saturated solution of borax only appreciably thickened the mucilages from *Anogeissus latifolia*, *Buchanania latifolia*, *Olinia wadiei*, *Terminalia tomentosa*.

3. Mercuric chloride gelatinised the mucilage from *Buchanania latifolia*, and gave precipitates with *Anogeissus latifolia* and *Terminalia tomentosa*.

4. Stannous chloride gave no reaction with the solutions of *Acacia leucophloea*, *A. ferruginea*, *A. farnesiana*, *Buchanania latifolia*, and *Odinia wadiei*.

Ammonium oxalate, basic lead acetate, and alcohol gave precipitates more or less copious with all the samples examined, and, as already mentioned, ferric chloride gelatinised many of the acacia gums as well as those obtained from other trees.

Traces of phosphoric acid were found in the ashes of all the samples with the exception of *Acacia catechu*, *A. leucophloea*, *A. modesta*, and *Bauhinia variegata*, and, although material was insufficient for an estimation, it was apparently present in fair quantity in the ashes of *Acacia ferruginea*, *Bauhinia retusa*, and *Terminalia tomentosa*.

It will further be noticed that nitrogen was found in all the gums examined, varying in amount from 0.031 to 0.082 per cent.

From this investigation it will be seen that the Indian gums vary very considerably in character, and as this examination is by no means exhaustive, I hope that further attention will be directed to the subject. Statistics are wanted as to the best localities for the growth of these different trees, and also the climatic conditions which occur in those districts. No doubt the geological structure of the country also materially influences the quality of the gum yielded by the tree; and if this paper will lead to the work being carried on in India, there can be no doubt that we shall eventually obtain from that country gums of known value and suitable for many industrial purposes.

DISCUSSION.

MR. PETER MACEWAN said that the mistake made by those who had taken up the question of gum arabic and its substitutes was that they had not persevered with the subject. He was pleased to notice that Dr. Rideal persevered, and there was need for that as the various gums known as gum arabic differed very much, and not only did the gums from different countries differ, but those from one country varied considerably according to the nature of the season. He trusted, therefore, that Dr. Rideal would still continue his research.

MR. WATSON SMITH said that he had examined the waste liquors of the sulphite cellulose process for preparing wood pulp, and had found a considerable amount of gums of very adhesive nature. On evaporating these liquors, the same sickly and disagreeable odour was developed that was characteristic of the vapours proceeding from the works when the contents of the digesters were discharged. So long as water remained and the gum existed in solution, the smell remained. On evaporating to dryness the gum possessed no smell, but on re-dissolving in water the solution smelt as disagreeably as ever. So far, any method he had found efficacious in destroying the odour also seriously interfered with the gums.

DR. RIDEAL, replying to Mr. Watson Smith, said that he would be very glad if he would send him a sample of the substance referred to. He agreed with Mr. MacEwan's remarks.

Liverpool Section.

UNIVERSITY COLLEGE, BROWNLOW STREET.

Chairman: H. Brunner.

Vice-Chairman: A. Norman Tate.

Committee:

E. Carey.	A. H. Knight.
V. C. Driffield.	D. McKechnie.
F. Gossage.	E. K. Muspratt.
W. D. Herman.	Henry Tate.
C. L. Higgins.	A. Watt.
F. Hurter.	

Hon. Treasurer: W. P. Thompson.

Hon. Local Secretary:

Dr. Chas. A. Kohn, University College, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies, and will take office in July next:—Vice-Chairman: E. Carey. Committee: J. Campbell Brown, Jos. C. Gamble, G. Schack-Sommer, and A. Norman Tate.

Meeting held Wednesday, 2nd March, 1892.

MR. A. NORMAN TATE IN THE CHAIR.

ON AGRICULTURAL FERTILISERS AND FEEDING STUFFS AND THE BILL NOW BEFORE PARLIAMENT TO AMEND THE LAW WITH RESPECT TO THEIR SALE.

BY DR. GUSTAF SCHACK-SOMMER.

ON previous occasions I have had the honour of appearing before you as an advocate of the cultivation of beetroot in England and Ireland for the purpose of sugar manufacture, as that industry is conducted on the Continent, and more especially in Germany and France. The subject which I wish to bring before you to-night may be regarded as somewhat remotely connected with that of beetroot cultivation, it relates to fertilisers and animal food stuffs. You are no doubt aware that a Bill was introduced by Mr. Chaplin into the House of Commons last July in his new office as Minister of Agriculture, to regulate the trade in these articles. The Bill runs much upon the same lines as the Food and Drugs Act, and, as it is virtually an extension of this Act which relates to the adulteration of food, and is an attempt to prevent the adulteration of fertilisers and feeding stuffs prepared upon chemical principles, I think the subject should have a strong claim upon the attention of societies such as this. Manufacturers (and more especially those whose business is conducted on scientific principles) should be afforded an opportunity not only of criticising the proposals of the Legislature, but when advisable, of bringing pressure to bear with a view to their amendment. Under these circumstances it is clearly our duty, in the best interests of the community, to make our weight as a society felt, by offering such suggestions as those I have the honour of submitting to-night, and which I hope may be speedily supplemented by others coming from those who possess more extensive scientific knowledge and larger practical experience.

Before proceeding further it may be well to recite the provisions of the Fertilisers and Feeding Stuffs Bill, and of course I shall not trouble you with its legal phraseology but merely with a brief *résumé* of its clauses.

Taking these in their order we find a penalty of 20*l.* is imposed for the first offence and 50*l.* for each subsequent offence, when a conviction is obtained for selling adulterated fertilisers and food stuffs for cattle; but that the seller shall not be liable if the article purchased was not used for the purpose for which it was sold: yet that it shall be no defence to allege that the purchaser, having bought only for analysis, was not prejudiced by the sale; that an invoice must be given to each purchaser specifying the nature and quality of the article sold, and in the case of a compound article its material ingredients with the percentage or approximate percentage of each; that any material inaccuracy in the description in the invoice shall render the vendor liable to the before-mentioned penalties; that a seller shall not be liable if he can prove that he sold the article as he received it; that a seller who can prove this, but who is convicted, shall be able to recover the fine with all costs and damages either from the manufacturer or from the dealer from whom the article was purchased in the first instance; and, that the Board of Agriculture may appoint a chief analyst.

In this Bill I may remark that I do not find any provision for punishing a dealer who sells feeding stuffs which, through decomposition or because of their composition, or for any other reason, may be unfit for the purpose for which they were sold. The Bill, too, should be so amended as not to unnecessarily harass manufacturers in the business, or place obstacles in the way of honest dealing in such articles. Take, as an example, the case of a manufacturer who, having discovered a by-product which contains one or more of the four principal fertilisers, mixes this by-product with other substances containing the other necessary fertilisers. Why should he be compelled to divulge the secret of his manufacture by describing it on an invoice as proposed in the Bill? In my opinion all that is necessary is a guarantee that the article sold contains certain proportions of nitrogen, phosphoric acid, potassium and lime. In the case of feeding stuffs a very large trade is done in mixtures, and as long as those are guaranteed to contain stated proportions of good, sound, digestible food, including protein, fat, sugar, and non-nitrogenous extractable matter, there is clearly no necessity to require the secrets of manufacture to be published in an invoice for the benefit of trade rivals. What is of great importance is, that farmers should be taught clearly the elementary chemical principles underlying the successful preparation both of manures and feeding stuffs, so that they may be able to select the best goods for their purpose. This, of course, means technical education for farmers, and when it is achieved there will be less necessity for special legislation for their protection.

Glancing at other countries we find that while France and Belgium have special laws affecting this subject, a different state of things prevails in Germany and Austria. The Governments of the latter countries, after going fully into the question, have arrived at the conclusion that by private arrangement between manufacturers, dealers, and purchasers, they are able to protect one another, and this has resulted in the establishment of a set of rules which have to be adhered to by the members of such an association, consisting of the manufacturers, dealers, and buyers of feeding stuffs and fertilisers. These rules all aim at one object, and that is the protection of the small buyer. Buyers on a large scale are astute enough not to begrudge the small fee for testing the goods they buy, and so assuring themselves that they get full value for their money. The small buyer on the other hand has to be protected partly from want of technical instruction, for it may be presumed he rarely knows of agricultural testing stations and laboratories, or if he does he distrusts them, and partly perhaps from finding that however small the fee, it increases the price of his purchase, and for this purpose the following rules were established. They state that the article must be sold in its original bag or package with the following information written or printed legibly upon it:—

- 1st. The maker's name or that of the factory.
- 2nd. The article it contains, and whether in powder, granular, or in lumps.
- 3rd. What ingredients are guaranteed.

A dealer who had bought a one hundredweight bag could not repack it into two half-hundredweight bags, but in the case of a demand for the latter would have to get the smaller size from the manufacturer. The advantages of these rules are so obvious that I must apologise for dwelling on them. Any honest manufacturer or dealer will court being checked by an agricultural chemist, and will most likely contribute to laboratories which not only guard the purchaser, but at the same time the interest and reputation of the manufacturer.

As far as this country is concerned I think it is safe to assume that if adulteration takes place it will arise through a system of fraudulent repacking by greedy middlemen, a species of cheating, which the rules I have mentioned make impossible on the Continent. In such a case, should a dishonest dealer imitate the bag or package of a manufacturer, or re-pack and adulterate the contents, he would run the risk of being found out, and of course, on conviction, could be punished by the law as it now stands. What we want, in fact, is not an alteration of the English law but the introduction of the German and Austrian rules of sale. The weak point in the situation, as far as the chance of the adulterating middleman being found out is concerned, lies in the absence of testing stations and laboratories in connexion with the various agricultural societies, as well as of travelling teachers to give the farmers the technical instruction which they stand so much in need of. An ideal system, if I may mention such a thing *en passant*, to a practical society, would be for the agricultural societies of each district to form themselves into co-operative associations for the purpose of buying feeding stuffs and fertilisers in large quantities, and distributing them amongst their members, and retaining a chemist well versed in botany, and employing teachers to travel in the district to impart instruction. I have been told that such a combination has just been formed in Yorkshire, and the Agricultural and Horticultural Association, Limited, in London, generally called the "One and All," have done much useful work in that direction for some time past.

Even on the Continent, with their rules of sale, and their chemical testing stations and laboratories, they have not by any means attained perfection, for Professor Maercker and others have expressed an opinion that the agricultural laboratories in organisation and methods of analysis are not yet sufficiently advanced, especially in the matter of determining the purity of articles. That being the case on the Continent, matters are of necessity very much worse in this country, where, to the best of my knowledge there are only two agricultural testing stations and laboratories, viz., one at Rothamstead and one at Aberdeen; perhaps this may seem a small matter to those who believe that it is easy for the purchaser of food stuffs to ascertain that they contain a guaranteed amount of fat, or nitrogenous substance, and in the case of fertilisers to obtain satisfactory guarantees of the presence of a certain preparation of nitrogen, phosphoric acid, or potash. The difficulty is, however, for the purchaser to protect himself against such articles as contain injurious matters in addition to other innocuous materials which may have been purposely added, or occur accidentally through careless manufacture, or by using unsuitable or inferior raw material.

With the help of such trade rules as I have already told you are in force in Germany and Austria, there would be little necessity for legislation of any sort to prevent adulteration. Agricultural societies and their journals should constantly bring such regulations under the notice of farmers, and warn them against buying fertilisers which were not delivered in accordance with such regulations.

What these regulations are you will perhaps allow me to describe a little more in detail, and I hope in doing so as briefly as possible I shall not try your patience. The bags containing the fertiliser must be branded with—

1. The name of the factory where the fertiliser was made.
2. The commercial name of the article; and
3. The percentage of each important constituent.

The bags should contain even weights, say 56 lb., 1 cwt., or 2 cwt.

I have prepared a table showing what constituents should be guaranteed in fertilisers. *Phosphoric Acid soluble in*

water in superphosphates, Thomas slag; precipitates, bone ash, Baker guano.

N.B.—If these manures are valued and paid for according to their contents of soluble and insoluble phosphoric acid, then, of course, the percentage of both will have to be given.

Phosphoric acid soluble in water and all the nitrogen (N) should be stated in bone meal, fish guano, flesh meal, Peruvian guano, and ammoniacal and nitrogenous superphosphates, horns and other residue of tanneries.

Nitrogen (N) in blood meal, germ meal, nitrate, &c.

Potash (K_2O) in kainite and other potassium salts.

When samples are drawn they must be taken by the buyer or his representative, if possible in the presence of the seller or sender, or his representative, on the quay, or at the station, within two days of arrival at destination.

It would be very desirable if we could formulate on similar lines conditions for the sale of *feeding stuffs*, but unfortunately it is not so easy as in the case of fertilisers, for there are many more factors to reckon with. In feeding stuffs we could not remain content with a declaration that they contained a certain proportion of protein, fat, sugar, and extractable non-nitrogenous matter, for it is essential to know how much of the protein is digestible. What is also important to learn is not only whether it is unadulterated in the general sense of the term, but whether the food is clean and wholesome. The introduction of an obligatory guarantee as to contents and quality is of the highest importance both to agriculturists and manufacturers. A certain reasonable minimum figure should be fixed for the percentage of fat separately for the various feeding stuffs and the same for protein. In a letter which I received from Professor Dr. Maereker this morning, he communicates the fact to me that at a recent meeting in Berlin the representatives of the German Agricultural Boards and of the experimental stations have come to an agreement with the dealers in feeding stuffs to give a separate guarantee for both "*fat*" and "*proteine*" in future. And none below this percentage ought to be allowed to be sold. Oilcake, for instance, varies from 10 to 20 per cent. in fatty matter, according to the amount of pressure used in the manufacture, and as the fat is not only valuable itself but further aids the animal in digesting the other ingredients, it is really the most important element to be taken into account when estimating the value of a feeding stuff. A higher percentage of fat therefore might be paid for on a sliding scale, on the system which has proved so successful in the sugar industry. Let me here point out that the agricultural experimental stations and laboratories in Germany and Austria allow a latitude of one and a half per cent. for protein tests, and of one half per cent. for fat tests, as a margin for errors in testing. It would be difficult to formulate the exact extent to which a guarantee could be given as to the good and healthy condition of a feeding stuff and its freedom from foreign, injurious, valueless, or indifferent ingredients, but each invoice should include the guarantee upon which the article was sold. These guarantees, however, are not all-sufficient. The farmer should have such technical knowledge as would enable him to choose the best feeding stuffs and fertilisers for his particular purpose; yet how many farmers possess this necessary knowledge? It may therefore possibly be useful if, with your permission, I submit a few observations with regard to the most important cattle fodders, and the nature of the most frequent adulterations.

Artificial feeding stuffs include bran, feeding meals and cakes, by-products from distilleries and breweries, and last but not least those also of beetroot sugar factories.

Bran is very nutritious in consequence of being inseparable from the harder outer part of the real grain which contains much gluten. Its feeding properties are protein, of which wheat bran may contain up to 14 per cent., and fat, 4.9 per cent. The woody fibre, which is the valueless portion, is in the best kind of wheat bran only about 5.5 per cent., whereas in buckwheat bran, with 10 per cent. protein and 2 per cent. fat, the woody fibre is 38.2 per cent., and pea-kin bran with 8 per cent. protein and 25 per cent. fat, the woody fibre is 43.7 per cent. If the

bran has not been properly stored it gets mouldy, and this can be detected by the microscope which shows the fungi, as well as by the disagreeable odour. In that condition, of course, it is unfit for feeding purposes, but this is more easily guarded against than the danger arising from the addition of such weed seeds as are absolutely and actively injurious. Among these are ergot (*sclerotium clavus*), corn cockle (*agrostemma githago*), darnel or bearded ryegrass (*lolium temulentum*). Moreover sand, slate, gypsum, husks of oats, rice and other grains, and sometimes as much as 10 per cent. of water is added to increase the weight.

Of feeding meals the best known perhaps is rice meal, which ought to contain about 11.5 per cent. fat, and 46.1 per cent. soluble non-nitrogenous contents. This is often adulterated with its own or other husks, as for instance pea-skins which are absolutely without any nutritious value; also with chalk up to 22 per cent., with sand and gypsum up to 20 per cent., and from 15 per cent. to 20 per cent. of sulphate of barium. Linseed, cotton-seed, and other meals are simply ground cakes after the oil has been extracted from the respective seeds. Linseed meal is often adulterated with the seeds of gold of pleasure, cabbage, rye meal, and groundnut meal, clover seed, clover-seed chaff, coffee kernels, mustard seeds, and sand and soil up to a total of 48 per cent. It is also adulterated with the seed of plantain, dodder, garlic, mustard, and castor, any of which give the cattle colic, with the result that not infrequently they die. Meat feeding meal is a good and nonriching feeding stuff, containing 11.14 per cent. of fat, and is mostly made in Fray Bentos by Liebig's Extract of Meat Company. It has happened before now that stuff sold as this, or as a similar article, contained no meat substance whatever, but turned out to be a mixture of rubbish from tanneries such as glove and calf leather, with bran and about 5 per cent. of alum. Oilcakes are of the highest feeding value, and contain a large amount of protein, in the groundnut cakes as much as 42.8 per cent., and a varying quantity of fat according to the greater or less pressure used in extracting the oils. These oilcakes are sometimes mixed with sand, stones, and other rubbish to make weight, but this does not happen so often as does adulteration with less valuable and sometimes really harmful products. For instance, so-called German rape cake is very often made almost entirely of the unwholesome garlic mustard seed, which for that purpose is specially imported from Russia. Groundnut cake is adulterated with castor-oil seed, castor-oil seed chaff, and castor oil, and at other times with poppy-seed cake, which has not half the value of groundnut cake. Some East Indian rape cakes are full of myronates, which when brought in contact with water turn into mustard oil, which may do the cattle harm, and therefore it is obviously necessary to know where the cake comes from. Groundnut cake, when adulterated with poppy-seed cake, has a tendency to go musty, and the opium in the latter is very bad and dangerous for the cattle, while the milk of cows fed with this stuff cannot fail to be injurious to young children. Cakes which have been badly stored sometimes get heated, and this causes the protein to decompose, with the alarming result that the food may not only make the cattle ill, but actually kill them. These cakes have frequently been ground up and mixed with good meal, and then sold for feeding purposes. Such a case of fraud, the consequences of which cannot be estimated or foreseen, is one of the worst that has come to my knowledge, and is, as you will see, a very difficult one to detect and punish. Oilcakes of all kinds are often adulterated with the husks of cereals, which are themselves absolutely without feeding value, and merely load the stomachs of the animals unnecessarily. Then, again, dried grains from breweries and distilleries, malt-sprouts and molasses, and dried beetroot slices, which should, according to Dr. Maereker's table, contain protein from 6 per cent. to 33 per cent. and fat up to 23 per cent., are, however, often adulterated to increase their weight with sand, tale, lime, oxide of iron, and manganese. The weed seeds gathered in the cockle machine, which cleans the grain before it is ground into flour, are sold for the purpose of adulterating feeding stuffs, and these are distinctly injurious and poisonous. They are henbane, spurge, crow's-foot, yellow rattle, ergot, &c., comprising altogether about 72 different varieties.

Kind of the Feeding Stuff.	Protein.	Fat.	Non-nitrogenous Extract Compounds.	Total of Feeding Value Units.	Price.	
					Per Cwt.	Cost per Feeding Unit.
Rapeseed cake.....	32'00	9'20	28'40	143'00	s. d. 6 0	d. 0'55
Groundnut cake	46'60	7'30	25'10	180'00	7 0	0'47
Cotton-seed meal.....	45'30	13'00	20'70	183'00	7 0	0'47
Poppy-seed cake.....	35'50	8'60	20'20	114'00	5 6	0'45
Palm kernels cake	16'50	8'10	36'40	102'00	5 9	0'67
Cocconut cake.....	20'10	11'90	37'40	122'00	7 3	0'71
Sesame cake.....	37'60	13'00	22'40	161'00	6 6	0'48
Rice feeding meal	11'50	11'50	46'10	104'00	5 6	0'68
Malt-sprouts	23'40	2'00	42'30	117'00	5 0	0'51
Dried brewers' grains	20'70	5'90	40'40	114'00	5 6	0'57
Wheat bran	13'70	2'90	57'20	104'00	6 6	0'75
Rye bran.....	15'40	3'50	58'70	112'00	7 6	0'80
Dried distillers' grains, f.....	26'00	8'00	41'00	138'00	6 0	0'52
Dried distillers' grains, ff.....	33'00	23'00	22'00	167'00	7 0	0'50
Dried beetroot slices from which the sugar was extracted.	6'55	..	56'70	76'40	3 0	0'47
Molasses	6'00	..	66'00	84'00	2 6	0'36

The necessity for microscopical and bacteriological examination of feeding stuffs is of the very greatest importance. As a rule one may form an opinion of the purity or otherwise of a feeding stuff from the appearance of the textures or elements of textures, and it is therefore almost indispensable that chemists should make themselves sufficiently acquainted with the use of the microscope so as to be able to examine and judge the feeding stuffs from a botanical point of view. There are three distinct microscopical methods in use, namely—(1) Witmack's paste method, (2) Bencke's flour proof method, and (3) Dr. Von Weinzierl's mechanical microscopical examination. Special directions as to how to proceed cannot be laid down, but every one must be left to choose his own way. Every sample, however, should first be examined on the outside for animal or vegetable parasites, or foreign admixtures, and if any are detected the sample ought to be put aside to be in due time further examined.

This brings us to the question as to when a feeding stuff may be considered to fall into one of three categories, namely—(1) impure, (2) adulterated, and (3) injurious. By the last-named, of course, I mean injurious to the animals, or to those who use the products, such as milk and butter. Under the first and second heads I would include adulterations which cannot be proved to be injurious, but which have a less nutritious value and are added to make the article cheaper, or for fraudulent reasons. It certainly should be punishable by law to offer as feeding stuffs articles which contain from 30 to 40 per cent. of materials which are not only absolutely valueless for nutrition, but overcharge the stomachs of the animals, and which, through continual use, would counteract the effect of or destroy altogether the gastric juice, and harden the organs of digestion. But before pursuing this question further, permit me to repeat that I fail to see what good would be done by revealing to the purchaser the secret of the manufacturer who combines valuable by-products, or material, either in the composition of fertilisers or feeding stuffs. What would the manufacturers of Pears' soap, who have kept their secret for more than a century, according to their advertisement, say; or what would the more modern "Sunlight" makers of a similar article, be likely to say to a proposal that every package should have legibly printed upon it every detail of the chemical and other ingredients? You see at once, of course, that such a suggestion is repugnant to common sense, and that the suggestion could

not be entertained for a moment as in the remotest degree approaching practicability. This does not apply, of course, to compounds containing simple elements, the proportions of which can and ought to be guaranteed to the purchaser. It only applies in the case of a manufacturer who has made his feeding stuff a specialty by careful and laborious research, and who certainly ought not to be called upon to proclaim the results from the bonetops for the benefit of less industrious rivals. In my opinion—which, of course, I give merely for what it is worth—it ought to be quite sufficient if, in the case of fertilisers, the percentage of nitrogen, potassium, lime, and phosphoric acid was published, and in the case of feeding stuffs that of protein and fat. This would enable the manufacturer who had his wits about him to mix such products as come, for instance from East India and Africa, where, for want of good machinery, the oil is not properly squeezed out of the seeds, or other raw material with their own oilcake and so make a mixture that would be of a better value to the farmer than it would be without this addition. That such mixtures are legitimate has lately been demonstrated in a very able and interesting paper by Professor Maereker, in which he specially dilates on the scientific way of putting such mixtures together so as to secure as much nutriment as is contained in bran, while, taking into account the high price of the latter at the present moment, they would not cost more than about half the price. I will give you here the gist of his calculations. The average figures of the nutritious contents have been taken from the analysis of the fodders during many years at the experimental agricultural station in Halle. To estimate the nutritious value, he adopted the figures of value of Professor König of Münster, who laid it down that the feeding value unit of non-nitrogenous compounds may be taken as one; that of fat as double, say two; and that of protein half as much again as fat, or say three; here, however, I must inform you that Professor Maereker writes me:—

"The relative value of protein to fat and non-nitrogenous substances is calculated by the united agricultural trial stations in Germany, according to the method of the smallest squares from the prices of the most important feeding stuffs, and this calculation is checked every year by the variations in prices." The last calculation made by Professor König gave the proportion as 3:2:1, but since then the nitrogenous fat-containing feeding stuffs have risen in cost so considerably that this proportion is no

longer correct—as Professor Maereker knows privately from Professor König—and in the next calculation, which will soon be published, the proportion will most likely be 3:3:1, so that as a matter of fact fat and protein have become of equal feeding cost. This would, of course, be altered as soon as the feeding stuffs which contain much fat fall in price. On the question of what part in the digestion is done by fat, Dr. Maereker says that for the preservation of heat, fat acts equal to its equivalent of heat, that is, 2.5 of the carbohydrates; but that as a nutritious substance in place of albumen it is only equal to 1.8 to 2 of the carbohydrates. The actual part which fat takes in the digestion has not been proved with certainty, but it is generally assumed that the action is both mechanical and dietetic, that is to say that the intestines work better when they are, as it were, lubricated or oiled. I doubt this, says the Professor, and believe that the feeding stuffs which are rich in fat are so highly valued because they always at the same time contain much protein. As far as the actual nutritious value is concerned the fat can be easily replaced by the equivalents of carbohydrates, though an exception ought of course to be made with fats that have a specially favourable influence on the fat of the milk, like that of the palm kernels.

Taking wheat bran at 6s. 6d. per cwt., he says that it contains 13.7 per cent. raw protein, which in the proportion of three to the whole makes 41.1 units, 2.9 per cent. of fat,

which at two makes 5.8 units, and 57.2 per cent. of non-nitrogenous substance which at one makes 57.2 units. Total 104, feeding value units, for which 6s. 6d. has been paid, and therefore one unit costs in wheat bran $\frac{3}{4}$ d. per feeding value unit. It is after this principle that the table (see preceding page) of the most important feeding stuffs has been put together by Dr. Morgan, and with the help of this table it is easy to find which feeding stuffs are, according to the prices of the day, the cheapest, and which it is best to select in order to make up not only the cheapest, but the most nutritious class of feeding stuff. A glance at the last column shows that wheat and rye bran are the most expensive among the fodders named. The question, therefore, of how to replace them by cheaper mixtures is obviously of the greatest importance.

From this table the actual money value of each unit of the feeding value, according to chemical analysis, can be easily seen. Another important point is, however, how much of the feeding value unit of protein is digestible. Sometimes two feeding stuffs of the same chemical composition will vary greatly in their nutritious value, as the total of the feeding value units in the one is more easily and more thoroughly digestible than in the other.

The following table will give a few figures as to the digestibility of the different kinds in the feeding stuffs, and these figures ought to be taken as the basis for calculating the rations of equal value:—

Kind of the Feeding Stuff.	Total of Digestible Feeding Value Units.	The Cost of One Digestible Feeding Value Unit is	Per Cent. Digestible Compounds.		
			Protein.	Fat.	Non-nitrogenous Soluble Matter.
Molasses.....	84.00	<i>d.</i> 0.36	6.0	..	66.0
Dried beetroot slices out of which sugar has been extracted.	73.80	0.48	5.6	..	57.0
Cotton-seed meal.....	168.50	0.49	42.0	11.4	19.7
Groundnut cake.....	170.70	0.49	44.5	6.3	24.6
Poppy-seed cake.....	129.90	0.58	31.9	8.0	18.2
Sesame cake.....	144.40	0.51	35.7	11.7	14.1
Dried distillers' grains, II. (60 per cent.).....	152.40	0.55	30.4	20.7	19.8
Dried distillers' grains, I. (35 per cent.).....	126.00	0.57	24.0	7.2	39.6
Rapeseed cake.....	111.50	0.64	28.4	7.3	21.7
Malt-sprouts.....	100.80	0.50	20.8	1.0	36.4
Hay at 3s. 6d. per cwt.	61.10	0.65	7.5	..	41.6
Clover hay at 1s. per cwt.	70.00	0.60	10.0	..	40.0
Rice feeding flour.....	96.30	0.68	10.0	10.1	46.1
Dried brewers' grain.....	91.40	0.72	18.1	5.0	27.1
Palm kernel cakes.....	89.20	0.77	13.2	7.7	34.2
Cocoanut cake.....	111.70	0.78	19.2	11.9	30.3
Wheat bran.....	80.50	0.96	10.1	2.2	45.8
Rye bran.....	92.70	0.97	13.5	2.6	47.0

From this table you will see that the braus are by far the most expensive feeding stuffs of all, for in the cotton-seed and groundnut meal a feeding value unit will only cost 0.49d., whereas in wheat and rye bran just twice as much has to be paid for it, that is, 0.96d. and 0.97d. respectively. Molasses and dried beetroot slices, the by products of the beetroot-sugar manufactory, also are much cheaper. This is one more reason—though I must plead guilty to having mentioned it in previous lectures here—to recommend the introduction of the beetroot-sugar industry in England, as it would enable the farmers to get their feeding stuffs in the form of molasses and beetroot slices so much cheaper. A feeding stuff having a nutritious value, both on account of its nitrogenous elements, as well as of those that are free from nitrogen, that is to say, a replacement of one nutritious element

by another of equal value, can, of course, only take place if the different nutritious contents, or compound elements, are in the same proportion to one another. This, however, is very seldom the case, and this is the reason why it is necessary to mix different stuffs, as, for instance, to mix a feeding stuff very rich in nitrogenous matter with a poorer one, and use that in place of a medium nitrogenous fodder. As an illustration I may say that it would not do to replace bran by cotton-seed or groundnut meal, as in these, to every one part of digestible nitrogenous, nutritious substance, there would be only 1.15 non-nitrogenous—that is fat—whereas in wheat bran the proportion is 1 to 1.508. It is, however, possible to make up for this, if to the mixture is added a substance that has a large proportion of non-nitrogenous nutritious matter in comparison with the

nitrogenous contents, as, for instance, rice meal (1:7·1), dried beetroot slices (1:10·2), and molasses (1:11·0). The two latter, which can be obtained in abundance in all beetroot-growing countries, are really some of the most useful and cheapest feeding stuffs, and cannot be too highly recommended to farmers for this purpose.

As to the dietetic influence of bran as one of the most esteemed fodders, I may say that a great many mixtures made up according to the principles already shown have been used with the very best results for years by the greatest cattle rearers on the Continent. Feeding with bran has only been adhered to in the rearing of young animals and with milch cows which are kept for young children.

May I venture to suggest in conclusion that it is evident that the question of feeding stuffs is to the British farmer of the greatest importance, for, in spite of the decrease in agricultural pursuits in this country, cattle and other domestic animals have increased in numbers as the following figures show :—

----	Horses.	Cattle.	Sheep.	Pigs.
1880.....	1,432,620	6,508,632	27,272,450	2,773,609
1891.....	1,488,403	6,852,821	28,732,558	2,888,773
Increase in 1891.	55,783	344,189	1,460,099	115,164

Now, if the rearing of cattle is one of the main sources of income for the farmer, nothing should be left undone that will tend to make that industry a thriving one. Moreover, domestic animals are dependent for their comfort and well-being on man, and it is the duty of all stock rearers to feed their beasts with good sound food, and treat them generally in the enlightened manner which science teaches and common sense dictates as being best for both man and beast. The Government, too, must do its duty and recognise the necessity for regulating the trade in feeding stuffs and fertilisers, and stamping out deleterious compounds and the fraudulent manufacturer of them. The Bill which Mr. Chaplin is going to submit for investigation to a departmental committee will not, I fear, do this. It will harass the makers of feeding stuffs and the manufacturer of manures without benefiting the farmer.

First and foremost, efficient agricultural trial stations and laboratories should be established, scientific farming and feeding should be encouraged by every known means. Farmers should be shown the kinds of food which should be given. They should be taught how to mix the different feeding stuffs so as to provide each animal with the substances best suited to its special requirements of befitting its special work, while the supervision of the feeding should be his constant care.

Finally, if the farmer is to do his duty, he must learn first and foremost the rudiments and principles of scientific feeding, gain an intelligent appreciation of the value of the different feeding stuffs and of what special use the principal well-defined chemical substances are, and then he will be soon able to invest his money for fodder to the very best advantage, and by that time he will require no embourgeois law to protect him from being swindled in his purchases of feeding stuffs and fertilisers.

DISCUSSION.

Mr. TATE said that legislation was required, as there was no doubt that at the present time a great deal of rubbish was sold both for manure and cattle food purposes.

The Bill as it at present stood required very considerable amendment, its provisions being very loose and indefinite. He thought it was unnecessary and undesirable to state definitely of what any particular manure was made up, but the nature and percentage of the constituents considered of special manurial value should be distinctly mentioned. A similar course could be followed with cattle foods, although with these it was desirable to state more definitely the substances from which they were produced, as a feeding

cake for example, made from one kind of seed or substance might have a very different value to another on account of relative conditions for assimilation, although the actual proportions of fat, nitrogenous constituents, &c. were the same. As Dr. Schack-Sommer had well pointed out, not only was it desirable to note the chemical constituents of foods, but also other characteristics, as for instance, their texture, which might be sufficiently coarse or rough and indigestible to do mischief by mechanical irritation in the intestines of animals.

Microscopical examination certainly should supplement the chemical in nearly all cases of cattle food, so as to obtain a clearer insight into the nature of the constituents present. One point Dr. Schack-Sommer had alluded to was of the highest importance, viz., that there should be a stipulation that no element of an injurious character should be present either in manure or food, especially in the latter, and here the provisions for the appointment of analysts in different centres would be useful. The appointment of trained analysts for special agricultural purposes would prove of great service to agriculture generally, providing farmers and others made use of their services. It was quite possible to so amend the present Bill as to make it a really useful measure; and Dr. Schack-Sommer had done good service in calling attention to it so that those interested could think over in what direction amendment might be possible.

Dr. LEATHER said he did not think that the majority of manufacturers practised adulteration, and certainly the larger portion of the materials sold as manures were not adulterated; but he did think at the same time that there were a number of smaller dealers who did habitually adulterate to a large extent. There was an admitted necessity for legislation, but in what way were they to legislate? One of the knottiest questions in the discussion of that measure would be as to the way the materials should be branded, if at all; whether the percentages of ingredients should be branded, or whether a statement should be given that the bags contained merely such and such materials. At first sight it did seem best that the bags should be branded, showing that they contained certain percentages of phosphoric acid, nitrogen, &c. It was not, however, so simple as that, because these ingredients—phosphoric acid, nitrogen, potash, &c. might be derived from different materials in which they were present in forms of varying assimilability. It was not sufficient to say that a manure contained, for instance, so much nitrogen; they must indicate also in what form that nitrogen was present, in order that the farmer might know what its worth was.

With compound manures, the only thing would be for manufacturers to brand percentages if they had to name them at all. Personally, he thought the best plan would be to use simple materials, and not buy compound manures. The quality of the materials of which food stuffs were made was of greater importance than the actual percentage of ingredients contained in them. Mr. Tate had pointed out the absolute necessity for those materials which were offered as food for stock being made of thoroughly sound substances, and he (Dr. Leather) objected there again to recommending farmers to use compound materials. It would be better if the farmer used simple materials and mixed them himself; most farmers possessed machines for crushing, &c.

The only way to make the Bill work at all would be to appoint, not merely chemists, but inspectors also, and that manures and food stuffs should be analysed and sampled by the county authorities whenever they thought fit, making it on a par with the Food and Drugs Act of to-day. If the Bill were passed in its present form and it were left to the farmer's own initiative to employ the chemist, he was persuaded that the provisions of the Bill would be practically inoperative.

Mr. SMETHAM said that Dr. Schack-Sommer had brought a severe indictment against manufacturers generally, and shown that all sorts of things were adulterated to a great extent. It was doubtless true that such adulteration did exist, but not to the extent that the lecturer would have them believe. As the result of considerable experience in analysing both feeding stuffs and manures, he maintained that so far as the large manufacturers were concerned, the

substances sent out were usually what they were represented to be, and of good quality, the adulteration and the misrepresentation being done chiefly by the smaller dealers, who bought a thing in one name and sold it as another, transacting their business usually with the more ignorant farmers over a pint of beer in the public-house. The Bill in its present form was quite unworkable. Manufacturers would never allow such a Bill to pass; manufacturers of food stuffs, such as calf meals, would never state in detail the whole of the constituents. To do so would do away with all enterprise, and many of the best men would leave business—that is if they were compelled to tell their secrets to every rival. Another difficulty in the Bill, which had already been pointed out, was that the working of the Act depended entirely on the voluntary sending of samples by the purchasers. Farmers generally would not take the trouble and pay for the analysis, and manufacturers would object to the district analyst and go to the chief analyst, and by so doing would place obstacles in the way of the successful working of the Act. The Bill in its present form was practically dead, and was to be referred to a Committee, when all points would be thoroughly thrashed out.

Mr. DAVIES pointed out that with regard to the general question, so far as food stuffs were concerned, it would not do for the manufacturer to be obliged to specify all the materials he employed, though it seemed quite practicable that the amount of fats, proteins, &c. should be stated, and that the manufacturers should give a guarantee that no injurious substances were used. Regarding manures, in his experience, manufacturers did supply the article that they claimed to do when analyses were given.

Dr. SCHACK-SOMMER, in reply, said that in his paper he had laid stress on the fact that large consumers would not object to send samples for analysis, but that the small farmers, if they knew of the existence of such a being as an analytical chemist, would shirk the expense of sending samples of their purchases to him, as even the smallest fee would increase the cost of the manures or feeding stuffs. He therefore thought that the advice of consulting chemists paid by Government or county councils should be at the disposal of the small farmers free of charge, as was done with regard to the Food and Drugs Act. Money expended in that way would repay itself a thousandfold. All through his paper he thought he had made it clear that he was particularly anxious to protect the small and generally less educated farmer, the man who really did not know what he ought to buy when he made his purchases of manures and feeding stuffs. He cited a case lately reported in the newspapers, where some unscrupulous person had sold to various farmers in the South at 5*l.* per ton refuse from tanneries for which the tanners hitherto had paid 10*s.* per load for getting rid of, and which had no fertilising value whatever. It should be made compulsory to send samples of all purchases for analysis.

Dr. Leather's point was, that it was more important that manures should have the names of the principal ingredients printed on the bags than the percentage of nitrogen, phosphoric acid, lime, and potassium. In nitrate of soda and sulphate of ammonia the nitrogen was undoubtedly at once available for absorption by the plants when put in the ground; whereas in leather and shoddy, with their small percentage of nitrogen, this was not the case, and he would therefore suggest that only soluble nitrogen should be the basis of the purchase. There should be no possibility that those who desired to buy a certain article, say for instance sulphate of ammonia, should get something else mixed with sulphate of ammonia.

Manchester Section.

Chairman: Ivan Levinstein.

Vice-Chairman: Edw. Schunck.

Committee:

J. Angell.
G. H. Bailey.
R. F. Carpenter.
G. E. Davis.
Harold B. Dixon.
H. Grimshaw.

J. Grossmann.
P. Hart.
A. Liebmann.
Sir H. E. Roscoe, M.P.
C. Truby.
D. Watson.

Hon. Local Secretary:

J. Carter Bell,

Bank House, The Cliff, Higher Broughton, Manchester.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next:—Committee: F. H. Bowman, J. M. Irving, and E. Kuecht.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Friday, 6th May 1892.

MR. I. LEVINSTEIN IN THE CHAIR.

TESTING THE ILLUMINATING POWER OF COAL-GAS.

BY GEORGE E. DAVIS, F.I.C., ETC.

A TRIAL of the illuminating power of coal-gas is not in any sense a chemical operation: it is a physical measurement of the result of the combustion of coal-gas in ordinary air measured against sperm candles burning at a specified rate.

It will be known to most of you that a Select Committee is now sitting, having for its object an inquiry into the subject of a standard for photometric purposes, the sperm candle for a long period not having been considered satisfactory. It will therefore be obvious to you that I could not enter into a discussion upon the matter of a standard light, but there are many other points open to consideration, contrasting the basis upon which physical tests are made with that upon which chemical examinations are founded. It may be taken for granted that if coal-gas was always of one and the same quality, there would be no need for a trial to be made of its illuminating power. But coal-gas is not a simple gas, it consists in a great measure of non-illuminating hydrogen and feebly illuminating marsh-gas made luminous by partial saturation with the vapours of benzol, toluol, crotonylene, and other hydrocarbons, the excess of which vapours are found in the tar which is condensed from the crude gas. The gases further do not come off from the coal in regular and even proportions, the composition of the gases given off during the first half of the period of carbonisation yielding greater luminosity than those given off during the latter half. In fact, towards the end of the charge, little else than pure hydrogen is given off, having very little, if any, luminosity when burned.

I am fully aware that the gas leaving the hydraulic main in a well-regulated gasworks is of fairly constant composition—its illuminating power will vary in different works, according to the length of time (and temperature) the gas is allowed to remain in contact with the tar, and this is brought about by the regular and alternate system of charging the retorts; but it is possible that a variation of quality from this source may have to be considered in the future, as it would be quite easy to arrange the charging so that that of 20-candle power could be collected from the anterior portion of the charge, and 10-candle gas from the posterior,

I do not suggest, however, that any irregularity occurs through charging the retorts, except in small and terribly mismanaged works.

The quantity of gas yielded by the ton of coal does, however, affect the illuminating power, as you may learn by studying the paper read before the London Section of this Society in 1884 by Mr. Lewis T. Wright, who was then manager of the gasworks at Nottingham. My own experience in this matter is not a small one. In the gasworks I was instrumental in establishing near Sheffield, it was my aim to secure a large quantity of illuminants, and as the result of many experiments, working the same quality of best fresh-wrought gas-coal, I obtained 9,060 cub. ft. of 18-candle gas to the ton, 10,100 ft. of 16-candle gas, and 11,400 cub. ft. of 14 candle gas to the ton of 20 cwt. In the first case the coke was too soft for sale, in the last case it was hard and saleable. The tendency is nowadays to run the production up to the highest possible limit, and without more benzol is volatilised from the tar than formerly, the result will be a debased gas.

There is another reason why coal-gas should have trials made of its illuminating properties. A process was introduced some years ago, better known perhaps as Hawkins' process, for introducing carburetted air into the gas before its entry into the oxide purifiers, in order to prevent the necessity of so frequently changing the contents. The oxygen of the air introduced acts upon the sulphuretted hydrogen in the presence of oxide of iron, forming water and free sulphur, while the nitrogen remains in the gas, diluting its illuminating power. Now the testing of the illuminating power of coal-gas is not such a simple process as the testing of butter for margarine or of milk for added water. Parliament in its wisdom has seen fit to prescribe that certain forms of apparatus shall be used for trying the illuminating power of coal-gas. I take it that the Legislature has only sought to ensure that reliable methods and apparatus should be used, so as to guarantee that the consumer gets what he pays for, for it is pretty obvious that the producers may as a rule be left to take care of themselves.

Part I. of the schedule of the Gas Works Clauses Act of 1871 specified that "the apparatus for testing the illuminating power of the gas shall consist of the improved form of Bunsen photometer known as Letheby's open 60-inch photometer or Evans' enclosed 100-inch photometer, together with a proper meter, minute clock, governor, pressure gauge, and balance." "The burner to be used for testing the gas shall be such as shall be prescribed." "The candles used for testing the gas shall be sperm candles of six to the pound, and two candles shall be used together."

Such are the regulations in respect of testing apparatus, but strange to say, though the Gas Acts are so stringent with respect to the testing of meters, there are at present no compulsory powers for the public testing of photometers. A photometer may be perfectly accurate when first purchased, but a disarrangement or displacement of the scale, the candle balance, or the standard burner, is quite enough to give the most fallacious results, and there is no compulsory provision for verifying these instruments.

The President of the Eastern Counties Gas Managers' Association, in an address delivered at Sleaford in March last, said: "I maintain that gas men have no business to bother about these developments of the illuminating power of gas. The people who buy and not the people who sell the gas should take this trouble." This is all very well, but as the cost of either of the instruments, duly fitted, prescribed by the Act of 1881, is about one hundred and twenty pounds sterling, it is not likely that many gas consumers will incur the expense.

It will thus be seen, as I have already stated, that the testing of coal-gas is placed on quite a different footing to such substances as butter, milk, &c. In the testing of these substances the Legislature does not step in and say what size filter shall be used, how the alcoholic potash shall be made, or the particular kind of gas-burner employed for heating the flask, and in the many prosecutions which take place on this matter, no counsel ever thinks of questioning the apparatus or methods employed by the expert whose testimony is to convict or acquit the defendant.

This is not the case with coal-gas, the suppliers can legally object to the use of any other apparatus than that specified, but this of course makes no difference whatever in the accuracy of the results. In fact, various details of photometry have been greatly perfected since 1871, and I doubt very much, if a Gas Works Clauses Amendment Act were passed to-morrow, whether the apparatus and methods would be the same as specified in the Act of 1871.

My own photometer was designed not only for the examination of ordinary coal-gas, but for the purpose of all-round uses, one of which was a thorough examination of the illuminating power yielded by the vapours of different hydrocarbons, and of which I hope to speak to you at some future time.

My photometer may be called a 60-inch enclosed "Evans," but it differs from the "Evans" in that the scale is divided into inches and tenths instead of being graduated for "candles." This makes a calculation necessary for each experiment, but as we have calculated a table for each possible position of the screen index, a simple inspection of it gives the candle-power direct. The apparatus is fitted with an experimental meter reading to the one-hundredth of a cubic foot; it is also fitted to burn either the prescribed pair of sperm candles, or a ten-candle Methven light prepared with great care for me by the well-known firm of W. Sugg and Co., the gas to be tested is burned in one of Sugg's London argands as prescribed.

We have now made nearly 1,000 tests with this apparatus, and I have thought that a summary of the results may be interesting to you. As the apparatus was fitted in our laboratory we had to be satisfied with the Salford gas supply, a photometer of this kind not being a very portable instrument. The reason a ten-candle standard was adopted was, first, because it is a very convenient standard having regard to the experiments in which I was engaged, and secondly, because the screen is thus brought nearer the centre of the graduated bar, thus ensuring greater accuracy than when a two-candle standard is employed, and thirdly, there will only be the same absolute error in adjusting a ten-candle standard as in making a two-candle standard, in which latter case the error, if any, is five times greater than with the ten-candle standard. This ten-candle standard was presumably made and standardised with London gas. When tested with Salford gas against sperm candles burning 120 grains of sperm per hour, it yielded a light of 9.94 candles; 30 separate tests were made to establish this, according to the directions given for testing gas by the Gas Referees. Of these 30 tests, five were rejected owing to the abnormal rate of consumption (being below 144 grains or over 126), while if the 10 nearest tests to 120 grains be taken the illuminating power comes out exactly ten candles.

When the testing was first established I was surprised at the low results, and having satisfied myself that the ten-candle standard was correct, absolutely, I carefully examined every point in detail without finding any error. The testing was continued in this manner for about three months, the average value coming out about 15.7 candles. The apparatus was then altered by the substitution of a pair of sperm candles for the ten-candle Methven standard and tests were made twice a day for upwards of three months. The average in this case came out 15.4 candles.

The nuisance of using candles in place of the Methven standard was so obvious in the foregoing experiments that candles were abandoned, and in continuing the experiments the Methven standard was alone employed, and further experience has shown me that it is far more reliable than the sperm candle, and much more convenient to use.

A few words as to the consumption of sperm in nearly a thousand tests may not be out of place, the consumption was most irregular, varying from 108 grs. on the one hand to 137 grs. on the other. The Gas Referees having prescribed that all tests in which less than 114 grs., or more than 126 grains are consumed should be discarded, and this has been done in all our tests; the proportion discarded has been 15 per cent. The tests retained, in which less than 118, or more than 122 grains were burnt, amounted to 55 per cent., while the test burning from 118—122 amounted to the remainder of 30 per cent. This is the boasted parliamentary standard, and to do it as much justice as possible,

I may say that the candles were from a recognised leading maker. It would be invidious to mention his name. My experience in photometry leads me to say most emphatically that the parliamentary "candle" is by no means a *standard* that analytical chemists would be satisfied with, it might suit gas engineers, but not a chemist with any idea of accuracy.

And this leads me to another point. Coal-gas is usually tested at the gasworks, which in my opinion is a most unjust provision of the law. Consumers do not burn the gas at the gasworks, and sometimes there is a great difference between tests made in the gasworks and tests made half a mile away. My own tests are cases in point. Taking the Salford supply to our laboratory, on July 2 last year by my photometer the gas tested (day supply) 13·4 candles; on November 16, 13·2 candles; December 5, 13·6 candles; December 22, 13·1 candles; December 23, 12·3 candles; and December 24, 12·5 candles. The two last tests were made during the very foggy Christmas week when gas was being burned all day long, and when the consumers were complaining to each other very generally that "the gas was very bad." A summary of the whole of my tests of our gas supply from July 1, 1891, to February 27, 1892, is as follows:—

Month.	Illuminating Power.	Grains of Sulphur per 100 Cubic Feet.	Carbonic Acid vols. per Cent.
July 1891	14·70	16·81	0·56
August 1891	14·31	11·60	1·22
September 1891 .	14·40	17·12	1·14
October 1891	15·20	20·01	1·13
November 1891 ..	15·46	21·92	1·05
December 1891 ..	14·72	21·88	0·98
January 1892 ...	15·00	19·07	1·12
February 1892 ..	14·75	19·86	1·07

Now, the results of these examinations do not agree with the tests made at the gasworks, why I do not pretend to explain, but I have convinced myself that the readings of my photometer are accurate; each point has been checked in every possible way, and there is practically no difference in the results obtained with either candles or the Methven standard, provided that all tests be rejected in which an abnormal combustion of sperma has taken place. Again, a 10-candle standard made in London tests exactly 10 candles upon my photometer though used with a different gas. But the Salford gas committee say that the tests made by them (in the works) averaged for 1891, 18·86 candles at one works, and 18·71 candles at another station. This is very poor consolation for those who have to burn the gas a mile away from the works, and I am of opinion that the subject is important enough for the city council to investigate over the heads of the gas committee.

The foregoing remarks bear upon gas-testing generally all over the country, and if this paper falls into the hands of our legislators I hope they will consider whether the time has not arrived when the testing station should be removed from the precincts of the producing works to some public office at a distance. Salford is a good instance: there are the town halls at Salford, Broughton, and Pendleton, each served by the Salford works, why should not a photometer be fitted up in each place, and the borough analyst deputed to make regular tests on each apparatus? Such a process would undoubtedly be more assuring to the consumer than the present system; if the results should turn out identical with those obtained at the works, those in charge of the works would not complain, while if the results differed the sooner the cause of it was discovered and remedied the better for all concerned.

One thing has struck me during these experiments, and that is the ease with which a special standard for each gas supply might be made and verified. It is simple, though somewhat tedious, to make a large number of tests with sperm candles, rejecting, say, all under 118 grains and all

over 122 grains consumption. A Methven screen could thus be cut with very great accuracy, and this could be made of the minimum power the works were allowed to supply. Such a standard should not be put into use before verification by the Standard Department of the Board of Trade, and reverification should be made compulsory every six or 12 months under heavy penalties for disobedience.

At present I am not aware that the verification of photometers is compulsory. I have already pointed out that serious differences have appeared between the results obtained with my photometer and that of the Salford gasworks; may they not be due to the employment of an unverified photometer at the gasworks.

The Gas Act is faulty in many respects, and now that I have given the results of my experience I hope the matter will be taken up, and the testing of coal-gas for its illuminating power be put on a proper basis.

DISCUSSION.

MR. CARTER BELL said he had made some experiments with Mr. Davis' photometer, and was bound to admit that the 10-candle standard as used by him and his method of graduation of the beam was an immense improvement on the ordinary method of testing coal-gas, and he believed far more accurate than the photometer mentioned in the Act of Parliament.

DR. GROSSMAN said that the difference in the illuminating power of gas, as shown by the photometer at the gasworks and by the time it reached the consumers, might be accounted for by the hydrocarbons deposited in the mains; but, in his opinion, the consumers had nothing to do with this, as gas companies and corporations should be compelled by their Act of Parliament to supply gas of a certain standard to all their consumers however far they might be situated from the works.

DR. DREYER thought that, as gas contained certain hydrocarbons which produced the illuminating power, it was a question whether it could not be more accurately tested by chemical analysis than by the ordinary means of photometry.

DR. CARL WEBER said he was afraid that the relation between the hydrocarbons and their illuminating powers was so complicated and exceedingly difficult of interpretation that the photometric test was the best test of the illuminating power of gas, and that chemical analysis was not admissible.

MR. STENHOUSE (of Rochdale) wished to know if Mr. Davis had noticed any considerable difference between tests made in the daytime and those made at night? It was quite possible that they had not been so particular in the daytime when the gas was not used for illuminating purposes. It was generally acknowledged that the best time for making a test was at night time, when the largest consumption was taking place, but Mr. Davis' experiments seem to have been made during the day.

DR. BOWMAN said it was usually considered that a greater condensation took place in the daytime than at night, when the gas was more agitated by the increased consumption going on. He had found as much as five-candle power difference, between noon and night. He was quite convinced from experiments which he had made that the mechanical means of testing was much better than any chemical method could ever hope to be.

MR. WILSON said that when, in consequence of complaints which had been made by consumers at Bury, the gas committee established a photometer some distance from the gasworks. Serious differences were found between the quality of the gas at the gasworks and the testing station, and this difference was at the time attributed to condensation.

DR. BAILEY wished to call attention to a fact which might have been overlooked, and that was that very frequently low results were obtained simply through air having got into the pipes, and the gas not being allowed to burn before the test was made.

MR. GEORGE E. DAVIS, in reply, said, referring to the remarks of Dr. Grossman, he did not consider that condensation in the mains was a serious matter. He had been served with gas some miles away from the gasworks, and it was practically delivered to him at the same degree of illuminating power as it left the works, there not being more than half a candle difference. Besides, if condensation kept taking place in the mains, this condensed liquid should appear in the street syphons, where it is well known that nothing but foul water usually appeared. A deposit of hydrocarbon from the gas could only take place if such gas were saturated with hydrocarbon vapours. He had never yet met with a sample of gas thoroughly saturated, and he quite agreed with Dr. Grossman that gas companies should supply all their consumers with gas of the standard illuminating power. It was not sufficient to test at the works, which he thought had been sufficiently proved. If gas were tested outside the works in some public building from the ordinary mains, he felt quite sure the complaints of bad gas would be reduced to a minimum. In reference to Dr. Dreyfus' remarks, he was of opinion that the physical test of photometry was far more reliable than it was possible to make any chemical test. For instance, there was a great difference in the illuminating power of the vapour of benzene (C_6H_6) and hexyl hydride (C_6H_{14}), while the chemical difference, so far as regarded percentage of hydrogen and carbon, was very small. Dr. Frankland and others had attempted to value the illuminating power of coal-gas by means of its chemical composition, but it was his opinion that all such endeavours must end in failure. In reply to Mr. Stenhouse, the tests of the gas were made in the Manchester technical laboratory at 10 o'clock in the morning and between 3 and 4 in the afternoon, and he did not attribute the difference between the tests made at the gasworks and his own tests to anything more than the presence of nitrogen and air. It was impossible to have gas of a high quality when it contained as much carbonic acid, nitrogen, and oxygen as the gas did in the daytime, and this bore upon the question put by Dr. Bailey. Every precaution was taken to sweep out all the old gas from the pipes before a test of any kind was made, as at 9 o'clock in the laboratory a large gas sand bath was always lighted and kept burning for an hour before a test commenced; and further, the instructions of the Gas Referees as to the testing of gas were always implicitly followed. If the argument were a valid one, that hydrocarbons were deposited in the mains during a slow flow of gas and taken up again in the equal rush by night, the candles lost in the daytime should increase the luminosity of the gas in the evening, but he had never found such an increase, although there was a difference between the day quality and the night quality; but this difference was mainly due to the greater percentage of nitrogen in the daytime than at night.

THE ESTIMATION OF NITROGEN IN COAL-GAS.

BY C. H. NEW.

AMONGST the numerous methods which have been suggested for the estimation of nitrogen, there are, to the best of my belief, none which are not based either upon the conversion of the nitrogen into ammonia, or measuring the volume of gas obtained after the removal of all other gases, by absorption or other suitable means.

Owing to the presence of appreciable quantities of cyanogen and basic compounds, the former method is not capable of being readily applied to the estimation of the nitrogen in coal-gas, and therefore it is upon the latter method, namely, that of ascertaining the volume of the residual gas, that the method which I shall shortly describe is based.

The circumstances which created the need for a speedy and accurate method for the estimation of nitrogen gas, arose in connection with some experiments which were

being conducted by my esteemed principal Mr. G. E. Davis, in the Manchester Technical Laboratory, upon the amount of air which it is advisable to introduce for the purpose of purifying coal-gas.

In order to accomplish this end, Hawkins suggested the use of carburetted air, but during recent years the practice of introducing air pure and simple into coal-gas (previous to its passage through the purifiers) so as to oxidise the sulphur compounds and assist the purifiers to maintain their activity, has rapidly grown in favour amongst gas managers.

Under these conditions it is without doubt advisable to ascertain that air is not introduced in unduly excessive proportions. It is with this object therefore that the following method has been adopted, since by ascertaining the amount of nitrogen present prior to, and subsequent to, the introduction of air, a very close approximation of the amount of air introduced can be made.

The outline of the method consists in first removing the majority of the bases, and certain hydrocarbons such as benzene, xylene, &c., by passing the gas through strong sulphuric acid (sp. gr. 1.85) and then converting the whole of the remaining hydrocarbons into carbon dioxide and water, by passing the gas over red-hot copper oxide. The gases which result from this treatment consist of carbon dioxide and nitrogen, so that the former may be absorbed by caustic soda and the volume of the remaining nitrogen ascertained.

The apparatus employed is not of a very elaborate nature, the idea being that the manipulation should be as simple as is compatible with accuracy. It may be divided into five parts.

- (1.) An apparatus for generating CO_2 .
- (2.) A burette graduated to hold 100 cc. of gas, fitted at the top with a three-way tap, and connected at its lower extremity with an aspirator.
- (3.) A combustion furnace containing a combustion tube about 80 cm. long, projecting some 10–12 cm. beyond the furnace, and packed with coarse copper oxide to within 7 cm. of the ends of the tube which are fitted with india-rubber bungs. Through each bung a piece of small-bore glass tubing passes, one of these being connected with a small bottle of about 30 cc. capacity containing strong sulphuric acid.
- (4.) A receptacle in which to collect the CO_2 and nitrogen resulting from the combustion of the coal-gas, capable of holding 200 cc., and graduated with a containing mark at 150 cc., and at 200 cc.
- (5.) Hempel's gas apparatus.

For the generation of the CO_2 , HCl and marble are used. The familiar arrangement of two aspirating bottles as generally employed for the preparation of hydrogen sulphide gas is preferable to a Kipp's apparatus, as the gas can then be generated under pressure.

It is advisable to about one-third fill the generating flask with broken glass before introducing the marble.

As it is essential that the CO_2 employed should be completely absorbed by caustic soda, HCl and marble have been selected for the generation of this gas, upon the authority of Hufschmidt (Ber. 18, 1441) who states that these reagents are preferable to sodium carbonate and sulphuric acid, three litres of the CO_2 obtained from marble and HCl containing on an average 0.2 cc. of gas unabsorbed by caustic soda.

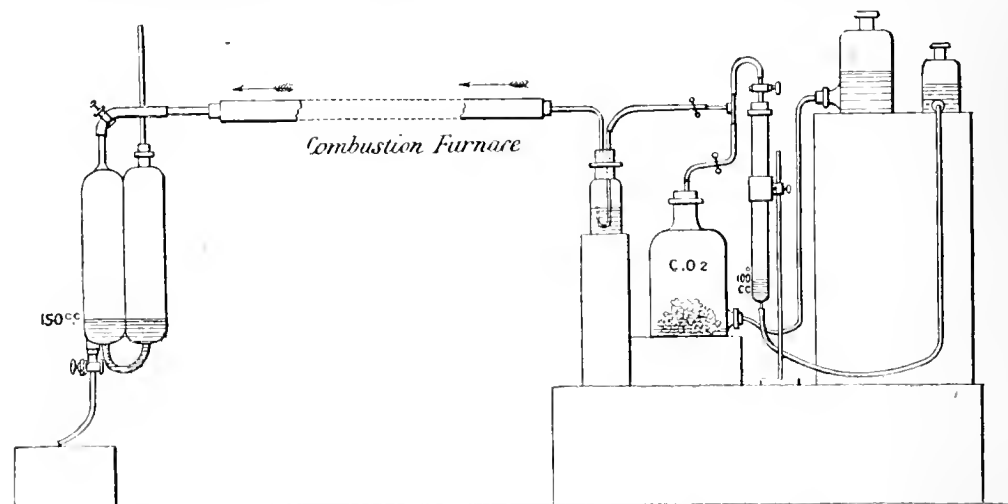
The gas burette may conveniently be made from an ordinary 100 cc. tube fitted at the top with a good india-rubber bung, through which passes, flush with the bottom of the bung, a well-greased three-way tap. (In a case of emergency a plain tap connected with a T-tube may be substituted.) The bottom of the burette which is contracted, is connected by thick walled india-rubber tubing with a small aspirator, the burette being firmly held in a strictly perpendicular position by means of a screw clamp attached to a retort stand weighted with lead.

Of the combustion tube, &c. there is no need to speak, the usual precautions in packing the tube being observed.

The receiver which is recommended is shown in the accompanying illustration. It is an Orsat's absorption tube, such as is used for absorbing O by Cu gauze and $AmHO$,

which is easily adapted for this purpose, all that is necessary being to insert a piece of glass tubing of narrow bore into the wide-mouthed tubulure by means of a collar of india-rubber, and to fit the the smaller tubulure at the bottom

with a tap in the same way. The side furnished at the top with a capillary tube is then graduated at the 150 cc. and 200 cc. containing mark, and fitted with a piece of india-rubber tube and a pinch cock.



The Hempel gas apparatus required is similar to that usually employed, two absorption pipettes being requisite, one charged with caustic soda of about (1.30 sp. gr.), and the other with alkaline pyrogallate.

With regard to the fluid over which the gases may be collected both before and after the combustion, mercury of course is to be preferred, but owing to the cost entailed by the loss of this material through careless handling, any other suitable fluid may be employed, as for instance air-free water, or heavy petroleum oil.

The former of the two latter is obtained by boiling distilled water briskly for about 30 minutes after it has attained a temperature of 100° C., and allowing the same to cool in an atmosphere of coal-gas, and will be found perhaps the most desirable substitute for mercury.

The process itself which I am now about to describe, although possibly appearing rather involved when detailed at length, is in practice by no means so, since the whole operation from the passing of the CO_2 to the final reading of the nitrogen may be accomplished in a period of 30 minutes duration.

Assuming therefore that the combustion tube and the copper oxide contained therein have been raised to a full red heat, during which operation a current of air has been aspirated through the tube by means of a Bunsen pump, so as to carry away any aqueous vapour which may be given off, and to ensure that none of the copper remains unoxidised, the air pump is stopped and the CO_2 generating apparatus connected through the three-way tap with the combustion apparatus.

A brisk current of CO_2 is then passed through the sulphuric acid absorber and combustion tube, thus sweeping out all traces of air. After this has gone on for about three minutes the tube connecting the three-way tap with the absorbing bottle is closed by a pinch cock, and the gas receiver having been completely filled with mercury is connected with the other end of the combustion tube taking care to avoid the entrance of any air. The pinch cock intervening between the CO_2 generator and the three-way tap is also closed.

The india-rubber tube connecting the absorption bottle with the three-way cock is then temporarily removed, and after displacing all air in the burette with mercury, coal-gas is admitted by connecting with the gas supply and lowering the aspirator bottle, the gas being adjusted to the 100 cc. mark by levelling the height of the mercury.

The absorption bottle is now again connected with the three-way tap, and the pinch cocks both here and at the top of the receiver opened. The gas is then slowly chased over from the burette through the absorption bottle and

the combustion tube, the rate at which the gas is passing being ascertained by observing the bubbles in the absorber. The displacement of the 100 cc. of coal-gas should occupy about 15 minutes.

When this is done the connexion with the burette is closed and the tap once more connected with the CO_2 generator, from which a current of CO_2 gas is slowly passed through the whole apparatus, displacing the coal-gas in the absorber, and carrying over all the nitrogen in the combustion tube into the receiver.

The mercury in the receiver is brought during the experiment nearly to a level maintaining the gas, however, under a slight pressure, and adjusting the same by means of the small tap at the bottom, so that when the gas reaches the 150 cc. mark, and the pinch cock at the top and the tap at the bottom are simultaneously closed, the levels of the two columns of mercury are coincident with each other. The receiver is then disconnected, and the combustion tube having been opened to the air the pump is again started to reoxidise the copper oxide.

The wide-mouthed limb of the receiver is then filled with mercury and 100 cc. of the gas passed into the Hempel burette. The CO_2 being absorbed with caustic soda in the usual way. It has also been found necessary to remove traces of oxygen from the gas before taking the final reading as nitrogen.

The average amount of oxygen in coal-gas as taken from 19 experiments upon the gas of towns in all parts of the United Kingdom, is, according to Frankland, about 0.3 per cent., and a varying amount of this oxygen passes over the nitrogen and carbon dioxide, though it would be supposed that a considerable portion would be retained in order to reoxidise the reduced copper. Having, therefore, removed all oxygen the volume of remaining gas is noted, calculated on to 150 cc., and after correction for temperature and pressure gives the per cent. per volume direct.

In summarising the foregoing there are five precautions which it is advisable to observe, viz., (1) to work the apparatus under a slight pressure; (2) to make sure that all air is displaced from the apparatus before commencing the experiment; (3) also to ascertain that the CO_2 used is wholly absorbed by caustic soda; (4) to thoroughly reoxidise the CuO so as to avoid the presence of any metallic copper in the tube; (5) and, lastly, to pass the coal-gas at a rate that will ensure complete oxidation.

The figures which are given below indicate the amount of nitrogen found in the Salford gas as supplied to the Manchester Technical Laboratory, being a series of tests made at different times during a period of several weeks.

TABLE I.—SALFORD GAS.

No. of Experiment.	Nitrogen per Cent. per Volume.
1	14.1
2	13.5
3	13.8
4	8.7
5	7.4
6	6.4
7	10.9
8	11.7
9	10.3
10	6.3
11	7.0
12	7.3
13	7.6
14	7.8
15	4.6

In the early days of the gas industry it was considered highly detrimental to the quality of the gas to admit the slightest quantity of air. This belief existed as late as 1878, when in a report made by the manager of the Salford Gas Works it is stated, "To pump air into gas would not simply dilute it . . . but the gas would be absolutely destroyed as regards fitness for lighting purposes, as may be seen by consulting the following table":—

Percentage of Air added.	Illuminating Power in Candles.
Original gas	25.00
2	22.25
5	10.75

It is therefore safe to assume that the amount of nitrogen found in Manchester gas, as given in Roscoe's translation of Bunsen's Gasometry, may be taken as representing the amount of nitrogen existing in the coal-gas itself, and not due to the introduction of air, the amount there stated to be present being 2.46 per cent. Subjoined are two analyses which apparently are drawn from the same source. No. 1 is to be found as an analysis of Manchester gas due to Bunsen, and is taken from Humphrey's "Chemistry of Illuminating Gas." No. 2 is the original as it occurs in Bunsen's Gasometry. No. 2, being in all probability the correct one, is recommended as the more suitable of the two for the purposes of comparison.

TABLE II.—ANALYSES OF MANCHESTER GAS.

	No. 1.	No. 2.
Hydrogen	45.58	45.58
Marsh-gas	34.30	34.30
Illuminants { Etlal. } { Ditetyl. }	6.46	{ 4.08 2.38
Carbonic oxide	6.64	6.64
H ₂ S .....	..	0.29
Nitrogen	3.67	2.46
Carbonic acid .....	..	3.67
Oxygen	2.46	Nil.

It is noticeable that the amount of nitrogen occurring in coal-gas was in many cases much greater in 1883 and 1884 when the use of air was increasing, as is shown in the following analyses made by Frankland about that time:—

	Per Cent. N
Liverpool	6.10
Birmingham	10.10
Bristol	5.11
London Chartered Co.	5.95
Newcastle-under-Lyme	6.22
Ipswich	10.84
Preston	4.79

There is also another point of interest, which is shown in the following table, which gives the percentage of nitrogen found on different days at varying times.

TABLE III.

Time P.M.	12.30	1.0	1.30	4.20	4.30	7.30
Per cent. per vol. N.	11.7	10.9	..	8.7	..
" "	13.8	..	..
" "	14.1	..	..	..	..
" "	10.3

Time P.M.	8.0	8.20	8.50	9.20	9.40
Per cent. per vol. N. . .	..	..	..	..	..
" "	4.6	..	..	..	..
" " .....	..	7.6	..	..	7.8
" " .....	..	..	7.0	7.3	..

It will be seen that the amount of nitrogen occurring in the gas is much larger in the daytime than at night, an occurrence of such significance that it needs no explanation.

DISCUSSION.

The CHAIRMAN asked whether he fully understood the author to say that there was more air in the daytime than in the evening, and how did the air get into the pipes? If it were pumped in, how did he know there was more in the house than at the station? He understood it was due to the distance.

Mr. STENHOUSE thought that the results obtained by Mr. New were most extraordinary, inasmuch as 14 per cent. of nitrogen meant a great quantity of air, which must have been purposely forced into the gas; and not only would there have to be a large quantity of air pumped in, but there would have to be a corresponding proportion of oxygen. Probably the oxygen would be reduced 1 per cent. assuming the coal-gas to contain 1,000 grains to the 100 cubic feet of sulphuretted hydrogen. There would be sufficient oxygen to oxidise the sulphuretted hydrogen and deposit all the sulphur. Therefore a quantity of air would go forward. Was it quite certain that all the compounds that should be absorbed by the sulphuric acid were absorbed by simple bubbling? Surely the gas had to be agitated with the different reagents before the compounds were absorbed.

Dr. GROSSMAN asked if the author had made an analysis of the air, and if so, what figures he had obtained for nitrogen? The apparatus seemed to require to be handled very carefully, or the results would not be reliable to 1 or 2 per cent.

Mr. STENHOUSE stated that, according to a recently published analysis of the London gas, the average was 0.15 per cent. by volume of oxygen and less than 1 per cent. of nitrogen, and this was greatly different from the results shown.

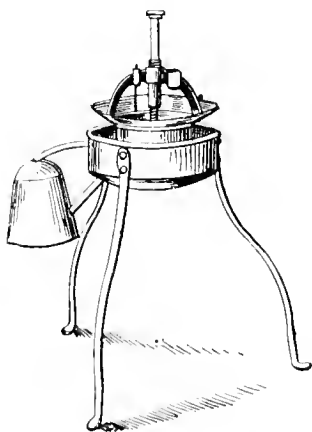
In reply to Mr. Stenhouse, Mr. NEW said that Frankland found on more than one occasion 10 per cent. of nitrogen, and he had himself found oxygen in the coal-gas to an extent which would correspond to the excess left after that required for reducing the sulphuretted hydrogen had been used up. In regard to the complete removal of the compound absorbed by sulphuric acid, sulphuric acid was only used in a bubbling bottle in order to ascertain the rate at which the coal-gas was passing. As a result some of the hydrocarbons were absorbed, but it was immaterial whether they were or not, since they would all be decomposed during their passage over the red-hot copper oxide.

A VISCOMETER FOR TESTING THE VISCOSITY OF OILS.

BY GEORGE H. HURST, F.C.S.

I bring before you this evening a new form of viscometer or viscosimeter for testing the viscosity of oils. No new principle is involved in the construction of this instrument, as you see. It follows the lines on which most of those now in use, and which have been found to give the most satisfactory results are constructed, viz., the determination of the speed of flow of a measured quantity of oil. The instrument differs from those hitherto made in that it requires a smaller quantity of oil, in the oil flowing through a tube of small bore, and in the mode of heating. As you see, it consists of an outer vessel which holds the water required to heat the inner oil chamber. This water is heated by a separate boiler working on the circulatory system placed at one side of the apparatus. I may say in passing that I have found this mode of heating very satisfactory, and in passing I may remark that it would be worth while adopting it in all cases where it is required to heat and keep at a high temperature water-baths and water-jackets, especially where it is not possible to apply a Bunsen burner direct to the water-jacket.

The inner vessel is the oil vessel. From the bottom of this passes a short tube with a narrow bore, the entrance to which is closed by a valve. By raising or lowering of this valve the oil may be allowed to run or be stopped as may be required. A gauge pin to regulate the amount of oil placed in the oil chamber, with arrangements to support thermometers in the oil and the water-jacket, complete the apparatus.



The instrument is not put forward as a standard instrument, but readings of several such apparatus have been found to give concordant results, so that it might fairly be quoted as a standard. At all events, any instruments sent out will be so made as give concordant readings.

The apparatus is an inexpensive one, and possesses many advantages over the viscometers which are in general use by oil dealers.

The following table embodies some readings made with the new instrument, which will serve to show its range and capacity:—

TABLE OF VISCOSITIES OF OILS.

	Temperature—Fahrenheit.				
	70°	100°	120°	150°	180°
Castor oil	1,248	487.5	201.5	91	48
Thickened rape oil....	1,370	331.5	279.5	156	78.5
Sperm oil.....	58.5	36.4	26	19.5	17
Colza oil.....	131	56	44	32.5	28
Whale oil.....	128.7	61	44	28.5	28
Tallow oil.....	105	63	45	30	20
Cotton oil.....	100	55	40	25	20
American 885 oil	68	35	23	15	14
American 905 oil	113	44	32.5	19.5	18
American 915 oil	140	47	36	21	19.5
Scotch 865 oil	32.5	22	18	15.5	13
Scotch 885 oil	58.5	26	22	18	15.5
Scotch 890 oil	71.5	39	26	19.5	17
Russian 906 oil.....	292.5	97.5	56	30	22
Russian 911 oil.....	462	143	91	82.5	26
Rosin oil, dark.....	152.5	97.5	38	22	18
Rosin oil, pale	136.5	49.4	25	18	17
Cylinder oil, medium...	..	385	255	170	70
Cylinder oil, pale .....	..	405	265	120	30
Cylinder oil, dark.....	..	890	495	230	100

Yorkshire Section.

Chairman: Sir James Kitson, Bart.

Vice-Chairman: Dr. F. H. Bowman.

Committee:

A. H. Allen.	J. Lewkowitsch.
W. B. Brett.	G. Rawson.
T. Fairley.	Jas. Sharp.
A. Hess.	A. Smithells.
R. Holliday.	G. Ward.
J. J. Hummel.	T. Whitaker.

Hon. Local Secretary:

H. R. Procter, Yorkshire College, Leeds.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next: *Committee*: J. B. Cohen, F. W. Richardson, G. W. Slatter, and J. B. Wilkinson.

Notices of Papers and Communications should be addressed to the Hon. Local Secretary.

Meeting held Monday, 4th April 1892.

MR. GEORGE WARD IN THE CHAIR.

ON THE IMPURITIES IN COAL-GAS.

BY T. FAIRLEY, F.R.S.E., F.I.C.

IN 1886 (this Journal, 283—6) I read a short paper before the Manchester Section on this subject, and I now, at the request of the secretary, bring before you this short note reporting further experience of the method for analysis of coal-gas proposed in that paper.

The chief impurities in coal-gas, itself a complex mixture, are those substances which give unwholesome combustion products, or which interfere with the development of the light-giving properties of the gas when the latter is burnt in an ordinary gas-burner. The sulphur compounds, hydrogen sulphide, carbon disulphide, and other more complex compounds such as thiophene, are among the first, and carbon dioxide, ammonia, air, and nitrogen are among the second.

Of the sulphur compounds, hydrogen sulphide is scarcely ever present in the gas from any ordinary well-conducted works. The processes for its removal are so effective that there is no excuse for the presence of this impurity. Sometimes, in spite of efficient purification, this substance is found in the gas in certain parts of the area supplied, and in two cases within my own experience the source of the impurity was traced to leakage from crude gas-liquor mains, or storage tanks.

Sulphide of carbon and other compounds of a more or less acid nature are generally found in coal-gas supplied to consumers. Their partial removal is effected by means of alkaline earth sulphides, such as calcium sulphide or sulphhydrate. No sulphur compounds of a basic character have as yet been detected in coal-gas.

In my former paper I gave a *résumé* of the methods hitherto used for the estimation of the sulphur in coal-gas as supplied to consumers, and I have before you the Referees' apparatus, now generally used for this purpose (this Journal, 1886, 283).

In place of the solid ammonium carbonate round the burner in the Referees' apparatus, I proposed the use of a dilute solution of hydrogen dioxide, run in through a capillary tube at the rate of about 3 cc. per hour at the top of the condenser. The sulphur dioxide is completely oxidised into sulphuric acid, and may be determined by titration with standard alkali. If a solution of sodium hydrate used contain 0.25 grain NaHO or 0.0162 grm. NaHO per cubic centimetre, then the number of cubic centimetres of standard sodium hydrate give without calculation the number of grains of sulphur per 100 cubic feet of gas, when ten cubic feet of gas are burnt. There should always be a slight excess of hydrogen dioxide in the condensed liquid, so as to secure complete oxidation of the sulphur. I do not advise the use of standard ammonia in this titration, as higher results are obtained when this alkali is used, the dioxide apparently tending to assume the part of an acid. If such an excess of dioxide is present as to interfere with the use of litmus or other indicator, then the liquid may be evaporated to dryness in a small bulk with an excess of standard soda, and the excess of alkali titrated with standard acid.

The dioxide must be carefully tested for impurities, especially sulphuric acid or barium salts.

The gas before burning should be as completely freed as possible from ammonia, by passing through a saturator containing a large excess of sulphuric acid. Minute quantities of nitric acid are sometimes found in the condensed liquid, probably formed by the oxidation of ammonia or other nitrogen compound left in the gas. I have not found this circumstance to practically interfere with the use of the process.

As compared with the ammonium carbonate process, the use of hydrogen dioxide has two other advantages. The reagent is supplied at a uniform rate throughout the experiment,

whereas with ammonium carbonate there is a large excess of ammonia at the beginning of an experiment, followed by a possible deficiency before the twenty hours (required for a ten cubic feet combustion) have expired. There are no solid products, such as ammonium sulphate, formed in the chimney or condenser. The apparatus may therefore be used continually for days together, and a true average of the sulphur contained in the gas supplied at all times obtained by simply analysing a fractional part of the condensed liquid, without washing out the apparatus. This is specially valuable in a gasworks, where it is desired to constantly test the gas as it is made. Under ordinary circumstances a continuous test of the gas as supplied to consumers would give an undue preponderance to the gas supplied during the day, as the sampling would be taken from a smaller consumption.

The numbers obtained by the use of hydrogen dioxide generally give from one to two grains of sulphur per 100 cubic feet of gas more than is obtained by the use of ammonium carbonate. Out of a large number of tests, the following may be quoted:—

Ammonium Carbonate by precipitation with BaCl ₂ .	Hydrogen Dioxide by precipitation with BaCl ₂ or by titration as above.
13.40	{ 15.73 by precipitation. 15.42 by titration.
13.30	15.43 by titration.
13.27	14.71 by precipitation.
12.89	14.60 by precipitation.
12.31	14.31 by precipitation.

I have also devised an apparatus for the continuous testing of gas for carbon dioxide and ammonia, which I have before you. The results obtained by the use of this apparatus I hope to bring to the notice of the Section on a future occasion.

My best thanks are due to my friend and assistant M. B. A. Burrell, F.I.C., a member of our Society, for carrying out many of the tests mentioned in this paper.

DISCUSSION.

The CHAIRMAN inquired whether he rightly understood Mr. Fairley that the "Referees' process" for estimating sulphur in coal-gas only estimated half the sulphur present? Also whether Mr. Fairley had ascertained in his process any of the atmospheric nitrogen was oxidised into nitric or nitrous acids by the hydrogen peroxide employed. It would be very convenient if the sulphuric acid produced could be estimated by the specific gravity of the solution.

Mr. F. W. RICHARDSON wished to know whether the equation, $\text{SO}_2 + \text{H}_2\text{O}_2 = \text{H}_2\text{SO}_4$ was really the result of observation, or whether it was not more likely that the hydric peroxide acted simply as an oxidising agent, parting with its oxygen, and being reduced to water. He also inquired whether it was better in Pettenkofer's process to employ standard oxalic or hydrochloric acid.

Dr. LEWKOWITSCH said that in some experiments he had occasion to make on crude German petroleum, the bad qualities of which were ascribed to sulphur, he first used a process in which the petroleum was burned, and the sulphur was oxidised in the wet way by a solution of bromine in hydrochloric acid, but afterwards adopted a method proposed by Victor Meyer for the determination of sulphur in thiophene; as Mr. Fairley wanted to put a convenient method in the hands of gas managers, was it perhaps possible so to regulate the combustion of the sulphur that the whole might be burnt into sulphur dioxide, and estimated by its action on iodine solution?

Prof. TILDEN said it was interesting to see how faithfully Mr. Fairley stuck to his favourite reagent, hydrogen peroxide. There was a very great advantage in being able to use titration in place of the usual gravimetric method. As regarded the possibility of so burning sulphur that sulphur dioxide only should be produced, a proportion of sulphuric acid always resulted when sulphur was burnt in presence of water vapour. Its production was shown in a very striking way by the drops of oil of vitriol, which often condensed on glass bells suspended over gas burners. In evaporating water in a basin covered with filter-paper over an ordinary Bunsen burner, it was often found that the surface of the paper was charred, not with the heat, but by the action of the sulphuric acid evolved.

Mr. ARCHBUTT suggested the use of phenolphthalein in titration of the CO_2 absorbed by sodic hydrate.

Mr. S. C. LUTON had made a few experiments in the early days of the "Referees' process" under the direction of Mr. Harcourt, with the object of obtaining a more simple method. Attempts to oxidise the sulphur in the gas in the wet way by passing it through a hot acid solution of potassium dichromate or chlorate contained in a Brodie's tube, failed from the liability of the liquid to project from the tube.

The converse method of reduction proposed by Mr. Harcourt (B. A. Reports, 1875) promised much better results. If gas free from hydrogen sulphide be passed through a red-hot tube packed with broken porcelain, a fairly regular proportion, though possibly not the whole of the sulphur, is converted into hydrogen sulphide. This may be absorbed by an alkaline solution of lead nearly saturated with sugar, which retards the formation of a precipitate, and estimated colorimetrically.

Mr. H. R. PROCTER inquired if Mr. Archbutt found phenolphthalein a satisfactory indicator for carbonic acid. In his experience the bicarbonate and not the normal carbonate of soda was neutral to it, and the end reaction was not extremely sharp. He alluded to the injurious action of the sulphuric acid produced by the combustion of gas upon leather, and mentioned a case in which he actually found upwards of $1\frac{1}{2}$ per cent of free sulphuric acid in leather, which had been destroyed in this way.

Mr. ARCHBUTT replied that it was correct that the acid carbonate and not the normal was neutral to phenolphthalein, but that he found the estimation of carbonic acid in water was very satisfactorily accomplished by the use of a standard solution of sodic carbonate with this indicator, the reaction being exact though not very rapid.

Mr. FAIRLEY in reply, said, that the sulphur converted into sulphuric acid by the combustion of sulphur in an ordinary or Bunsen gas-burner varied from one-half to one-tenth of the total, but the product was always a mixture of sulphurous and sulphuric acids.

Specific gravity could not be used in place of titration, to determine the amount of sulphuric acid produced, since the variation due to the acid was small compared with that caused by changes of temperature. The temperature of the air had also some influence on the amount of water condensed with the acid.

Oxides of nitrogen were found in the products of combustion of the gas, but might be due to the presence of traces of ammonia, which purification had failed to remove.

Obituary.

PROFESSOR AUGUST WILHELM HOFMANN, PH.D., F.R.S., &c.

MEMBER OF THE SOCIETY OF CHEMICAL INDUSTRY.

It will remain a disputed question whether in the fields of chemical investigation and research, or in the capacity of teacher of his science and lecturer, Hofmann held most potent sway. But whether considered as thinker, investigator, or teacher, the world has indeed lost a master-mind, and of this fact, England, mindful of his devoted services and brilliant career from 1848 to 1864 at the Royal College of Chemistry, London, will cordially join with Germany, also mindful of a like career at Bonn and Berlin, from 1865 to the date of his decease, in bearing honourable and grateful testimony.

Some of the most eminent English chemists were trained under Hofmann in the Royal College of Chemistry, and one and all retain a grateful recollection alike of the patience and perseverance characteristic of him as a teacher, as of his kindly interest in their progress. Judging from the subsequent careers of so many of his old pupils, it is probably safe to venture the deduction that Hofmann had a clear and accurate estimate of the true position and value of chemical technology as a composite branch of science in itself. The correctness of this deduction receives immediate support when we remember Hofmann's celebrated Report of the Advance and Position of Applied Chemistry at the period of the Great Exhibition of 1851, a report without which, for many years, no chemical library was thought complete, a report still sought after and prized. It is with pleasure, moreover, that the writer records the fact that from the very foundation of the Society of Chemical Industry, the name of A. W. Hofmann has been recorded in our list of members, indeed the very first name of a chemist of distinction mentioned in the very first paragraph of the "Report of Council," which opens this Journal, as that of a distinguished foreigner "who had already expressed a desire to be enrolled upon the register," was the name of Professor Hofmann.

Hofmann was born at Giessen on April 8, 1818, and after first studying modern languages devoted himself to chemistry, under Liebig, at the university of his native town. After graduating, he acted as Liebig's assistant until 1845, and during that time began to devote special attention to the investigation of the coal-tar bases. From 1845 to 1848 Hofmann acted as Privat-doцент in Bonn, whence he removed to London, where he had been appointed superintendent at the Royal College of Chemistry in Oxford Street, now the chemical department of the School of Mines, at Liebig's recommendation, and at the nomination of H.R.H. the late Prince Albert. Among those who attended Hofmann's lectures in Germany were Prince William of Prussia, afterwards William I., German Emperor, and his son, the late Emperor Frederick. Until close upon his death the old Emperor William was kept constantly informed of the progress of chemical science by Professor Hofmann, and one of the first acts of the late Emperor Frederick upon ascending the throne was to confer a patent of nobility upon his former teacher, with whom he was upon terms of close personal friendship. Professor Hofmann remained in London until 1863. The Prussian Government asked Hofmann to undertake the reorganisation of the chemical laboratory at Bonn University, and in 1863 he was appointed Professor of Chemistry in Berlin, a position which he has held ever since; indeed, his last lecture was given on the morning of his death. Hofmann was a great friend of Italy; his vacations were mostly spent in that country, and he was on terms of close friendship with many prominent Italian statesmen, authors, and scientists. Hofmann's doctor-jubilee was celebrated with great pomp last year in German University and chemical industrial circles. To him was due the discovery of the composition of rosaniline, and his researches on this and allied compounds proved subsequently of great technical importance in the Coal-tar

colour industry. His studies were principally in the domain of the organic bases, and he did a huge amount of work on this subject. One of the earlier and once greatly admired aniline dyes, "*Hofmann Violet*," was named after him. In 1868, Hofmann founded the German Chemical Society, of which he was the first president. He was also its president at the time of his death. He was one of the foremost scientific advisers of the German Government.

In 1851 he was elected a Fellow of the Royal Society, and in 1854 received the Royal Medal in especial consideration of his "Researches on the Molecular Constitution of the Organic Bases." In 1875 Hofmann further received the Copley Medal—the highest distinction that science in this country can confer. He has been President of the Chemical Society of London, and was up to the period of his death one of its vice-presidents. The immediate cause of death, which took place on the 5th instant, was paralysis of the lungs. He has gone to his grave laden with distinctions, honour, goodwill, and high esteem.—W. S.

GEORGE HOGARTH MAKINS.

MEMBER OF THE SOCIETY OF CHEMICAL INDUSTRY.

GEORGE HOGARTH MAKINS was born in 1815. He was educated for the medical profession, and passed the usual qualifying examinations, but he never practised. His tastes were from the first strongly directed towards chemistry, which he had the advantage of studying under Professor Daniell, of King's College. After qualifying as a medical practitioner he was successively lecturer on chemistry at the Aldersgate and at the Middlesex Schools of Medicine. For a few years, 1849—52, he carried on the manufacture of pure chemicals at Surbiton, and during this time prepared, by a process of his own, a considerable amount of spongy gold for the use of dentists. At the recommendation of Mr. Field, assayer to the Mint, he then came to London, and after a preliminary study in the Mint laboratory, opened an assay office in Coleman Street. This work proved a great success; he was soon appointed assayer to the Bank of England and afterwards made their referee. Mr. Makins introduced a number of improvements into the process of assaying. He designed a new balance, which was described at the Chemical Society in 1852; he gave up the use of "trial plates" and substituted for them pure gold and silver; he improved the apparatus employed for "acid parting;" he abolished the charcoal furnace and substituted anthracite as the fuel. In 1863 Mr. Makins was obliged by ill-health to retire from the assay laboratory. He continued to deliver a short annual course of lectures on metallurgy at the Dental Hospital in Leicester Square from 1860 to 1880. These lectures were enlarged and published as a "*Manual of Metallurgy*" in 1862; a second edition, much increased in size, was brought out in 1873. Mr. Makins was elected a Fellow of the Chemical Society in 1845, and served repeatedly on the Council. He was an original Fellow of the Institute of Chemistry, and was a member of the Council at the time of his death. He was also an original member of the Society of Chemical Industry. Chemistry, however, by no means absorbed the whole of Mr. Makins' energy; he was an amateur architect of considerable experience, and a thorough musician. He was devoted to the organ, and constructed himself three organs in the course of his life. In his later years a new sphere of activity was opened to him. In 1880 he was elected on to the Court of Assistants of the Society of Apothecaries, and for 12 years was most assiduous in his endeavours to promote the welfare of the Society. He became Master of the Society in 1889. Mr. Makins retained his activity till a few months before his death, which took place on 12th April 1892. Mr. Makins was much esteemed by those who knew him. He was methodical and painstaking in his work, and of a very kindly disposition.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

A Process for Treating Chemically Softened Water, so as to prevent the Formation of an Adherent Deposit in the Feed Apparatus of Steam Boilers. L. Archbutt and R. M. Deeley, Derby. Eng. Pat. 3051, February 19, 1891.

In order to convert any carbonates which may be present in water already softened by the addition of lime, sodium carbonate, &c., into bicarbonate, the gases from the chimney or other source which contain considerable quantities of carbonic anhydride, are brought into contact with the softened water in the softening tank, and before the water enters the injectors or pumps. In one arrangement the water passes from the storage tank by means of a siphon, which rises several feet above the water level. At the top of the bend of the siphon a small pipe is attached, and through this the gas containing the carbonic anhydride is allowed to pass, and is thus brought into intimate contact with the water. In another arrangement suitable for a large plant, the gases from a coke stove are pumped into the water by a special cylinder. A slight excess of carbonic anhydride over and above that required to convert the carbonate into bicarbonate is recommended, the following test being made: 10 cc. of the uncarbonated softened water are treated with the carbonated softened water, until phenolphthalein is decolourised, and from 90 to 100 cc. should be required.—J. W. L.

Improvements in Filters. R. W. Barker, London. From H. Goodacre, Lexington, U.S.A. Eng. Pat. 4817, March 18, 1891.

The improved filter consists of an upright cylinder, with double walls, packed with a non-conducting substance. It is provided with a cover fitting air-tight, provided with a threaded nipple to which may be connected the pipe from the source of supply. The draw-off cock is at the lower end, and above it is a box carrying a removable ice-drawer.

* Any of these specifications may be obtained by post by remitting 8d.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

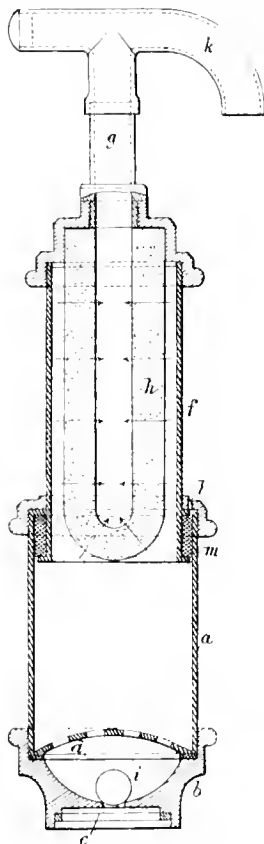
The filter comprises an upper and lower circular disc, both of which have a central hole. The upper disc is provided with several concentric series of curved slots, and with curved depending flanges on the under surface. The lower disc is similarly provided with curved slots, but with the flanges on the upper side. Between the two discs is placed a series of porous filtering cylinders, graduated to fit one within the other, and dividing the filter into a series of annular filtering compartments, a bolt keeping the discs and cylinders in position. The unfiltered water passes through the slots in the upper disc at the upper end of each alternate compartment, through the filtering cylinders to the slots and compartments of the lower disc, and the filtered water is thoroughly cooled before being drawn off, by flowing round the ice-box.—E. S.

Improvements in Digesting Apparatus. W. H. Munns, London. From G. Kaffenberger, Cleveland, U.S.A. Eng. Pat. 6057, April 8, 1891.

The object of the present invention is to produce a digesting apparatus, in which the process may be carried on in a continuous manner. The invention comprises a conduit, which has a receiving and a discharge end. Two valves are arranged near the discharge end forming a chamber in the conduit between the valves. A similar arrangement is provided at the receiving end. Suitable horizontal cylinders, with piston and valves, open at one end into each of the above-mentioned chambers. The digester thus consists of three chambers. For details of the mode of working, which here specially refers to the digestion of straw for paper-making, the specification should be consulted.—E. S.

A New or Improved Filter Pump. F. C. Nordmeyer, Breslau, Germany. Eng. Pat. 7155, April 25, 1891.

The patentee provides a filter in the shape of a pump, which he calls a "filter pump," in which the piston or ram



IMPROVED FILTER PUMP.

is composed of filtering material through which the water passes in a filtered state as the ram is pressed home; the unfiltered water enters the pump through a suction-valve. The accompanying cut shows one of the two modifications illustrated in the drawings.

a is the pump cylinder, *b* the suction-valve casing, with the opening *c*, the ball-valve *i*, and the strainer *d*. To the ram *f* is secured, in a central position, the filtering material *h*, through which the water passes reaching the spout and handle *k* through the stem *g*. An outlet valve is stated to be unnecessary, owing to the resistance offered to the water by the filtering substance on the return stroke.

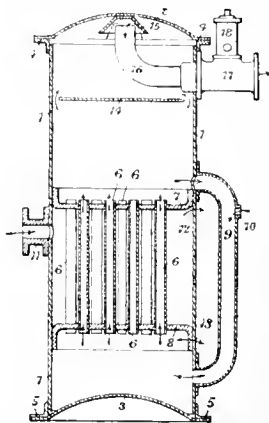
This pump is intended to replace the ordinary portable pocket filter. It raises the water to a convenient height for drinking and can be readily taken to pieces for cleaning purposes.—B.

Improvements in Apparatus for Ejecting or Withdrawing Vapours and Gases from Pipes and Chambers. E. Edwards, London. From L. Kohrmann, Krauschwitz, Germany. Eng. Pat. 7579, May 1, 1891.

This patent refers to details of manufacture of a porcelain or clay tube provided with an annular opening at one end through which steam is to be ejected for the purpose of withdrawing gases of a corrosive nature from pipes or receptacles. For further particulars the specifications should be consulted.—B.

Improvements in and Relating to Evaporators and Feed-Water Heaters. L. Burnet, Govan. Eng. Pat. 22,863, December 31, 1891.

THE improvements described relate to evaporating vessels specially suitable for supplying auxiliary feed-water to steam boilers, is best shown in connexion with one of the illustrations accompanying the specification, which is here reproduced.



The outer shell 1 is fitted with a cover 2 and bottom 3, secured by angle-iron rings 4 and 5. The heating surface is formed by vertical tubes 6 fitted into plates 7 and 8, and a return pipe 9 for facilitating circulation is fitted to the outside of the shell. The feed inlet valve may be fitted to this pipe at the point 10, 11 is the inlet for the steam, 12 the air outlet, and 13 that for condensed water. The baffle plate 14 is to prevent priming from the surface of the evaporating liquid, and the resulting vapour is carried away through 15, 16, and 17, a safety-valve being represented at 18. The specification refers to several variations, including some with removable tubes. If the apparatus is arranged for use in "multiple effect" the last evaporator is fitted with a feed-water heater or economiser, which is constructed on the injector principle and may, if necessary, be supplied with fresh steam in addition to the vapour issuing from the last evaporator.—B.

II.—FUEL, GAS, AND LIGHT.

The Origin of Petroleum. Sickenberger. Chem. Zeit. 1891, 15, 1582—1583.

In support of the animal origin of petroleum, the author gives in detail an account of his observations with regard to the connexion he believes he has traced between the excessive animal life, and consequent animal remains in the Red Sea, and the tarry and bituminous matter found in the chalk on the coast.—A. R. L.

Fuel Gas; its Production and Distribution. A. Kitson. Jour. Franklin Inst. 1891, 132, 424—448.

THE author discusses at some length the comparative value of producer-gas, water-gas, and semi-water-gas, and strongly advocates the employment of the last-named as being the cheapest gas, provided it is supplied within a reasonable distance from the place of production; he believes that, allowing for all contingencies, it is possible to obtain from 2,240 pounds of anthracite from 150,000 to 160,000 cubic feet of semi-water-gas, averaging 165 heat units to the cubic foot, which will contain 25 million units of potential heat, or about 83 per cent. of the heat energy of the coal itself.

The cost of production of semi-water-gas is trifling, and the labour attached to its manufacture very slight; with coal at 3 dollars per ton its cost should not exceed 2½ cents per 1,000 cubic feet, that is to say, one million heat units at a cost of 15 cents.

The objections that are urged against the use of semi-water-gas are (1) that the presence of such a large proportion of non-combustible gases (nitrogen and carbon dioxide) necessitates the use of large pipes; and (2) that combustion is maintained with difficulty. The first objection only applies where it is absolutely necessary to use pipes already existing, as, in laying a new service, it would not matter much whether a 9-inch pipe had to be laid instead of a 6-inch pipe, for example; the second objection is confined almost entirely to producer-gas, because the combustion of semi-water-gas is readily maintained, especially when it is heated prior to ignition.

Not the least of the advantages which semi-water-gas, or "steam-jet" producer-gas, as it is sometimes called, possesses over water- or coal-gas, is the ease and simplicity of its production. It can be made in a furnace not much larger than some that are in use for heating dwellings, it requires no storage, is automatic in its production, and can be made in quantities varying from 500 cubic feet, to an indefinite quantity, per hour.

The apparatus designed by the author for the production of semi-water-gas, and which has been in use for some time driving a Körting gas-engine, is described (see this Journal, 1890, 48).

The Kitson gas generator occupies about 10 sq. ft. of floor space, and stands 8 ft. from the floor to the top of the feed hopper; it will give 1,500 cubic feet of gas per hour. It consists of a cylindrical shell of boiler iron, lined with brickwork, the internal diameter of the brickwork being 21 in., and the height from the grate to the top of the furnace 3 ft. 6 in.; the grate is connected on one side with a steam and air injector, on the other with the gas supply pipe, and is surrounded by a cast-iron box, which forms the ashpit, and which is securely fastened to the cylindrical shell; the whole apparatus is supported on four cast-iron legs. The ash box terminates in a mouth piece, which is opened and closed with a valve worked by a lever from the outside, and serves to dump the ashes whenever necessary without interfering with the process of gas making. The top of the furnace is closed by an iron plate on which is fastened the hopper, openings in the plate being provided for a pipe leading to the chimney, and for a connexion leading to a gas supply pipe, both pipes being provided with valves. A small reservoir, forming the boiler, is placed on one side; it communicates with two coils contained in the brickwork, the lower of which generates steam, whilst the upper one acts as a superheater. An injector is

provided at the top of the furnace, and air channels are arranged spirally in the brickwork through which air is drawn by the injectors. The walls of the furnace are inclined inwardly towards the top so that the entire weight of the fuel is thrown on the grate; the grate is provided with mechanism for giving it a rotary and an up-and-down motion, the effect of which is to break up any clinker, to keep the coal in a compact mass, and to throw the dust and ash into the ash pit.

The author claims that this form of generator is cheap in construction and economical in working; it can be made small enough to produce 500 cubic feet of gas per hour, which means a consumption of only six or seven pounds of coal. It is also easily set up, taken down, and removed; there is no danger from fire or explosion, and it requires but ordinary care, as in the case of a common coal furnace.

—F. S. K.

PATENTS.

Improvements in and connected with Apparatus for Burning Hydrocarbon or other Oils for Heating and Lighting Purposes. G. Rose, Glasgow. Eng. Pat. 829, January 16, 1891.

THIS specification proposes improvements in apparatus described in patent No. 18,101, 1889 (this Journal, 1890, 1025) in which hydrocarbon ores are burned by aid of steam generated from water supplied to a coil pipe heated by the flame.

A single tank divided into two compartments or two separate tanks may be used, a pipe leads from the reservoir containing oil to the burner, and another pipe leads water from the other tank or division to the steam generating coil. The steam is led from the coil to the burner to spray the oil.

A sheet of drawings accompanies the specification and illustrates the details of the application of this invention to rivet heating, anapola, and other furnaces or boilers.

—D. A. S.

Improvements in the Treatment and Desiccation of Peat. W. P. Thompson, Liverpool. From J. M. A. Gérard, Paris, France. Eng. Pat. 5036, March 20, 1891.

IT is proposed to produce from peat, rapidly and economically, a dense agglomerated fuel which may be used in every kind of furnace. The blocks of peat from the turf pit are immersed in water and are subsequently raised by an elevator to a horizontal pug-mill where the peat is thoroughly disintegrated. The peat, in the form of a fluid paste, is led into purifiers where impurities, such as sand and clay, are separated by gravity. The paste is then spread on an endless metal gauze band travelling on cylinders arranged in a horizontal frame, and by means of a cam shaft receives a series of shocks to assist the drainage. On leaving this frame a second endless wire gauze band is led over as a cover and continues to circulate throughout the subsequent operations, thus carrying the peat enclosed.

The bands pass through rolls and other suitable arrangements to press out as much water as possible, and travel subsequently through a drying stove maintained at a temperature high enough to drive off the gas and volatile matter and partially carbonise the peat, the tar is, however, retained to aid in the agglomeration and combustion.

On leaving the furnace the bands separate, the peat being removed by means of revolving brushes, is led to a mill, where after being mixed with agglomerating substances it is finally moulded into briquettes. The process is continuous, but may be varied according to the quality of peat used. A drawing of the apparatus is attached to the specification.—D. A. S.

Improvements in and connected with Gas Retorts. W. T. Cotton, London, and E. F. B. Crowther, Manchester. Eng. Pat. 6947, April 22, 1891.

THIS invention relates to certain improvements in gas retorts by which it is rendered possible to take the gaseous products from the top of the retort to the hydraulic main,

and also to charge the retort directly from an overhead tram or railing by a very simple apparatus.

The retort is built in the stack in an inclined position, and its lower end is closed by a suitable lid. The upper extremity is provided with two lateral openings close to the end of the retort; one of these openings is connected with a vertical pipe leading to the hydraulic main. The other opening is closed with a suitable lid, directly over which can be brought a hopper or vessel containing the charge, and suspended on an overhead tram or railway. When the lid and the hopper valve are opened the coal falls directly into the retort. At the top end of the retort there is a third opening, through which, when the cover is removed, a rod may be thrust in order to clear away any coke or carbon deposit. The retort is inclined at such an angle that when the door at the bottom is opened the coke will fall out of the retort.—F. S. K.

Improvements relating to the Manufacture of Gas from Hydrocarbon Oils, and to Apparatus therefor. H. H. Lake, London. From C. H. Wilder, Boston, U.S.A. Eng. Pat. 18,498, October 27, 1891.

THE object of this invention is to provide a process for feeding oil or any other hydrocarbon liquid to a vaporising retort in such a way that sediment and other foreign matter present in the oil may be deposited before the oil is passed into the retort.

This is effected by heating the oil in a tank which is partially filled with water, and then forcing it by hydrostatic pressure, together with a suitable proportion of air, into the vaporising retort; in this way not only is the oil fed uniformly into the retort, but it is also purified by direct contact with the hot water, the sediment being drawn off by a pipe at the bottom of the vessel. The vaporising retorts are coated inside with a pasty mixture of plumbago and molasses, which on heating forms a protecting covering of fixed, practically indestructible carbon.—F. S. K.

Improvements in the Manufacture of Gas and in Apparatus to be used therein. T. G. Springer, Chicago, U.S.A. Eng. Pat. 19,641, November 12, 1891.

IN the manufacture of a fixed illuminating gas from water-gas and oil or liquid hydrocarbon it is evident that oils of high specific gravity will require a higher temperature for their complete vaporisation than those of low specific gravity. According to this invention the vaporisation of the oil is effected by providing a vaporiser quite independent of the water or steam gasifier, so that the temperature may be regulated according to the specific gravity of the oil.

The vaporiser described consists of a retort, heated directly by a furnace of its own; the oil is delivered directly from a ring pipe into the top of the retort, the sides of which are inclined inwards and downwards, so that the oil is caused to flow in a thin film down the heated walls, the impurities being at the same time directed towards the bottom, whence they can be readily removed. The fixing chamber may advantageously contain trays filled with lime, which removes some of the carbonic acid present; on reheating, the carbonic acid is driven off and the lime is rendered capable of again acting as a purifier.—F. S. K.

Improvements in Manufacture of Gas. G. M. S. Wilson, Toronto, Canada. Eng. Pat. 535, January 11, 1892.

THE improved apparatus consists of a series of retorts arranged in such a way that a mixture of air, steam, and oil is exposed for as long a time as possible to a uniform heat; the result of this treatment is that practically the whole of the hydrocarbon vapour is fixed, and the gas obtained is exceptionally clean and free from readily-condensable vapours.

There are five retorts, three of which are placed close together and occupy the whole width of the inside of the

furnace; the upper surfaces of these retorts form the bed for a fire which not only serves to heat the retorts but also to heat the steam boiler. Below the retorts just mentioned are placed two others, heated by a fire underneath. The oil, steam, and air are introduced through pipes and jets into the ends of the two outer top retorts; the mixture passes the whole length of these retorts and is then conducted by elbows to the two lower retorts; after traversing the whole length of the latter the two streams are united and passed first into the centre top retort, and finally through a smaller tubular retort supported centrally in the larger one; the fixed gas then flows into the discharge pipe. Each retort is provided at its end with a removable plug so that it can be easily cleaned out should any accumulation of carbon take place.—F. S. K.

Improvements in Machinery or Apparatus for Effecting the Complete Mixture of Inflammable Gas or Vapour with Air. W. E. Vickers, Surbiton, and G. A. Everett, London. Eng. Pat. 965, January 18, 1892.

THE machinery or apparatus described in this patent consists essentially of a number of force pumps by means of which air and an inflammable gas or vapour are first forced together through a single pipe into the lower end of a chamber A: the mixture then passes through a large number of small holes or jets in the walls of the chamber A and impinges on the inner walls of a somewhat larger chamber B, which surrounds the perforated chamber A. The mixture, which is in this way rendered very intimate and permanent, finally passes out of the chamber B through a delivery pipe. The pistons of the force pumps are driven by adjustable eccentrics, so that the quantity of air and of inflammable gas or vapour can be conveniently and accurately regulated.—F. S. K.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

PATENTS.

Improvements in Means and Apparatus for Refining Paraffin. J. and W. Baxter, Addiewell. Eng. Pat. 4321, March 11, 1891.

THE improved process described relates to the refining of paraffin wax, and consists in placing the cakes of paraffin on their edge inside a wire cloth case which may be lined with canvas; the cases are secured (a space being left between each) to carriages running on wheels with rails or guides on each side, top and bottom. The carriages are connected together by an endless pitch chain, and after being charged are run by means of the pitch chain at the desire of the operator. The sweating chamber is heated with steam pipes suitably placed. It is claimed that by sweating in this perpendicular manner, the heat being aided by the pressure of the paraffin itself, the impure matter flows more freely from both sides of the cake and a better result than hitherto can be obtained.

After the sweating is completed the carriages are run on and passing under are inverted and so discharge their contents mechanically into a finished product tank.

In the accompanying drawings Fig. 1 is a side elevation, and Fig. 2 the end elevation, a^1 and a^2 show the carriages, g the pitch chain passing round notched wheels $e e$, fixed to shafts $f f$, mounted on bearings on a frame mounted on pillars i ; k is the tank for receiving the discharged finished product, $d d$ the rails, j a saucer beneath the carriages to carry off the impure matter, $l l$ steam pipes, the inlet being

Fig. 1.

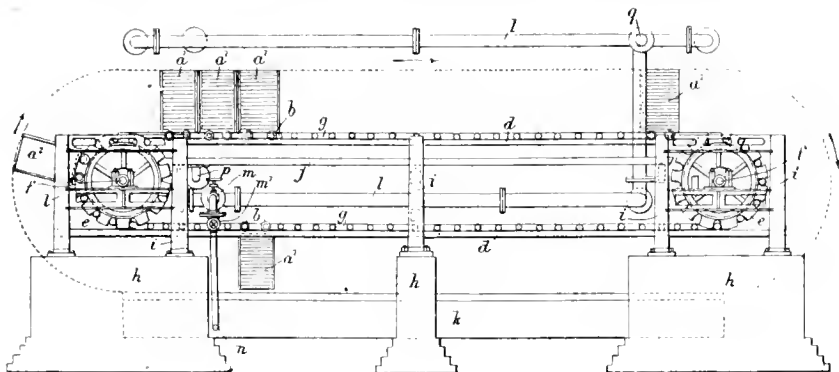
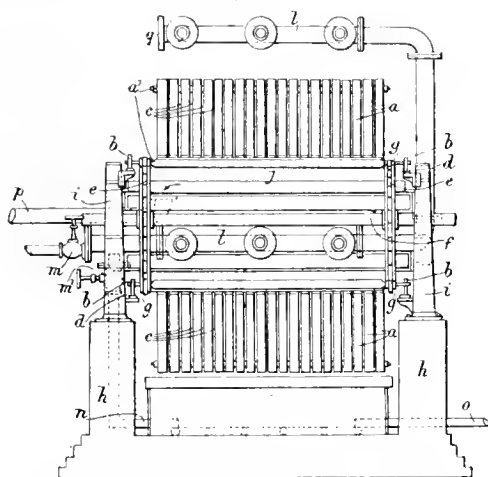


Fig. 2.



IMPROVED APPARATUS FOR REFINING PARAFFIN.

at *g* and outlet at *o* after passing through the tank *k*. The operator can cause the carriages to revolve at will by setting the chain in motion. The whole of the apparatus is erected on and embedded in brickwork shown at *h*.—D. A. S.

PATENT.

Improvements in Cauldrons for Melting Pitch and Fatty Substances. B. D. Henley, Bamber Bridge. Eng. Pat. 324, January 7, 1892.

See under XII. page 446.

IV.—COLOURING MATTERS AND DYES.

On the Constitution of the Ortho-hydroxyazo Compounds. S. Ganelin and St. v. Kostanecki. Ber. 1891, 24, 3976.

In many cases it is difficult to decide whether an ortho-oxazo compound contains a hydroxyl group, or whether its constitution is that of a hydrazone. Monohydroxylated colouring matters containing the hydroxyl group in the ortho position to certain atomic groups are capable of dyeing mordanted fibre. By substituting in such colouring matters

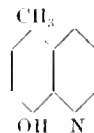
the quinone oxygen atom for the hydroxyl group the resulting compounds lose their affinity for dye mordants, so that probably the azo colouring matters containing respectively the above two isomeric groups will show the same difference in the dyeing test, and the latter would therefore be a very simple method to determine the constitution of a given ortho-oxazo compound. *Noelting* and *Trautmann* (Ber. 1890, 23, 3660) and *Kostanecki* (Ber. 1891, 24, 150; this Journal, 1891, 356) found ortho-oxoquinoline to dye mordanted cotton, while ana-nitroso-ortho-oxoquinoline—



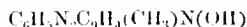
had lost this property. The same difference is likely to exist between the two corresponding ortho-azo derivatives of ortho-oxoquinoline, viz.:—



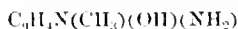
Anaphenylazo-ortho-oxoquinoline being a para-azo derivative is sure to contain a hydroxyl group, and this compound the authors found to dye yellow upon an alumina mordant, brown on an iron mordant. In order to obtain an ortho-azo compound of ortho-oxoquinoline the authors used *Noelting* and *Trautmann's* ortho-hydroxyanamethylquinoline—



Metaphenylazo-ortho-hydroxyanamethylquinoline—



This azo compound was obtained by adding to a solution of diazobenzene chloride a corresponding quantity of ortho-hydroxyanamethylquinone dissolved in hydrochloric acid. On addition of alkali the colouring matter is precipitated and recrystallised from glacial acetic acid, when it is obtained in the form of carmine-coloured needles, melting at 120° C., insoluble in cold water, very little soluble in hot water. Alkalis dissolve only very small quantities, concentrated sulphuric acid dissolves the substance, forming a yellowish-red solution. This compound dyes a yellowish-red on alumina mordant and a dark brown on iron mordant, which goes to prove that it is an azo compound and not a hydrazone.

Meta-amido-ortho-hydroxyquinamethylquinoline—

On treating the above described azo compound with tin and hydrochloric acid the hydrochloride of this compound is obtained, crystallising from hot water in large prisms. Carbonate of soda precipitates the free base, which crystallises from benzene in thick broad needles, melting at 139° C.

According to the theory of the authors the azo compounds of such hydroxyquinolines as do not contain a hydroxyl group in the ortho position to the nitrogen of the pyridine ring should be incapable of dyeing on mordants. On testing *Mathews'* phenylpara-hydroxyquinoline, in accordance with this theory, it was found unable to dye mordanted cotton.

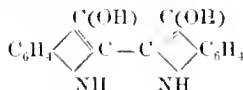
This shows that the colouring matters of the quinoline series and also the hydroxyazo compounds of the quinoline series are in perfect accordance with the theory advanced for all other mordant dyeing colouring matters.—C. O. W.

On Acetyl-Indigo White and Acetyl-Indigo. C. Liebermann and F. Dickhutt. Ber. 1891, **24**, 4130.

TREATING indigo with a mixture of zinc dust, sodium acetate, and acetic anhydride (Ber. **21**, 442 (*footnote*); this Journal, 1888, 205), di-acetyl-indigo white—

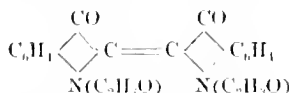


is obtained, whereas Baeyer's indigo-white formula—



would lead us to expect the formation of the tetracetyl compound. This latter, however, the authors failed to obtain under the above-mentioned conditions.

On heating a solution of di-acetyl-indigo white in acetic anhydride with a drop of nitric acid (1·20 sp. gr.), the mass assumes a beautifully red colour. The same reaction is obtained by using, instead of nitric acid, bromine, chlorine, or chromic acid. This reaction therefore is evidently due to an oxidation, resulting in the formation of di-acetyl-indigo—



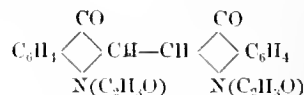
This substance is best obtained by suspending di-acetyl-indigo white in 70 times its weight of acetic anhydride, and passing through the mixture a current of nitrous acid. The reaction may be accelerated by gently warming, and is completed as soon as the mass shows a bright red colour. After filtration, the di-acetyl-indigo soon crystallises out in the form of fine carmine coloured flitters.

The substance is insoluble in water, and with great difficulty soluble in most of the ordinary solvents; it is best recrystallised from benzene. On heating with dilute alkalis the substance is easily and quantitatively converted into indigo. Di-acetyl-indigo dissolves in concentrated sulphuric acid, with a green colour which, on heating, changes into through formation of indigo-sulphonic acid. These reactions leave no doubt as to the constitution of di-acetyl-indigo white and di-acetyl-indigo.

Di-acetyl-indigo may be obtained direct by treating a boiling mixture of indigo and acetic anhydride with acetyl chloride. In place of the latter, hydrochloric acid may be employed, but in this case the reaction proceeds much more slowly.

In the above described di-acetyl-indigo white the acetyl groups are attached to the nitrogen atoms, and accordingly, that compound ought to contain two unaltered hydroxyl groups, which would render it soluble in alkalis. But this

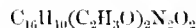
di-acetyl compound, being insoluble in cold alkalis, belongs probably to the class of tautomeric forms of indigo compounds (Bayer's ψ -forms)—



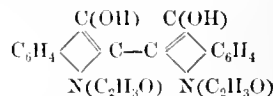
in which the hydrogen is attached to the two central carbon atoms instead of to the carboxyl groups.

Tetra-acetyl-indigo white, $\text{C}_{16}\text{H}_8(\text{C}_2\text{H}_3\text{O})_4\text{N}_2\text{O}_2$. This compound was obtained by treating di-acetyl indigo with a mixture of zinc dust, acetic anhydride, and sodium acetate. It is a colourless substance, which crystallises from its solution in boiling acetic anhydride in the form of a sandy powder. On boiling the substance with dilute alkali, indigo is obtained. Concentrated sulphuric acid dissolves it with a green colour, which on heating turns blue.

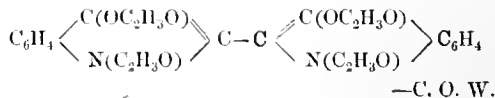
Tautomeric (β -) di-acetyl-indigo white—



was obtained by carefully heating a mixture of acetyl indigo (17 parts), phenylhydrazine (11 parts), and a small quantity of benzene. Evolution of gaseous nitrogen takes place, and at the same time a white, crystalline substance begins to separate out, which is the above-named compound. It differs from the first described di-acetyl-indigo white which is crystalline, by its indifference to nitrous acid which does not convert it into acetyl indigo, and its capability of dissolving in cold alkalis, thereby forming an indigo vat. This β -di-acetyl-indigo white is therefore—



This formula is confirmed by the fact that on treatment of this compound with acetic anhydride and sodium acetate the identical tetra-acetyl-indigo white is obtained, which has already been described above, and the formula of which must be accordingly—



V.—TEXTILES: COTTON, WOOL, SILK, Etc.

On Fibres made from the Leaves of Fir Trees. F. v. Hühnel. Centr. Org. f. Waarenkunde u. Techn. 1891, **1**, 144; and Chem. Zeit. Rep. 1891, **15**, 218.

ALL experiments to obtain good textile fibres from the leaves of European firs, especially *Pinus silvestris*, have been more or less unsatisfactory, as the product obtained called "pine-wool" (*laine végétale*, *Waldwolle*) consists of coarse, short, brownish fibres of little elasticity, which are not easily spun and bleached. If the leaves of *Pinus silvestris* are examined microscopically, they show an epidermis which is almost twice as thick as the hypodermal layers, and most of the leaves have a length of only 4 to 7 cm. Hence the fibres of *Pinus silvestris* are unfit for spinning. But some American species of firs, especially the so-called yellow pitch or bruce pine (*Pinus australis*) and the Loblolly pine (*Pinus Taeda*) seem to yield much more suitable fibres. Their leaves are 16 to 35 cm. long, and a microscopical examination shows that the epidermis is much less developed, being only one-half or one-third the thickness of the hypodermal layers. Moreover the latter

are mostly separated from the epidermis by a layer of cells with thinner walls, and the fibres are longer and stronger. The consequence is that this American pine-wool is often free from epidermis, and therefore much better adapted for textile fabrics. The coarse American pine-wool is used for upholstering and similar purposes. The finer kinds unbleached are light brown, bleached, of a yellow colour, and may be used for coarse yarns in the manufacture of common carpets, sacking, &c.—H. S.

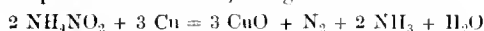
Properties of Ammoniacal Copper Hydrate. Prud'homme. Monit. Scient. 1891, 5, 681.

AMMONIACAL copper hydrate is an oxidising agent. This is proved by its bleaching action on cotton dyed a medium shade of indigo blue. Such cotton, when immersed in a solution of the reagent which has been sufficiently diluted to prevent its attacking the fibre, is decolourised in 24 hours; at 60° C. the decolourisation is complete in a few minutes. In this instance the oxidising effect of the ammoniacal copper solution is greater than that of hydrogen dioxide, which has little action on indigo. Again, when cotton is treated for a short time with a concentrated solution of ammoniacal copper, then well rinsed and treated with dilute acid (to remove copper hydrate) it possesses a strong attraction for Methylene blue, showing its conversion into oxycellulose.

Ammoniacal copper attacks and dissolves mercerised cotton more rapidly than it does ordinary cotton (this Journal, 1891, 835). As prepared by agitating copper turnings with ammonia solution, ammoniacal copper hydrate contains ammonium nitrite, as Berthelot and Péan de Saint-Gilles have pointed out. At the commencement of the operation, however, the blue solution obtained is free from nitrite, the latter being formed gradually in contact with air. Its formation may be observed by taking successive portions of the solution, faintly acidifying with hydrochloric acid, and adding aniline hydrochloride and an alkaline solution of α -naphthol, an orange colour being produced. Metallic copper acts in the cold upon a solution of ammonium nitrite, liberating nitrogen dioxide (red fumes) and afterwards ammonia—



In the presence of ammonia, nitrogen is evolved—



In both cases the liquid rapidly takes a blue colour. On the addition of a sufficient quantity of water to this solution, or to the ordinary solution of ammoniacal copper, cupric hydrate is precipitated. The blue solution in contact with copper in a closed vessel becomes colourless, and then contains cuprous oxide, since, on the addition of sulphuric acid, copper sulphate is produced along with a precipitate of metallic copper. The final composition of an ammoniacal copper solution evidently depends upon the extent to which the above actions take place.—E. B.

Action of Nitric Acid on Silk. L. Vignon and P. Sisley. Compt. Rend. 1891, 113, 701—704.

See under VI., page 430.

The Rotatory Power of Silk. L. Vignon. Compt. Rend. 1891, 113, 802—804.

ACCORDING to its chemical constitution silk ought to be classed amongst the albuminoids. Heated with dilute sulphuric acid, leucine and tyrosine are found amongst the decomposition products. Leucine is (optically) inactive, but by the action of *Penicillium glaucum* is changed into an active modification. Tyrosine is active and levo-rotatory.

The author's intention was to determine whether silk itself had any action on polarised light, and at first great difficulty was experienced from lack of a suitable solvent. This has been surmounted and the optical behaviour of the sericin and fibroin, separately studied.

I. Sericin.—After removing the natural colouring matter of the silk by means of alcohol containing a little hydrochloric acid the sericin was dissolved off with sodium hydrate (3 per cent. solution). This did not sensibly attack the fibroin.

(a.) After filtration, the slightly yellowish solution of sericin was immediately examined by a Laurent polarimeter, using the yellow monochromatic sodium light. A very clear deviation to the left was noticed, five observations giving an average—

$$-1^{\circ}43' = -1^{\circ}71$$

from which is deduced—

$$(x)_d = \frac{1^{\circ}71 \times 100}{2 \times 2^{\circ}20} = -38^{\circ}8.$$

(b.) 10 cc. HCl 32° Tw. were added to 20 cc. of the sericin solution, giving a clear strongly acid liquid deviating—

$$-1^{\circ}16$$

whence—

$$(x)_d = \frac{-1^{\circ}16 \times 150}{2 \times 2^{\circ}20} = -39^{\circ}5.$$

(c.) 10 cc. of distilled water added to 20 cc. of the original solution, gave $-1^{\circ}15$ to the left, corresponding to—

$$(x)_d = \frac{-1^{\circ}15 \times 150}{2 \times 2^{\circ}20} = -39^{\circ}2.$$

The rotatory power is slightly augmented by dilution, but the acid or alkaline character of the solution appears to exert no influence.

II. Fibroin.—To ensure the complete removal of the sericin (silk glue) the silk was “boiled off” twice with soap, and then thoroughly washed with water, acid, and alcohol. After drying it was dissolved in concentrated hydrochloric acid, the solution taking place very rapidly, forming a viscous homogeneous liquid. After diluting with water and filtering, this solution was examined by the polarimeter.

(a.) The acid liquid gave an average deviation of $-3^{\circ}17$ corresponding to—

$$(x)_d = \frac{-3^{\circ}17 \times 200}{2 \times 7^{\circ}33} = -39^{\circ}96.$$

(b.) When diluted with an equal volume of distilled water the solution is not precipitated. Its deviation then becomes $-1^{\circ}64$, from which—

$$(x)_d = \frac{-1^{\circ}64 \times 200}{2 \times 7^{\circ}33} = -41^{\circ}30.$$

(c.) The original liquid diluted with its own volume of ammonia gave a limpid solution, the deviation of which is $-1^{\circ}73$, from which we deduce as before—

$$(x)_d = \frac{-1^{\circ}73 \times 200}{2 \times 7^{\circ}33} = -42^{\circ}80.$$

Therefore dilution again slightly increases the rotation, but the values are found little different in acid or alkaline solution. It will be noticed that the numbers given by the fibroin solution are very near those of the sericin, and also approximate to those of other albuminoids.

The solution of fibroin in hydrochloric acid becomes yellow on adding nitrous nitric acid like other albuminous substances. By neutralisation a substance is deposited which appears identical with the original silk, but possesses the additional property of being easily and completely soluble in ammonia.

In conclusion, the author summarises his results, stating that the solutions of the two principal constituents of silk from *Bombyx mori*, i.e., sericin and fibroin, both exert a considerable action on polarised light; the action of both being levo-gyrate, and the rotatory power in each case being very near, -40° .—W. M. G.

VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

On the Methods of Increasing the Tinctorial Properties of Dye-Wood Extracts. V. H. Soxhlet. Chem. Zeit. 1891, 15, 1490—1491.

THE treatment of logwood-extract with ammonia and subsequent neutralisation with sulphuric acid (McFarlane and Clarkson) heightens the shade imparted to woollen fibres, but does not alter that imparted to vegetable fibres; even in the former case the increase in brightness is not permanent. This method is of no value to the extract manufacturer, as the extract must be treated at a density of 0.5 B., and on concentrating *in vacuo* decomposition occurs. The American process, which consists in the oxidation of hematoxylin to hematein gives fair results, but it is not likely to find favour with the extract manufacturer. The use of potassium permanganate with the extract has been abandoned because the product is not available for dyeing wool. After numerous experiments with different salts, the author found that all those extracts which are oxidised during the extraction, possess less intense tinctorial powers than when such oxidation is avoided. Chalk, borax, soda, &c. should not be present during the extraction, but may be subsequently added to the vacuum evaporation apparatus which is conveniently heated by a glycerol-bath.

When logwood is extracted in the presence of 0.05 per cent. of potassium nitrate and rock-salt, and 0.013 per cent. of a "bisulphite solution" of 40° B. (the percentages calculated on the logwood), and extracted at a pressure of 1.5 atmospheres, the shades produced are weaker than those obtained by extracting the logwood *per se*. On the other hand, when an oxidising agent is added to the dye-bath, cotton mordanted with iron, and wool boiled with bichromate and sulphuric acid, are dyed much brighter, the most intense shades being obtained by adding potassium nitrate and bisulphite to the bath. Borax, ammonia, water-glass, and soda give good results; the first, however, is not easily miscible with the extract, and the others by protracted action decompose it. By employing sodium chlorate in cotton-printing a shade of 10 per cent. more intensity is produced; whilst by the addition of potassium ferricyanide, wool mordanted with bichromate gives a bluish black 15 per cent. more intense than without it, *i.e.*, 15 per cent. more of the pure extract must be used to produce an equal depth of colour. The logwood is cut into transverse pieces avoiding the production of too much dust, and the author employs a battery of five copper extractors, four of which are filled with logwood, and are extracted five times under a pressure of 1.5 atmospheres for 15 minutes, whilst the remaining extractor is filled with boiling water and kept at a certain pressure; it serves to supply the others with water. The extractor is now recharged with logwood and the boiling extract having a density of 0.5 B., and boiling water together with one of the previously mentioned salts added; it is then allowed to settle in a tank, evaporated to a density of 30 B. in a vacuum apparatus, and mixed with the requisite quantity of potassium ferricyanide. The same method gives equally good results with Brazil-wood, fustic, and quercitron bark as with logwood.

Silk-blue is obtained as a paste of a golden lustre by precipitating a logwood extract with aluminium acetate and treating the precipitate with hydrochloric acid.—A. R. L.

On the Oxidation of Wool Fibres and a New Treatment of Unprepared Wool in Wool-Printing. Chem. Zeit. 1891, 15, 1674—1675.

It is a well-known fact that wool fibre may reduce substances which readily give off oxygen. This property is of importance for the application of colouring matters. Some time ago, V. H. Soxhlet found that if woollen yarns are treated with a potassium permanganate solution of 7 per cent. strength, and then dyed in the indigo vat, the shade is much darker than by the ordinary treatment, and the

author is inclined to think that this is due to an oxidation of the wool fibre by the permanganate. A series of experiments in which wool was treated with potassium permanganate of 7 per cent. strength, to which 1 per cent. of magnesium chloride was added, and afterwards dyed with different colouring matters (*e.g.*, Amaranth, Ponceau, Victoria-blue, &c.), showed, however, that in most cases the treatment with the permanganate is of little advantage. Also for printing on wool the application of permanganate proved unsatisfactory; but the author discovered that if sodium chlorate (6.67 per cent.) and vanadium dichloride (0.2 per cent.) are added to the dyes, darker shades are obtained by printing on unprepared wool than if wool prepared with chlorine be treated with colouring matters without these additions. Unfast dyes, *e.g.*, Amaranth, are an exception, as printing with them gives more intense shades on prepared wool. This new treatment has the advantage that the wool remains soft and white. If the dyes are allowed to stand for more than 10 or 14 days, with the above specified additions decomposition sets in; they should therefore be mixed shortly before use. By a further addition of acetate of tin (4 per cent. of 5½° B.) still more intense shades may be obtained.—H. S.

Indigo and its Application in Dyeing and Printing.
A. Wöcher. Zeits. f. angew. Chem. 1891, 731—738.

INDIGO is obtained from several species of leguminous plants indigenous to the tropics, the most valuable being *indigofera tinctoria*, *disperma*, *anil*, and *argentea*. Where its manufacture is carried on by natives, as it is in the main still, the yield and quality of indigo obtained are generally unsatisfactory. The factories directed by Europeans obtain a better yield and superior product. In India three crops of plants are obtained during the year. The land is sown in March and the plant-stalks cut down for the first time early in June, a second crop being collected in September, and a third in January. To separate the indigo, the plants are steeped in lime-water, when a fermentation takes place with the formation of leuco-indigotine. The solution of the latter is run into a tank situated at a lower level than the extraction tank and well agitated to oxidise the leuco-compound, the indigo formed being afterwards separated by subsidence and dried. The first crop of plants gives the greatest yield of indigo, the third the least. In regard to quality, however, this order is reversed, the indigo obtained from the third crop being the best. Usually the plants are extracted immediately after cutting; sometimes, however, they are first dried in the sun. In the latter case they must be extracted along with freshly-cut plants, as a ferment which causes the formation during extraction of leuco-indigotine is contained in the living plant and is destroyed by drying.

The author points out that definite proof is lacking that indigotine is present in the plant in the form of glucoside (indican), as it is usually assumed to be, indican having been isolated from woad (*isatis tinctoria* of the order Cruciferae) alone. If such a glucoside be contained in the indigo plant, indigo could be readily manufactured by decomposition of the aqueous extract with dilute acid.

The various qualities of indigo sent into the market are distinguished by the names of their places of manufacture. This, however, is an unsatisfactory method of classification, since the quality of the product varies according to the season of manufacture, and in one and the same district, according to the greater or less care exercised in its manufacture. Of the various sorts, that from Java is the most esteemed, as it contains a high percentage of colouring matter—a sample tested by the author showing 74 per cent.—with little or no organic impurity. This quality is chiefly employed for the manufacture of indigo-carmin. Bengal indigo is very variable; the best qualities are not inferior to Javanese, the worst are very hard and of little value. Bengal indigo frequently contains a considerable proportion of red and brown colouring matters which give it an additional value for dyeing dark bronzy shades. An average sample of it contains about 60 per cent. of colouring

matter. Madras sorts, on the whole, are inferior to those of Bengal manufacture. Guatemala indigo is unreliable, consisting, as it usually does, of good and bad qualities mixed together. A sample tested showed 34 per cent. of indigotine. Chinese indigo, as a rule, is of good quality; it is exported in the form of rounded cakes, sometimes in a wet state. African and Egyptian indigos are of moderately good quality.

The total annual production of indigo amounts to about 10 million kilos., representing a value of about 90 million marks.

Testing of Indigo.—The following modification of the permanganate test gives satisfactory results in cases where the indigo contains little organic matter other than indigotine and indirubin, and in all cases is very suitable for testing indigo which is intended for the manufacture of indigo-carmines:—1 grm. of a finely-powdered sample of the indigo is placed in a beaker of 50 cc. capacity, and mixed with 8 cc. of fuming sulphuric acid containing 10 per cent. of anhydride. The mixture is heated on a sand-bath to 50°–60° and well agitated. At the end of two or three hours, the solution obtained is rinsed into a litre-flask, and the latter filled to the mark. 100 cc. of this solution are then taken, mixed with 400 cc. of water and 50 of dilute (1:10)

sulphuric acid, and titrated with decinormal permanganate solution until the blue colour has entirely disappeared. The result is calculated on the basis of 1 cc. of the permanganate solution oxidising 7.415 mgrms. of indigotine.

Syntheses of Indigo.—The methods of manufacture discovered by Baeyer (this Journal, 1882, 17, 24 and 146) and Heumann (this Journal, 1890, 1121, and 1891, 41) are too costly to be industrially successful. Heymann's synthesis of indigo-carmines (this Journal, 1891, 758 and 827) is more practicable, both on account of its offering fewer difficulties in carrying out on the large scale, and on account of the greater yield, amounting to 60 per cent. of the weight of phenylglycocine, obtained.

Indigo Dyeing.—The application of indigo in dyeing is based on its conversion by the action of alkaline reducing-mixtures into leuco-indigotine, which dissolves in the alkali present. For this purpose there are variously used: lime, caustic soda, ammonia, and alkaline carbonates, along with ferrous sulphate, zinc powder, iron filings, sodium hyposulphite, stannous chloride, sodium xanthate, thiourea, arsenious oxide, and glucose. For wool-dyeing, vats are also prepared by the action of certain ferments. The composition of such fermentation vats is shown in the following table:—

Name of Vat.	Indigo.	Wool.	Madder.	Bran.	Turnips (sliced).	Quick-lime.	Potash.	Soda Crystals.	Caustic Soda.	Flour or Starch.	Glucose.	Magnesia.	Water.
	Kilos. 12–15	Kilos. 150–200	Kilos. 5–10	Kilos. ..	Kilos. ..	Kilos. 4–6	Kilos. ..	Kilos. ..	Kilos. ..	Kilos. ..	Kilos. ..	Kilos. ..	Litres. 8–10,000
Wool.....	12–15	150–200	5–10	..	..	4–6	..	..	..	..	..	..	8–10,000
Indian.....	8–10	..	4–6	5–6	..	..	10	..	..	..	..	..	4–5,000
German.....	6–8	..	0–4	50–60	..	2–4	..	12–15	..	..	..	..	4–5,000
Combination.....	6–8	50–100	8–10	20–25	..	4–5	6–8	..	..	..	..	..	6–7,000
Benoist and Collin's	8–10	..	..	..	..	..	..	1.6	5.4	16	8	1	8,000
Peptin.....	5	..	..	..	200–300	..	..	..	6–8	..	..	..	5,000

Most of these vats have been in use a long time, and although recently the theory of the action taking place in them has been better understood, no improvement of moment has been made in them. According to recent investigations, hydrogen is liberated by the action of the ferment-bacteria, the carbohydrates present being converted first into lactic acid and then into butyric acid, carbon dioxide, and hydrogen. This action takes place best in the presence of a moderate excess of alkali. Too much alkali hinders it, too little encourages a rapid and destructive fermentation.

The fermentation vats are being gradually replaced for wool-dyeing by the hyposulphite vat. In practice the turbid acid mixture resulting from the action of zinc on a solution of sodium bisulphite is directly used for reducing the indigo. Sometimes, however, a clear and more stable solution of sodium hyposulphite is prepared by adding milk of lime to this crude hyposulphite solution and allowing it to settle, when zinc hydrate and calcium sulphate are precipitated along with the excess of lime. With the hyposulphite, a concentrated indigo solution or vat is prepared and added to the dye-vat in the required amount. The alkali thus introduced into the vat is not absorbed by the material which is dyed, and tends to gradually accumulate. As an excess of it renders the vat inoperative besides injuring the wool, its increase must be checked from time to time by addition of hydrochloric acid or of the crude acid hyposulphite solution mentioned above.

The hyposulphite vat is less used for cotton-dyeing than those prepared with copperas and zinc dust. Zinc dust has the advantage of giving a much clearer vat than copperas, and so enables the dyer to employ shallower or smaller vats.

Substitutes for Indigo.—Indigo shades are closely imitated on linen and cotton by Paraphenylene blue, Indoine, Metaphenylene blue, Benzoazurin, and other dyes. Although not so fast as indigo, they have the advantage

over the latter of being fast to rubbing. The fulness of colour, characteristic of dark shades of indigo, cannot, however, be obtained with these dyes when employed alone, but is frequently obtained by first dyeing with them and then with a small quantity of indigo. For dyeing wool dark blue Alizarin-blue is very extensively employed, but is inferior to indigo in its resistance to light.

Substitutes for Indigo-carmines.—Indigo-carmines is extensively employed in the dyeing of woollen goods, as it possesses the property of dyeing along with other acid dyes and is useful for the production of compound shades. Recently two coal-tar dyes, Thiocarmine and Patent Blue, have entered into serious competition with it.

Application of Indigo in Printing.—Patterns in indigo are produced on calico either by printing reserves and dyeing, or by dyeing and then discharging the blue colour from certain parts, or again by directly printing with indigo. In the first method the entry of the leuco-indigotine into the fibre is prevented by such substances as kaolin, copper sulphate, copper acetate, tartaric acid, and alum. The last two compounds cause a superficial precipitation on the cloth of leuco-indigotine, which then acts as a mechanical resist. Discharge-patterns are produced by printing on the dyed cloth a thickened solution of sodium chromate, along with albumen and a pigment for colour-effects, and passing through a bath of sulphuric and oxalic acids. As pigments chrome yellow, orange, and green, vermilion, Prussian blue, and iron-oxide buff are used, with other pigments, which are capable of withstanding the action of chromic acid. White discharge-patterns are also produced by printing potassium ferricyanide and passing through caustic soda solution, as well as by printing a thickened mixture of a chlorate, potassium ferricyanide, and stannic oxalate and steaming for an hour. Beautiful effects are obtained by the chromic acid method, but the colours so printed are not satisfactorily fast as they are only superficially deposited and fixed with albumen, and again the fibre in the printed

part becomes more or less tendered through the formation of oxycellulose.

Of the numerous attempts made to print indigo directly, none has been so successful as the glucose process (this Journal, 1884, 52—62). An important extension of this process is its combination with the printing of chrome yellow and a mixture of indigo and chrome yellow in a Turkey-red discharge style. The Turkey-red cloth is padded with glucose, dried, and printed with a thickened mixture of indigo and caustic soda for blue, with caustic soda and lead oxide for yellow, and with indigo, lead oxide, and caustic soda for green patterns. It is then dried, steamed, washed, passed through dilute acid, again washed, and chromed.

Substitutes for Indigo in Printing.—Several very fast blues, giving shades resembling those of indigo, are employed in calico printing, but can scarcely be said to compete with indigo. Acetin blue and the so-called Printing blue (a spirit-soluble induline) are amongst the newest of these dyes.—E. B.

Action of Nitric Acid on Silk. L. Vignon and P. Sisley. Compt. Rend. 1891, 113, 701—704.

It is a well known fact that nitric acid imparts a yellow colour to albuminoids; and the authors, in specially studying the phenomenon in the case of silk, have made the following observations:—

I. The yellow colour is best produced by immersing the silk for about a minute in nitric acid diluted to 1·133 sp. gr. (26·6° Tw.) at 45° C. A characteristic deep yellow colour is immediately developed, which is retained on thoroughly washing with water. The colour is not readily affected by exposure to air and light, and is greatly intensified by steeping the silk in alkali, but restored to the original tint by acids. This yellow colour has been practically utilised in Lyons under the names "Mandani" and "Nitric acid" yellow.

II. Nitric acid free from nitrous acid does not produce any colouration under the above conditions.

III. Pure nitric acid with addition of a small amount of sodium nitrite gives a strong yellow colouration, which is intensified by increasing the amount of NaNO_2 , the concentration of the solution, and the temperature, but cannot be carried beyond a certain point without destroying the fibre.

IV. The colour obtained with the mixture of nitric and nitrous acids is also rendered darker by alkalis; a portion of the latter being permanently absorbed since a notable quantity may be detected in the ash left on incinerating the silk.

The shade of yellow obtained varies with the alkali employed, ammonia giving the lightest, and baryta water the reddest shade.

On the other hand the causticising of the alkali has no effect, NaOH and Na_2CO_3 , KOH and K_2CO_3 giving respectively the same shade.

The above experiments show that the presence of nitrous acid in the nitric acid is essential to the production of the yellow colour on silk. A second series of experiments was made with the object of studying the action more thoroughly.

I. Silk treated with nitrous acid ($\text{NaNO}_2 + \text{HCl}$) acquires a pale yellow colour which is not at all fast; the shade rapidly changing to pale brown on exposure to air or light. Boiling water or alcohol also changes the shade to brown without liberation of nitrogen. Alkalis develop a red-brown colouration.

II. A permanent yellow colour is readily produced from the unstable pale yellow obtained as above, by treating with pure nitric acid, the same effect being obtained upon silk previously treated with nitrogen dioxide (NO), or tetroxide (NO_2), in an atmosphere of carbon dioxide.

III. Permanganic acid ($\text{K}_2\text{Mn}_2\text{O}_8 + \text{HCl}$) develops a stable yellow colour on silk treated with nitrous acid, identical with that produced by pure nitric acid; the latter, therefore, acts simply as an oxidising agent.

The reaction which produces the characteristic stable yellow colouration upon silk requires the presence of NO , NO_2 or HNO_2 in conjunction with HNO_3 as an oxidising agent.

IV. Silk treated with nitrous nitric acid is slowly decolourised by a concentrated hot solution of stannous chloride or chromous chloride. Alkaline reducing agents have not the same effect.

V. Two examples of bleached Canton silk were submitted to elementary analysis after undergoing a preliminary purification by being "boiled off" with soap, washed with distilled water, dilute HCl , again with water, and finally with alcohol. After this treatment the ash only amounted to 0·023 per cent.

One hank was treated with nitrous nitric acid under the specified conditions, its weight thereby being increased about 2 per cent.

The numbers obtained on analysing the two samples were:—

	Purified Silk.	After Treatment with HNO_2 , HNO_3 .
	Per Cent.	Per Cent.
C.....	48·3	46·8
H.....	6·5	6·5
N.....	19·2	21·6
O (by difference).....	26·0	25·1

It will be noticed that after treatment the silk is richer in N, but contains less C and O, as would be expected from the above-mentioned increase in weight of 2 per cent.

The conditions of the treatment, and a consideration of analogous reactions, indicate that the nitrogen which has entered into combination was first fixed in the form of NO and afterwards changed by oxidation into NO_2 . It is improbable that the NO replaces hydrogen, the result of the analyses indicating that CO groups are eliminated, with formation of carbonic or oxalic acid.

The authors further state that wool acts in an exactly similar manner to silk when treated with nitrous nitric acid, and that their results differ materially from those obtained by Mûlder when preparing his xanthoproteic acid.

Nitrated silk does not deflagrate when burnt, but the combustion is quicker than with ordinary silk. It also smells like burnt feathers.

Towards solvents the nitrated silk behaves generally in the same way as ordinary silk, but when treated with concentrated sulphuric acid it swells up and gives a viscons mass similar to albumen.—W. M. G.

The Rotatory Power of Silk. L. Vignon. Compt. Rend. 1891, 113, 802—804.

See under V., page 427.

PATENTS.

Improvements in the Manufacture of Copying Ink. E. Coën, Turin. Eng. Pat. 3247, February 23, 1891.

See under XIII., page 446.

A New or Improved Method of Manufacture of certain Compounds of Chromium used in Dyeing and Calico Printing. W. Watson and E. Bentz, Manchester. Eng. Pat. 3385, February 24, 1891.

CHROMIUM acetate, basic acetate, and sulphite, or mixtures of these salts, either alone or with chromium sulphate or basic sulphate, are prepared by reducing chromic acid in the form of sodium chromate or bichromate, with sodium sulphite or sulphurous anhydride in the presence of a suitable acid, such as acetic acid.

Chromium acetate is prepared by dissolving 112 lb. of commercial sodium bichromate in 550 lb. of 25 per cent. acetic acid, to which is then added gradually 400 lb. of 30 per cent. solution of sodium bisulphite, the temperature being kept down. The mixture is allowed to cool to allow the greater portion of the sodium sulphate to crystallise out, a further quantity of sodium sulphate being separated by the addition of 20 lb. of sodium carbonate or its equivalent of sodium hydrate.

Chromium basic acetate is prepared by employing one-half the above amount of acetic acid, the amounts of the other materials remaining the same.

Chromium sulphite is prepared by dissolving 112 lb. of sodium bichromate in 400 lb. of water, adding 39 lb. of 95 per cent. sulphuric acid, and then gradually 800 lb. of a 30 per cent. solution of sodium bisulphite, after which the mixture is allowed to cool until the sodium sulphate has crystallised out as far as possible. Instead of using sodium bisulphite, sulphurous anhydride may be employed in such quantity as is necessary to produce the salt of chromium which is required.

A mixture of chromium acetate and sulphate is obtained by acidifying the solution of sodium bichromate with a mixture of acetic and sulphuric acids, the amount of water used depending on the strength of these acids.

A mixture of chromium acetate and basic sulphate is prepared by the use of the same materials as in the preparation of a mixture of the acetate and sulphate, but the quantities of acetic and sulphuric acid are reduced, or the addition of sulphuric acid may be omitted, sufficient being formed from the sulphurous acid.

A mixture of chromium sulphite and sulphate is prepared by dissolving 112 lb. of sodium bichromate in 400 lb. of water, adding 60 lb. of 95 per cent. sulphuric acid, and then gradually 667 lb. of 30 per cent. solution of sodium bisulphite, after which the sodium sulphate is allowed to crystallise out.

A mixture of chromium sulphite and basic sulphate is prepared in a similar manner, but only 30 lb. of sulphuric acid is employed.

A mixture of chromium sulphite and acetate is prepared by dissolving 112 lb. of sodium bichromate in 100 lb. of water, and 367 lb. of 25 per cent. acetic acid, and then gradually 534 lb. of 30 per cent. sodium bisulphite solution, after which the sodium sulphate is allowed to crystallise out.

The mixture of chromium acetate, sulphite, and sulphate is prepared by replacing part of the acetic acid employed in the last recipe by an equivalent of sulphuric acid, and a mixture of chromium basic sulphate, acetate, and sulphite is prepared by reducing the amount of acetic acid which is employed in the preparation of the mixture of sulphate, sulphite, and acetate.—J. W. L.

Improvements in the Method of and Apparatus for Manufacturing Inlaid Linoleums or Floor Cloths. W. G. Thomson, Halifax, and J. S. Powell, London. Eng. Pat. 4240, March 10, 1891.

A PATTERN block, constructed with one or more chambers of the various shapes required for the pattern, and of any convenient size, is surmounted by a plate carrying cores corresponding in size and shape with those of the chambers in the block. The block is filled with the "ingredients in the various colours required," and placed on the canvas to be printed, and the cores forced down; the block is then raised a little in order to leave a sufficient thickness "of material" on the canvas, a baud-knife being passed under it to detach the protruding colour-mixture. After thus printing, the block is mechanically raised and moved laterally to print a further portion of the canvas, which remains stationary, until all of it on the machine-frame has been printed. The mechanical details of the apparatus employed and several modifications of the above method of printing are described in the original specification, which is illustrated with three sheets of drawings.—E. B.

An Improvement in Dyeing Mats, Carpets, or other Fabrics of Fibre, Wool, Yarn, Silk, or any other Material. J. Daw, jun., North Dulwich. Eng. Pat. 6294, April 13, 1891.

THE object of this invention is to produce ornamental designs or colours on mats or other similar articles without the use of differently coloured materials in the weaving process. For this purpose the mat is placed under a metal stencil plate, and pressure being applied, the colour solution in the form of spray is brought into intimate contact with the material at a considerable temperature and pressure by means of a jet of steam.—W. M. G.

Improvements in the Manufacture of Coloured Rubber Goods or Rubber-coated Goods and a Material or Preparation to be used in the said Manufacture. C. Dreyfus, Clayton. Eng. Pat. 17,566, October 14, 1891.

See under XIII., page 447.

Improvements in and Means for Dyeing, Mordanting, or Bleaching Textile Fibres. F. Hughes, London. From A. Tebueghin, Gand, Belgium. Eng. Pat. 20,866, November 30, 1891.

THE principal application of the invention consists in an improvement of the ordinary "jigger" machine for cloth dyeing. The latter is constructed either with or without squeezing rollers, both systems having certain defects.

If the cloth is not submitted to a squeezing a good deal of liquor is carried over from one bath to another (say from mordant-bath to dye-bath), and there is consequently a great waste of mordant in the liquor carried forward, and of dyestuff through precipitation by the mordant; there is also a superficial deposition of unfixed dyestuff, which afterwards causes the defect of "rubbing off."

On the other hand, when squeezing rollers are employed in the ordinary way, the dyeing is apt to be irregular from the fact that the cloth is drawn through the liquor at an increasing speed as the diameter of the winding roller gradually increases by the rolling up of the material upon it. In some machines this defect is overcome by driving the winding roller by surface contact with the drawing off roller, but this arrangement is open to the objection that the pressure becomes greater as the weight of the cloth upon the winding roller increases. Thus, in ordinary jigger either the speed at which the cloth travels or the pressure to which it is subjected, is variable.

The inventor claims to have overcome these difficulties in a very simple manner. The improvement consisting solely in so fixing the top squeezing roller that it is easily raised out of contact with the bottom roller, and thus the improved jigger can either be used as an ordinary machine or with the squeezing rollers. The squeezing action depending entirely upon the dead weight of the top roller, is also of necessity constant. An equal speed of travel of the cloth is ensured by driving the winding roller by surface contact with the bottom squeezing roller.—W. M. G.

An Improved Process and Apparatus for Bleaching Paper Pulp and other similar Vegetable Substances. C. Kellner, Manchester. Eng. Pat. 22,437, December 23, 1891.

THE inventor has devised a novel apparatus for the continuous bleaching of paper pulp by means of chlorine gas, the material passing slowly in one direction and the bleaching agent continuously traversing the apparatus in the opposite direction.

The diagram clearly illustrates the construction of the apparatus, the tower A being built up of a series of (preferably) earthenware troughs which divide the structure into a number of compartments. Each trough is provided with one radial opening or slit, and the troughs are so arranged with respect to each other that the slots form an ascending or descending spiral, as shown in Fig. 2. The upper edge of each trough is provided with a gutter, into which the lower edge of the succeeding one is fitted and made gas-tight by a water-seal as indicated in Fig. 3.

Passing through a central hole in each trough is a perpendicular rotating shaft fitted with radial arms, one in each compartment (*a*, Fig. 1).

The paper pulp is fed into the apparatus through the hopper *k* and falls to the bottom of the first compartment; it is there pushed round by the radial arm until it reaches the slit through which it falls on to the next trough; proceeding in this manner until it reaches the bottom of the apparatus. Chlorine gas is meanwhile passing in the opposite direction, entering by the pipe *h* and finding exit at *i*. The height of the tower and the rate of supply of chlorine must be such that the pulp is thoroughly bleached, but no excess of chlorine escapes at *i*.

Fig. 1.

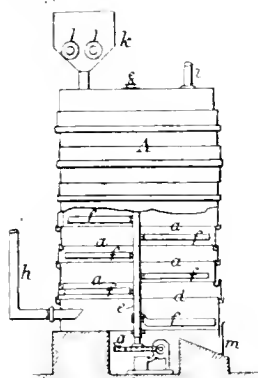


Fig. 2.

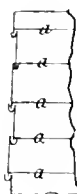
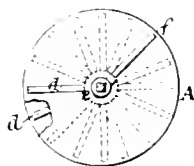


Fig. 3.



IMPROVED BLEACHING APPARATUS.

The hydrochloric acid produced in the bleaching operation is recovered and again used for the production of chlorine by the electrolytic method.—W. M. G.

VII.—ACIDS, ALKALIS, AND SALTS.

Variations in the Specific Gravity of Nitric Acid produced by Nitrogen Peroxide. G. Lunge and L. Marchlewski. Zeits. f. angew. Chem. 1892, 10—12.

Pure nitric acid of commerce, sp. gr. 1.4960 at 15° was mixed with different quantities of pure nitrogen peroxide, prepared by heating lead nitrate. The specific gravities were taken with a hydrometer at 15° , 17° , 19° , and 21° , with the following mean results:—

Percentage of		Specific Gravity at 15° in Vacuum.	Variation in Specific Gravity for each Degree of Temperature.
Nitrogen Peroxide.	Nitric Acid (Total Acidity).		
1	1.04	93.25	1.4986
2	2.93	93.37	1.5071
3	5.82	94.35	1.5129
4	7.32	95.09	1.5261
5	12.70	97.77	1.5415

To estimate the nitrogen peroxide the acid is charged into an accurately calibrated narrow burette, divided into $\frac{1}{100}$ cc., and which can be read to $\frac{1}{1000}$ cc., and allowed to assume the temperature of the room. It is then run gradually into a known volume of semi-normal permanganate heated to 40° , until the colour is discharged, the quantity of nitrogen peroxide being then readily calculated. The total acid was ascertained by running 16 cc. of the acid from the above burette (thus avoiding the inconveniences attached to weighing such material) into ice-cold water, making up to 100 and titrating, whilst warming an aliquot part. Litmus was used as an indicator. By considering the above numbers in various ways the following data are obtained, which show

	A.	B.	C.	Specific Gravity of Acid B.	Specific Gravity of Acid C.	Variation of Specific Gravity for each 1 per Cent. of N_2O_4 .
—	Nitric Acid corresponding to the Nitric Peroxide present.	Actual Nitric Acid less that due to Nitric Peroxide.	Actual Nitric Acid with half that due to the Peroxide.			
	Per Cent.	Per Cent.	Per Cent.			
1	1.42	91.83	92.54	1.4954	1.4969	0.00317
2	4.02	89.55	91.56	1.4899	1.4950	0.00599
3	7.97	87.58	90.56	1.4816	1.4924	0.00658
4	10.32	84.77	89.93	1.4760	1.4909	0.00693
5	17.40	80.37	89.07	1.4613	1.4886	0.00654

the relationship of the specific gravity to the amount of nitric peroxide present, and as this is not regular the authors noted down all results obtained, and struck a mean curve from which they have constructed the following table, to show the variations of specific gravity of the strongest acid of commerce under the influence of the presence of nitric peroxide. The experiments with weaker acids have not given satisfactory numbers.

VARIATIONS IN THE SPECIFIC GRAVITY OF NITRIC ACID, Sp. Gr. 1.4960 at 15° IN VACUO BY THE ADMIXTURE OF NITRIC PEROXIDE.

N_2O_4		N_2O_4		N_2O_4	
Per Cent.	Corresponding Variation in Specific Gravity.	Per Cent.	Corresponding Variation in Specific Gravity.	Per Cent.	Corresponding Variation in Specific Gravity.
0.25	0.00050	4.75	0.03050	9.25	0.06100
0.50	0.00075	5.00	0.03225	9.50	0.06325
0.75	0.00150	5.25	0.03365	9.75	0.06500
1.00	0.00300	5.50	0.03600	10.00	0.06800
1.25	0.00475	5.75	0.03775	10.25	0.06815
1.50	0.00675	6.00	0.03950	10.50	0.06975
1.75	0.00775	6.25	0.04175	10.75	0.07135
2.00	0.01050	6.50	0.04300	11.00	0.07300
2.25	0.01250	6.75	0.04475	11.25	0.07450
2.50	0.01425	7.00	0.04650	11.50	0.07600
2.75	0.01625	7.25	0.04720	11.75	0.07750
3.00	0.01800	7.50	0.05000	12.00	0.07850
3.25	0.01985	7.75	0.05165	12.25	0.08050
3.50	0.02165	8.00	0.05325	12.50	0.08200
3.75	0.02350	8.25	0.05500	12.75	0.08350
4.00	0.02525	8.50	0.05660		
4.25	0.02680	8.75	0.05825		
4.50	0.02875	9.00	0.06000		

The nitric peroxide is regarded as all inactive in the above table, inasmuch as the authors consider that the reaction, $N_2O_4 + H_2O = HNO_3 + HNO_2$, may be disregarded when using such strong acid, but if it is to be taken into consideration, a smaller number than those above given would have to be deducted from the numbers given in Lunge and Rey's tables (this Journal, 1891, 544-546), in order to ascertain the actual amount of active nitric acid and a special table would have to be constructed.—D. A. L.

PATENTS.

Improvements in the Treatment of Soda Waste. F. Ellerhausen, Heliurn-on-Tyne. Eng. Pat. 20,012, December 8, 1890.

Waste, consisting principally of sulphide of iron and sodium is treated either in the wet condition in a closed vessel with carbonic anhydride or in the dry state in a muffle furnace. If the treatment takes place in the wet state hydrogen sulphide is expelled, whilst in the furnace the sulphur passes off as sulphurous anhydride. In any case the resulting mixture of sodium carbonate and ferric oxide is heated until sodium ferrate is formed.—J. W. L.

Improvements in the Manufacture or Production of Salt from Brine. E. O. Lambert, London. From S. Pick, Szczakowa, Galicia. Eng. Pat. 1453, January 27, 1891.

The invention has for its object the precipitation of salt from brine by treatment of the brine with solution of substances having a strong affinity for water, such as the chlorides of calcium and magnesium. The quantity and quality of salt precipitated from brine depends upon the strength and quality of the precipitating solution employed. By adding two volumes of chloride of calcium solution, having a specific gravity of 80° Tw. to one volume of brine, about 98 per cent. of the salt may be separated from the brine in the form of flour salt. By mixing one volume of chloride of calcium solution with 2 volumes of brine, only 25 per cent. of salt are precipitated again in the state of flour salt. In the latter case the remaining 75 per cent. may be obtained either as ordinary fine salt (table salt) or as coarse salt. In the first case the liquor is concentrated to a point at which salt begins to precipitate. On cooling, the salt crystallises out, it being more soluble in hot than in cold solutions of chloride of calcium. The mother-liquor may be repeatedly concentrated and cooled until it consists practically of chloride of calcium only. By varying the quantity of calcium chloride liquor employed in the first instance, and also the subsequent treatment of the mother-liquors, the different grades of salt may be obtained in any required proportion. In all cases the salt obtained is washed by brine in filters or other suitable vessels, and salt is produced from such water in the same way as described. Detailed drawings of an apparatus suitable for the production of salt in the above manner accompany the specification (this Journal, 1888, 426; 1890, 616; 1891, 624 and 749).

—K. E. M.

A New or Improved Method of Manufacture of certain Compounds of Chromium used in Dyeing and Calico Printing. W. Watson and E. Bentz, Manchester. Eng. Pat. 3385, February 24, 1891.

See under VI., page 430.

Improvements in the Production of Chlorine. F. M. Lyte, London. Eng. Pat. 4068, March 6, 1891.

PLUMBIC chloride is first formed from either native or waste chlorides, such as sodium chloride, hydrochloric acid, calcium chloride, magnesium chloride. From these chlorides hydrochloric acid is first formed, either by the Le Blanc, or Lyte and Steinhart's processes, and it is then treated with plumbic oxide, acetate, or nitrate.

Ammonium chloride may be boiled with plumbic oxide. The plumbic chloride thus obtained is melted in a trough or crucible of either earthenware or enamelled iron, and a current of electricity of low tension, about 5 volts, is passed

through it, the poles being either of carbons, or carbons form one pole, the anode, and molten lead, previously added, forms the cathode, the connection with the latter being made by means of a tinned iron bar passed through the bottom of the vessel.

The molten lead is allowed to pass away, as it is formed, through a syphon which maintains a constant level in the trough.—J. W. L.

Improvements in the Manufacture of Alkali and Apparatus therefor. W. Mills, London. Eng. Pat. 4661, March 16, 1891.

THE invention refers to the treatment of fused sodium chloride with a mixture of about equal volumes of hydrogen and carbonic oxide, such as water-gas, in shallow iron pans, Bessemer converters, or reverberatory furnaces. The gas is passed into the fused mass by means of perforated pipes. As a result of the reaction, "hydrochloric acid is given off, and a mixture of sodic oxide and carbon remains behind." This residue is available for the production of caustic soda, by lixiviating, filtering off the carbon, and evaporating the solution. The carbon may be otherwise eliminated by passing a blast of air through the melted mass, when "sodic oxide" will remain behind "in a pure state."—H. A.

Improvements in or Appertaining to the Manufacture of Alkali. A. G. Haddock, Ditton, and J. Leith, St. Helens. Eng. Pat. 5844, April 4, 1891.

IN a previously patented process (this Journal, 1891, 641) residues of alkali waste and of gypsum are obtained, both containing a certain proportion of sulph-hydrates. It is proposed to eliminate these by washing with water, decanting, and treating the remaining thick cream with carbonic acid, which is afterwards passed into the carbonators.

It is important for many processes in using carbonic acid to obtain the same free from oxygen. This end may be attained by adding to it water-gas, hydrogen, or hydrocarbons, either in the lime kilns or in other externally heated apparatus,—the oxygen being consumed in the combustion of these compounds.—H. A.

Improvements in Treating Waste Liquor from Galvanising Works and other Similar Liquors to obtain Ferric Chloride. J. W. Wilson, Manchester, and C. H. G. Harvey, London. Eng. Pat. 6509, April 16, 1891.

THE waste liquor is fed in from a suitable reverberatory furnace, which is provided with flues for carrying away the acid fumes evolved in the operation. The furnace is heated by means of fuel free from sulphur, in conjunction with an air blast. The liquor evaporating, gradually forms an impervious crust on the furnace bed, and when the crust is of sufficient thickness, the running in of liquor is stopped and the temperature of the residue on the furnace bed raised to a bright red heat. As ferrous chloride is converted into ferric chloride the latter is volatilised, and the vapours are condensed in tanks containing hydrochloric acid. The residue of ferric chloride and ferric oxide is introduced while hot into the same hydrochloric acid tanks, the contents of which may be heated to the boiling point. The whole of the iron is thus converted into a supersaturated solution of ferric chloride. The gaseous hydrochloric acid given off in the process, is condensed in suitable apparatus and may be used over again.—H. A.

A Process for Recovery of Sulphur, Carbonate of Soda, and Iron Oxide from Double Sulphide of Sodium and Iron. G. Lunge, Zürich, Switzerland, and J. Dewar, London. Eng. Pat. 8018, May 9, 1891.

IN a process for the production of caustic soda (this Journal, 1891, 543 and 547) a residue is left "consisting mostly of a double sulphide of sodium and iron, or it may be of several such double sulphides, the composition of

which is not exactly known." The moist residue, when exposed at ordinary temperatures to the action of a mixture of, say, one vol. of carbonic acid to about four vols. of air, decomposes with formation of sodium carbonate and of certain quantities of sodium hyposulphite, both of which may be extracted by lixiviation. The insoluble matter consists of hydrated sesquioxide of iron, sulphur, and a quantity of "special double sulphide or of sulphides of sodium and iron;" the amount of these latter depends on the length of time for which the process has been carried on. The sulphur may be melted out, burnt out, or extracted by means of carbon bisulphide, and the residue may be used over again for the manufacture of sodium ferrite, whilst the soluble sodium salts are utilised for the production of ash, caustic, or sodium ferrite.—H. A.

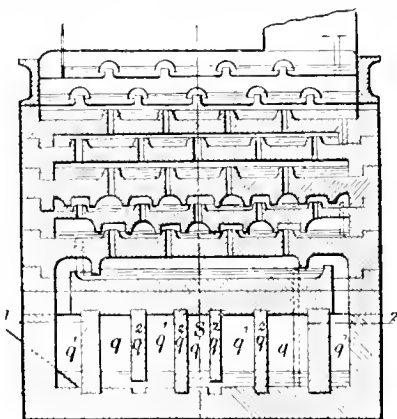
A Method of Manufacturing and Regenerating Salts of Peroxide of Iron. A. E. M. L. Paillard, Paris, France. Eng. Pat. 8841, May 25, 1891.

When reduced to ferrous salt in some technical oxidising process, it is proposed to regenerate the persalts for further useful oxidising action, by treatment of the ferrous salt in solution with the necessary amount of sulphuric acid and a small quantity of nitric acid, for conversion into sesquisulphate. The mixture is then blown by means of an injector into a receiver, where the separation of the liquid and the gases takes place. The latter are returned with an admixture of air to an absorbing chamber connected with the suction of the injector for the regeneration, to a certain extent, of the nitric acid.—H. A.

Improvements in and Apparatus for the Concentration of Sulphuric Acid. J. L. Kessler, Clermont-Ferrand, France. Eng. Pat. 19,215, November 6, 1891.

The apparatus consists of a series of shallow evaporating pans made of siliceous materials covered with lead, and the figure represents a vertical section of one form of it. The heat is derived from a large open fire of slow draught, and after putting on fresh fuel the draught must be cut off from the apparatus in order to prevent the acid from becoming contaminated with dust. The hot air is preferably drawn through the apparatus by means of an exhaust at the outlet. The temperature of the acid need not rise above 203°.

The apparatus consists of the trough S into which the hot gases pass from the furnace. They circulate first through the passages $q\ q$ ($q^2\ q^2$ are partitions) from which it passes to the passages $q^1\ q^1$, and the acid is readily concentrated



APPARATUS FOR CONCENTRATING SULPHURIC ACID.

to 66° B. in this trough. The gases pass upwards over each succeeding trough of acid, whilst from the upper troughs the acid flows downwards, finally reaching the bottom trough S. The weak acid to be concentrated is run into the uppermost trough and becomes gradually concentrated as it passes to the lower ones.—J. W. L.

Improvements in the Manufacture of Sodium Borates.

C. Bigot and J. Schreiter, Hamburg, Germany. Eng. Pat. 19,382, November 9, 1891.

CALCIUM borates may be converted into calcium tetraborate by treating them with sulphuric acid or sodium hydrogen sulphate, and the calcium tetraborate may be readily converted into sodium tetraborate by heating with sodium sulphate. The quantities recommended are: 100 parts of calcium borate, 200 parts of water boiled with 37 parts of sulphuric acid and 140 parts of sodium sulphate, or with 91 parts of sodium bisulphate and 85 parts of sodium sulphate. The mixture may be boiled under a pressure of 2½ atmospheres or in an open pan fitted with an agitator. The gypsum is then filtered off, and sodium baborate, borax, obtained from the solution of sodium tetraborate by the addition of lime or soda.

—J. W. L.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

PATENTS.

Improvements relating to Ovens, Kilns, or Furnaces for Firing Pottery or Earthenware, and for other Purposes.

F. Plant, Stoke-on-Trent. Eng. Pat. 4610, March 14, 1891.

In order to retard the passage of heat through the flues, "obstructers" made of fireclay or other refractory material having perforations or openings for the passage of the products of combustion are placed in or upon the outlets of the flues of the ovens. They are preferably circular or arch-shaped to prevent them collapsing owing to the high heat to which they are exposed.

In a pottery oven they may be placed on the top of the "bags" and also at one or more points in the well hole.

Along with these "obstructers" perforated laps or covers may be used, the combination forming chambers through which the heat and smoke pass to assist in the combustion. Steam or air is in some cases introduced into the chambers.

A dome-shaped cover is also described which may be placed on top of the oven and be raised when required by a lever or other suitable means.

There are two sheets of drawings showing ovens fitted with obstructers and covers.—D. A. S.

Improvements in, and in the Preparation or Manufacture of Enamelled Iron and Steel Plates and other Enamelled Iron and Steel Ware, having Letters, Figures, or Designs appearing at or in the Surface thereof. C. F. Clark, Wolverhampton. Eng. Pat. 4853, March 18, 1891.

HITHERTO letters, designs, &c. have been produced on iron and steel plates by first coating the whole surface with a coloured opaque enamel, and then forming the letters or designs of another enamel on the surface of the first enamel. Another method was to form the letters in opaque enamel on the surface of the metal plate and then to coat the general surface nearly or quite to the level of the raised letters.

In this invention letters or designs *sunk* in the metal plate are filled with opaque enamel, and after burning or baking a transparent or semi-transparent enamel is spread over the surface of the plate, and also over the opaque enamel.—V. C.

Improvements in Kilns for Use in the Manufacture of Pottery, Porcelain, and Earthenware and other similar Goods. F. Query, Montgesoye, France. Eng. Pat. 5068, March 21, 1891.

EACH of these kilns consists of three portions, the kiln proper, a regenerator situated below the kiln, and a drying stove for drying the articles to be afterwards fired in the kiln. When intended for use in making enamelled or glazed ware a supplementary laboratory or kiln body is used.

The waste gases from the kiln after passing through the regenerator are used for heating the drying stove. The air for combustion is admitted through the regenerator and so heated. A special feature of the furnace is its construction, enabling short bars of refractory material to be used, thus dispensing with grate-bars of cast metal, which effects considerable economy in the firing of glazed stoneware.

The inventor claims by the use of this kiln to effect saving in cost of fuel, fire-bars, and drying, while securing increased production from a number of kilns, as also great regularity in heating and cooling.

By means of such a kiln a charge of wares may be charged, fired, and discharged "in 72 hours at the most." The specification is illustrated with drawings.—D. A. S.

Improvements in the Manufacture of Terra Cotta Ware. W. S. Edwards, Ruabon, and J. W. Edwards, Wrexham. Eng. Pat. 17,384, October 13, 1891.

DURING evaporation of the mixture a "scum" or light-coloured substance is apt to form on the surface of terra cotta. The processes in use for removing this blemish (e.g., by scrubbing) are injurious, because they leave the surface rougher.

This invention aims at preventing the formation of a "scum" by coating the surface of the terra cotta with hot tar. Those surfaces which will not be exposed to view are left uncoated, and through them only evaporation takes place.—V. C.

Improvements relating to the Enamelling of Iron Plate. H. Claus, Thale in the Harz, Germany. Eng. Pat. 22,705, December 29, 1891.

IN order to enamel iron-plate utensils in imitation of granite or in mottled or variegated colours, and with a rough surface, the articles undergo three treatments.

They are coated first with an enamelled ground and then washed with a solution of magnesium and ammonium sulphates, which serve to decompose the next enamel coating. This second enamel is very coarsely ground to produce roughness. A thin paste of transparent enamel as finely ground as possible is finally applied.—D. A. S.

Improvements in the Production of Enamelled Iron Ware. H. Claus, Thale in the Harz, Germany. Eng. Pat. 22,732, December 29, 1891.

IN order to obtain mottled enamelled iron ware in grey, blue, or white marbling or other tints one of two processes may be used, either the iron receives a single thick coating or two or more thin coatings. For the former process the enamels are such that the metallic ground work may be partially oxidised and speckles produced in the enamel. The alkaline ingredients are reduced so as to obtain a completely glazed hard mass after melting down. In the second process the ground enamel is of elastic soft composition, and may be mixed with nickel or cobalt oxide; it should be applied in a very thin layer. The covering material consists of finely powdered felspar, granite, sand, cryolite, borax, saltpetre, kaolin, and tin oxide; when these are ground to a mass some nickel sulphate and cobalt sulphate are added. The mixture is then applied in thin layer, and while still moist is powdered over with some ammonia soda (sie) dried and fired as usual. The glaze is alleged to be beautifully tinted.

The inventor explains the reaction as due to the formation of NiCO_3 and CoCO_3 on addition of the soda; these substances tending to draw out and absorb the dissolved NiSO_4 and CoSO_4 to form basic salts, $2\text{CoCO}_3 + 3\text{Co(OH)}_2$ or $2\text{NiCO}_3 + 3\text{Ni(OH)}_2$, thus the colouring matter is concentrated at central points. On the addition of the soda, sodium sulphate is formed, this quickly takes up water of crystallisation causing currents in the enamel and producing beautiful designs.

These enamels are of great durability and resist acid. For the resistance of strong chemical reagents a thin covering of felspar, fluorspar, quartz, borax, and saltpetre is applied.

Salts of copper, chromium, iron and manganese may be used.—D. A. S.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Hydraulic Mortars from Slag. M. Müller. Zeits. f. angew. Chem. 1892, 196—110.

IT is well known that the basic slag resulting in the manufacture of grey pig iron has the property of hardening under water when mixed with calcium hydrate. Mixtures of such slag and calcium hydrate are extensively produced and used as Puzzolana cement: the proportion in which the ingredients are mixed being 3 parts of slag meal and 1 part of calcium hydrate, which latter may be substituted by Roman cement. The ironmasters themselves do not manufacture the cement, but they occasionally prepare stones from the slag, thus deriving sometimes larger profits from the by-product than from the pig made. For this purpose the slag, in the form of a coarse powder, is mixed with calcium hydrate in the proportion of 4:1, the mass shaped into stones and allowed to remain in the open air in a moist state until they have attained the required hardness. The great weight of these stones naturally localises such a trade.

Only those slags are suitable for the manufacture of the Puzzolana cement which result from grey pig made in blast furnaces, the slags from white iron, spiegel, &c. being completely unsuitable for this purpose. But this property of the slag to form a hydraulic cement does not depend solely on its chemical composition; only on the condition that the molten slag, just as it is flowing from the tap hole of the blast-furnace, is suddenly chilled by being run in a thin stream into water, will it be found suitable for the manufacture of Puzzolana cement. Through this operation the slag is disintegrated at the same time to a great extent, and can, after drying, be easily reduced to the finest meal by being ground between crushers.

If the slag be not chilled, but allowed to cool slowly, the powdered slag will not harden under water when mixed with lime, although the chemical composition is exactly the same.

The strongly basic slags have the property of swelling out in contact with air, and thus becoming disintegrated into a very fine powder; but this slag cannot give a hydraulic cement either.

The different behaviour of chilled and naturally disintegrated slag is therefore not caused by a change in its chemical composition, but by an alteration in its chemical constitution. In the chilling process, the chemical compounds, as they exist in the molten slag, are, so to speak, fixed, while, on slowly cooling, a change in the grouping of the atoms must take place. It is, therefore, evident that the molecules of the slag are under a certain tension, and thus enabled to easily form new compounds when mixed with other substances. The author had tried, some years ago, to define the chemical difference, but did not arrive at any tangible result, therefore he did not publish his work. A communication, however, of A. Busch (this

Journal, 1892, 165) induces the author to communicate the results of his researches. Busch concludes from the action of bromine water on the slag which has crumbled to pieces on contact with air, that such slag contains large quantities of free, dead-burnt lime, and that the chilled slag also occludes some such lime, wherefore these cements do not harden in contact with sea-water. The residue left from the action of bromine water on the slag is considered by Busch to have the formula $Al_2O_3(SiO_2CaO)_2$. The author attacks these conclusions of Busch as not consistent with the facts.

The material for a comparative examination of chilled slag and slag disintegrated by contact with air, not being easy to obtain, the author proceeded to prepare the latter from a chilled slag in the laboratory by heating the chilled slag in a muffle to a bright red heat, and allowing it to cool slowly. In consequence of this heating, the chilled slag loses altogether the property of yielding a hydraulic cement, whilst its chemical composition has undergone only slight alteration, the calcium sulphide contained in the chilled slag becomes oxidised through the heating in the muffle to calcium sulphate. The specific gravity, however, is considerably lowered owing to the increase in volume. The analyses of the original chilled and of the heated slag gave the following results:—

	Chilled Slag.	Heated Slag.
	Per Cent.	Per Cent.
SiO ₂	25.63	25.41
Al ₂ O ₃ (+ Fe ₂ O ₃).....	18.81	18.61
CaO.....	50.82	50.62
MgO.....	3.15	3.05
Specific Gravity.....	2.710	2.413

The action of bromine water on both slags was determined by allowing the finely-powdered slags to stand for a fortnight in a well-stoppered bottle with an excess of bromine water, and examining the filtrate from the undissolved portion. The analysis yielded the following values:—

Dissolved in Bromine Water in 14 Days.	Chilled Slag.	Heated Slag.
	Per Cent.	Per Cent.
SiO ₂	0.45	0.93
Al ₂ O ₃ (+ Fe ₂ O ₃).....	0.2	0.19
CaO.....	13.5	33.50
MgO.....	Not determined.	

When the bromine water is allowed to act for a longer period, the chilled slag loses considerably more lime, whilst the heated slag undergoes very little further change, as the author proved in another specimen of slag.

From these experiments the author concludes that the lime of disintegrated furnace slag is more loosely combined than in the chilled slag, but it would be premature to conclude, as Busch does, that this lime is dead-burnt lime, which, in contact with sea-water, forms calcium sulphate and magnesium hydrate, thus causing the uselessness of the Puzzolana cement for building purposes under sea-water. If Busch's opinion be correct, Portland cement, which withstands the action of sea-water well, ought not to contain free lime, and consequently not yield any lime to bromine water. The author examined, therefore, a good Portland cement (Stettin Star brand) containing 64.44 per cent. CaO, and found that bromine water dissolved from it during a fortnight the greatest part of the CaO; in fact 89.7 per cent. of the lime present in the Portland cement was found in the solution. As no one would contend that such a large percentage of free lime exists in Portland cement, it will be considered more likely that there is

present in it a chemical compound containing large quantities of CaO, which hardens easily by combining with water, but is easily decomposed by bromine water.

Experiments of the author to extract free lime from both the chilled and the heated slags by means of a 20 per cent. sugar solution showed that only very small quantities of CaO were dissolved.

It is generally assumed that the slag only hardens on addition of lime. The author concludes from his experiments that the slag meal itself takes up water slowly, thereby becoming hardened.

Chilled slag and heated slag were kept in test tubes under water for a period of five weeks, when the chilled slag was found to have become quite hard, whilst the heated slag could easily be crushed with the finger. The author determined the amount of water taken up by drying the samples in a desiccator and weighing the water given off on subsequent heating. He found, for the chilled slag, 7.15 per cent. water, and for the heated slag 3.55 per cent. Another experiment, extending over a period of three months, gave for the chilled slag 10.71 per cent., and for the heated slag 5.41 per cent. water.—J. L.

PATENTS.

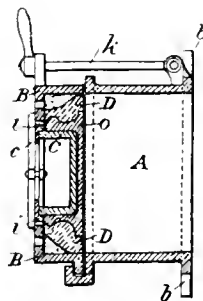
Improvements in and in the Preparation or Manufacture of Enamelled Iron and Steel Plates and other Enamelled Iron and Steel Ware having Letters, Figures, or Designs appearing at or in the Surface thereof. C. F. Clark, Wolverhampton. Eng. Pat. 4853, March 18, 1891.

See under VIII., page 434.

Improvements in Clay Presses for making Tiles and the like. C. Huelser, London. From E. Fröhlich, Schwerin, Germany. Eng. Pat. 5772, April 3, 1891.

A DEVICE for quickly forming tiles, &c., by means of clay presses.

The mould box B is secured to the mouthpiece of the



AN IMPROVEMENT IN CLAY PRESSES.

clay press, the box being provided with core pieces D, a stencil C which can be taken out, and slits i for allowing the air to escape. When the clay begins to come out through these slits the lever nut k is loosened and a wire is passed along the rear of the mould box b, whereby the tile O is formed.—V. C.

An Improved Artificial Stone. W. W. Horn, London. From W. L. Mason, T. W. Blakey, and J. A. Wright, Keene, U.S.A. Eng. Pat. 7184, April 25, 1891.

The material is made from the following ingredients: granite 40 parts, flint 15, felspar 5, fireclay 4. The granite is calcined and afterwards pulverised and sifted. The other materials in the proportions above stated are thoroughly mixed with the granulated granite and water. The mixture

is then moulded, set aside to dry, placed in saggars, and heated to about 4,000° F. The material obtained resembles granite but is stronger, is fireproof, and is practically impervious to water.—V. C.

Improved Fire-Resisting Bricks and Materials for Lining, Facing, or Coating Fire-places, Fire-boxes, Ovens, and Kilns of every kind. J. K. Thompson, Leeds. Eng. Pat. 21,997, December 16, 1891.

THE material consists of a mixture of 7 parts of ground fireclay, 1 part of graphite, 1 part of plumbago, 1 part of cement and the necessary water. When bricks are to be made the materials are moulded and subjected to hydraulic pressure, after which they are fired in the usual way.

The same mixture, but made more fluid by an additional quantity of water, can be used as a wash or coating for ordinary fire-bricks or other articles.—V. C.

Improvements relating to the Enamelling of Iron Plate. H. Claus, Thale, in the Hartz, Germany. Eng. Pat. 22,705, December 29, 1891.

Improvements in the Production of Enamelled Iron Ware. H. Claus, Thale, in the Hartz, Germany. Eng. Pat. 22,732, December 29, 1891.

See under VIII., page 435.

Improvements in Gypsum Casts. E. Websky, Tannhausen, Germany. Eng. Pat. 795, January 14, 1892.

THE inventor's object of rendering gypsum casts capable of withstanding exposure to the atmosphere, of improving their artistical appearance, and allowing their being easily cleaned, is attained by immersing the dried casts, previously heated to a temperature of 170°–200° F., into a drying oil having the same temperature. After 8 or 10 hours the gypsum casts are taken out and allowed to stand 12 hours in a place free from dust. The same process is repeated once more for a shorter period of time, the adhering oil is carefully removed and the casts again allowed to dry.

The gypsum casts are thus rendered translucent to a certain depth and acquire a stone-like appearance.

The oil used is bleached linseed oil (or red poppy oil, hemp oil, nut oil, castor oil) with or without an addition of 10–20 per cent. of Dammara resin. It is not advisable to accelerate the drying of the oil by adding a dryer.—J. L.

X.—METALLURGY.

Quantitative Analysis of Sulphides. P. Jannasch and V. Wasowicz. J. Prakt. Chem. 1892, 45, 94–102. (See also this Journal, 1890, 769.)

The Determination of Sulphur in Lead Glance and in Minerals containing Lead. P. Jannasch and K. Aschoff. J. Prakt. Chem. 1892, 45, 103–109.

Wet Methods of Analysis of Lead Glance. P. Jannasch and K. Aschoff. J. prakt. Chem. 1892, 110–111, and J. Prakt. Chem. 1892, 45, 111–113.

Dry Method of Analysis of Lead Glance. P. Jannasch and T. Bickes. J. Prakt. Chem. 1892, 45, 113–114.

See under XXIII., page 457.

A Quick and Reliable Method for the Decomposition and Analysis of Ferrochrome. H. N. Warren. Chem. News, 65, 186.

See under XXIII., page 460.

Canadian Nickel. Board of Trade Journal.

IN an article on Canadian nickel production, the *Monetary Times* of Toronto says that the nickel deposits at Sudbury, Ontario, form one of the two great sources of the world's supply of this metal, the other being the mines of New Caledonia, a colony of France situated in the Pacific Ocean, some hundreds of miles east of Australia.

The great deposits in New Caledonia are of garnierite, a hydrous silicate of nickel and magnesia, while the Sudbury ores are of nickeliferous pyrrhotite and chalcopyrite. The quantity of nickel mined in the United States in the last 16 years, according to a paper on nickel by Mr. W. R. Ingalls, M.E., has averaged only 121,000 lb. per annum. The principal source of the metal in that country is the Lancaster Gap, Pennsylvania mine, but its output is lessening, and in fact it shows signs of exhaustion. There are other deposits of the nickel in Nevada, Arkansas, Oregon, North Carolina, and Connecticut, as well as in the Black Hills of South Dakota, but none of these mines, we understand, have yet become regular producers. The deposits vary in character from a cobalt and nickel sulphide, as at Churchill, Nevada, to the nickel silicate found at Riddles, Oregon. Exports of nickel from the New Caledonia mines reached 885,000 lb. in 1890, nine-tenths or more in the form of nickel ore averaging 8 per cent. of the metal. Norway produced in 1889 some 149,000 lb. Says Mr. Ingalls:—

"The nickeliferous chalcopyrite and pyrrhotite of Sudbury are first roasted and then smelted in cupola furnaces to nickel-copper matte, containing about 20 per cent. nickel. These mattes are very refractory, and it is only within the past year that they have been successfully handled. Of the large output in the Sudbury district in 1890 but a comparatively small portion was shipped. About 15 months ago the Orford Copper Company devised a successful method for refining these mattes, and since then the bulk of the output of the Canadian mines has been brought to this country, the Orford Copper Company now being the largest nickel refiner in the world. Early in the year the United States Government purchased a large amount of matte of the Canadian companies, practically cleaning out their accumulated stocks, and all of this has been refined by the Orford Company. By the process used by the latter, which is a secret one, the copper and nickel in the matte are separated and the nickel converted into nickel oxide, which is said to be more suitable for the manufacture of nickel steel than metallic metal. A small part of the Sudbury mattes is sent to Swansea to be refined."

Of the three nickel smelting works in the United States, the American works at Camden, N.J., run on Pennsylvania, Missouri, and Canadian ores; the Orford works, opposite Staten Island in New York harbour, on Canadian mattes only; while the Canadian Copper Company's works at Cleveland, Ohio, are to run, when completed, upon mattes from that company's mines at Sudbury. La Société du Nickel, which owns the New Caledonia mines, has four refineries in operation; one near Havre, in France; one at Eiserohn, in Germany; one at Glasgow, Scotland; one at Irdlington, near Birmingham, England.

Matters in the Canadian nickel belt in northern Ontario, about Sudbury, are by no means stationary. We hear that the Drury Nickel Company, whose lands are in the township of Drury, have not only built a smelter which is about ready for work, but have constructed a line of railway to connect their property with the Canadian Pacific Railway.

A late paragraph mentions the formation at Havre of a company for the manufacture of nickel, which shall use the mineral from Canadian mines. This points to competition with La Société du Nickel, which controls the New Caledonia mines. At any rate this new company is erecting a factory on the Tancarville canal at Havre, and is said to have concluded an important contract with the Government of France for nickel-plating parts of the Lebel rifles.

On the Oxidation of Nickel Carbonyl. Berthelot. *Compt. Rend.* 1891, **113**, 679—680.

THE author has already described several new properties of nickel carbonyl, and showed that it behaves as a true organic radicle, the products of its spontaneous oxidation not consisting simply of oxide of nickel and carbonic acid. New details are now given.

Nickel carbonyl may be preserved without alteration in a flask under a layer of water, so long as air is absolutely excluded. If the air penetrates into the flask the compound is slowly oxidised, forming at the bottom a stratum of apple-green hydrated oxide of nickel (free from carbon in the author's experiments). At the same time some of the nickel carbonyl escapes and is oxidised by the air, forming fumes which deposit as a whitish film upon all objects in the same cupboard.

In order to collect this product of slow oxidation the flask was placed in a double tin jacket, and in this way several decigrammes of a complex oxide were collected. This body, which is whitish in film but greenish in bulk, is a hydrated oxide of an organic radicle compound of nickel.

Its analysis by oxide of copper gave numbers approximately corresponding to the formula $C_2O_3 \cdot Ni_3 \cdot 10 H_2O$.

It is the oxide of a complex radicle analogous to croconic or rhodizonic acid, and a part of the nickel may be combined or mixed with it as a simple oxide. In this case the complex oxide would be some such substance as C_2ONi , and would be derived from ethylene (C_2H_4) or a more condensed type of the same series.

The equation representing its formation would then be— $C_2O_4Ni + O = 2 CO_2 + C_2ONi$.

Further study of nickel carbonyl is necessary to prove this.—W. M. G.

Formation and Behaviour of Basic Calcium Phosphates, and their Relationship to Thomas Slag. O. Foerster. *Zeits. f. angew. Chem.* 1892, 13—22.

See under XXIII., page 460.

The Condition of Gold in Pyrites. Eng. and Mining J. 1892, 151.

TREATISES on ore deposits frequently refer to the occurrence of gold in the form of a natural sulphide as possible and probable. There is really foundation for the belief that gold often does occur in a state which resists amalgamation, even with the best mechanical appliances.

While the theory of the existence of a gold sulphide meets with no objections, and is assumed as a convenient working hypothesis, to establish it by positive proof is another and by no means an easy matter. A sulphide ore (pyrites, arsenopyrites, chalcopyrites, marcasite, blende, galena, &c., a mixture of two or more of these, or of silver sulphides, perhaps in connexion with arsenides, antimonides or tellurides) which carries 10 oz. to 20 oz. gold per ton, would be of exceptionally high grade. The bulk of the auriferous sulphuret concentrates does not run higher than one or two ounces per ton. And since of this gold a large part, nearly all, or the whole, may be in the metallic state, laboratory experiments become very difficult and their results uncertain, owing to the small percentage of gold (whether native or as sulphide) available to work upon. The same difficulty was met with in determining gold tellurides. If an auriferous pyrites ore is crushed and, without roasting, is panned or horned, a portion of the gold contents (as determined by fire assay) may be recovered, the gold being in various degrees of comminution down to a fineness which may escape the most careful panning. Such a pyrites, examined under the microscope, sometimes shows minute films and flakes of gold lying along the cleavage planes as though squeezed out in the process of crystallising, or in particles in the mass of crystals. Most of the gold-bearing pyrites does not occur in large blocky crystals, but finely disseminated through the quartz, spar, or other gangue, and hence does not lend itself readily to observation.

Some sixteen years ago Mr. W. C. Wynkoop detected what he believed to be a natural sulphide of gold in copper pyrites from the Stoughton mine, Ward district, Boulder county, Colo. This ore was not amalgamable raw, showed no gold nor any signs of an unknown mineral under the microscope, but on treating with ammonium sulphide gave a filtrate containing gold. Recently certain investigations have been described by Mr. T. W. T. Atherton, of the Nambucca Heads Gold Mining Company, of Deep Creek, New South Wales, which seem to be conclusive, if any doubt remains. Mr. Atherton proves that during his investigations on the ores of the Deep Creek mines he has found in them the long-sought gold sulphide.

If natural gold sulphide exists and is not amalgamable, it cannot be reduced by any simple process of grinding, which, however, may liberate some other forms of refractory gold. Roasting would probably drive off the sulphur more easily than from other sulphides, as the gold sulphide, it is to be presumed, is a less stable compound. But roasting would leave the freed gold in such a minute state of subdivision as to make it an awkward material to handle by any amalgamating appliances, since it would be likely to escape in the slimes. Concentration, roasting, chlorinating, and leaching ought to save it, or, perhaps, even a raw lixiviation process may be practicable. At present concentration and smelting after roasting (or raw, if in small proportion in the smelting mixture), in connexion with silver-lead smelting, seems to be the simplest and surest mode of treatment. But fine crushing before concentration would tend to slime the gold sulphide, which most probably exists as an intimate mixture scattered through the base sulphides, as a distinct mineral, perhaps, yet undistinguishable to the eye and not mechanically separable from the other sulphides.

These questions are pertinent: Does much of this gold sulphide really exist, and is its occurrence more frequent than is supposed? If so, will it prove to be of sufficient importance to modify metallurgical methods?

The World's Store of Tin. E. W. Clappole. *Iron*, **39**, 362—363; *Engineering Mag.* January 1892.

CASSITERITE is almost always found associated with primitive rocks, chiefly granite. It never occurs, as does iron, in seams, or in narrow solid veins, as do galena and some other ores, but disseminated in detached, and often very minute, crystals in the vein-stone. The veins may vary from a few inches to many feet in width, and through this mass the ore is dispersed with great irregularity, large parts being absolutely barren, while through others the cassiterite is diffused in shreds, streaks, and patches. This scanty diffusion in the granite or other matrix, and the small extent of workable tin country yet known in the world, are together the causes of the scarcity and high price of the metal in the market. The only countries in which we have any real knowledge of the geology of cassiterite are Spain, Saxony, Britain, and, to a smaller degree, South Dakota. In all the other regions from which tin is obtained, the ore is for the most part picked up on the surface, and not mined below it.

In Cornwall the granite occurs as a number of bosses projecting through the slates which formerly overlay them, but have been removed by erosion. Dartmoor, in Devon, is the largest of these, and they continue in a south-westerly direction through Cornwall and the Scilly Isles, but not all of them are equally stanniferous. The cassiterite in Cornwall occurs in lodes that traverse alike the granite and the slates, and are consequently of later date than both. These lodes run in a direction from west-north-west to east-south-east, and are cut by a series of cross courses running nearly north and south, and often carrying lead, silver, or manganese, but rarely tin. The country is thus cut up into a number of rudely-rectangular blocks, and the points of greatest productiveness, or pockets, are at the intersections of the lodes with the cross courses.

The Cornish tin-stone is not geologically ancient. That tin ore has, however, been formed in other cases at a later date than that above assigned to the lodes is proved by the discovery of deer-horns so thoroughly impregnated with cassiterite that they were as rich in tin as the average ore of

the county. The lodes of tin ore not unfrequently split up into fine thread-like veins which so penetrate the slate that both must be worked together.

The story of the Dakota tin is very different. There the cassiterite is confined strictly to the granite. But the granite is not a vast erupted mass as is that of Cornwall. It is probably a result of aqueo-thermal action. There is a wonderful similarity between the ores of the two places, indicating similar condition of formation. The tin-bearing lodes are for the most part on the western side of the Black Hills, among the older schists, and are of very different degrees of value. Some of them are of enormous thickness, exceeding 100 ft., but the cassiterite is not equally distributed in them. It is found in strings and patches and sheets, and many of the veins and large parts of others contain none. The granite veins are very numerous, and a large proportion of them are more or less stanniferous. But the percentage, as elsewhere, is very low, about equalling the average yield of the Cornish mines at present in operation. It is not easy to give figures, but a sanguine estimate might put both at 2 per cent., and probably in order to attain this some of the poorer mineral must be excluded.

The tin works of the Erzgebirge Mountains, between Saxony and Bohemia, are of little importance, but deserve notice because the cassiterite does not occur in distinct lodes, but forms a network of small veins traversing the stanniferous rock. A mine in rock of this kind is called a "stockwork." Cassiterite so diffused is more costly to work than the kinds already mentioned, and were it not that the mines have been operated for many years, and that labour is very cheap and appliances simple, the Saxon and Bohemian tin mines could not remain open. In the stock-works of Altenberg the rock is said to contain 0.33 to 0.50 per cent. of cassiterite. Their yield is constantly decreasing, and from some has already ceased.

But all other deposits of tin fade into insignificance with those of the south-eastern regions of the Eastern hemisphere. The wealth of Malacca has been known for centuries, but only of late years have its enormous stores of tin been brought into the market. The long granite axis of the Malayan Peninsula and its continuation in the Island of Banca is traversed by quartz veins containing tin-stone often so pure that it is of a light brown colour or even translucent. From these veins large quantities of cassiterite have been washed down into the valleys, where it is now gathered. The lodes resemble those of Cornwall, but, if we may judge from appearances, must be vastly richer. No attempts have yet been made to work them. All the tin-stone exported is picked up or washed out in the watercourses, as was formerly done in Cornwall. This is the "stream-tin" of the miner, and its collection is called "streaming." It is in Malacca remarkably free from arsenic, sulphur, and wolfram, but whether or not this same high quality will be maintained in the lodes remains to be seen.

Equal in richness and in value to these are the recently-revealed tin deposits of Queensland and New South Wales. The granitic range of the eastern coast of Australia is the matrix from which the tin-stone has been derived, and all that has yet been done is to mine and wash the stream-tin that ages of erosion have accumulated on the surface and in the watercourses. The workings on Vegetable Creek, in New South Wales, have proved wonderfully productive. Ninety feet of basalt cover the sands and gravels of an ancient buried river bed in which the tin ore was found. Below this and under a bed of pipeclay occur the stanniferous sands and gravels 15 ft. thick above water-level. How far they reach below is not known, as the workings at present cease when the water is reached. Later still the developments in Rose Valley have even surpassed these. From this mine, which closely resembles the other, and lies near it, more ore was taken in 1881 than is produced by any of the Cornish mines, with the exception of some half dozen. These Australian tin lodes reappear in Tasmania on a somewhat smaller scale, and considerable ore is now coming from Hobart, more than 3,000 tons having been shipped in 1881.

The following table includes all the regions that now contribute any appreciable amount to the world's stock of tin, or in which the ore possesses any geological interest:—

	Tons of Metal.
Cornwall (1882)	9,000
Saxony (1880)	170
Italy (1880)	16
Russia (1879)	2
Japan (1875)	7
Penang and Singapore (1882)	15,942
Penang and Singapore (1887)	18,515
Penang and Singapore (1888)	25,594
Banca and Billiton (1882)	8,550
Victoria (1880)	105
New South Wales (1882)	6,500
Queensland (1881)	63,000
Queensland (1882)	16,380
	Tons of Cassiterite.
Tasmania (1881)	3,500

The Lechesne Nickel Steel Process. Iron, 39, 1892, 360.

THE Société du Ferro Nickel, of France, has succeeded in obtaining nickel iron and steel containing a large percentage of nickel, and participating in the remarkable properties of this metal (non-oxidisability, brightness, &c.) and susceptible of being substituted for it in a large number of uses from which it has hitherto been excluded by the high price of pure nickel. In continuing the series of ferro-nickels, the lowering the percentage of nickel below 25 per cent. forms a category of metals the new properties of which constitute a special class of altogether peculiar interest. We have here no longer alloys of a somewhat high price, capable, on account of their richness in nickel, of replacing the pure metal, but metals comparable to iron and steel, and in which the intervention of even a small proportion of nickel modifies the constitution of the metal without (in low percentages) materially increasing its cost, and gives to the iron and steel employed an improvement of quality which is very remarkable.

The process consists in the simultaneous employment of manganese and aluminium with or without the addition of carbon, under the form of charcoal, or metallic or ferro-cyanides. In the case of manganese, either pure manganese is used or oxides mixed with a reducer, or ferro-manganese. In like manner for aluminium, either the pure aluminium is used or a mixture of iron and aluminium. The nickel itself is introduced either in the form of pure metal or in the form of malleable metal, or crude metal more or less rich in nickel, proceeding either from the treatment of nickel ore up to the point of elimination of the iron or from previous fusions of cast iron, wrought iron or steel with nickel. It is preferable to take the pure nickel or mixed with iron at the outset of the operation. The manganese, under whatever form it is employed, mixed or not with the chosen carboniser, is added in one or two increments in the course of fusion. The quantity of aluminium necessary is projected at the close of the operation in the bath of metal or in the casting ladle. The best results are obtained, with proportions of aluminium varying from a ten-thousandth to about one-thousandth, and of manganese varying from one-thousandth to about two hundredths per kilogramme of alloy to be produced according to the quantity of nickel and the quality of the metal to be attained.

From the point of view of the carbonising agents, it has been ascertained that according as it is wished to obtain metal soft or hard, carburetted or not, with the same percentage of nickel, carbon or cyanide must be used in variable proportions. In this way it is possible, by the employment of ferro-cyanide with manganese aluminium, without even the addition of nickel, to transform the iron into a tempered steel naturally susceptible of furnishing turning tools without tempering and by direct forging. We shall give, for instance, the best quantities for obtaining on the hearth a ferro-nickel with 5 per cent. of nickel, starting with a nickelliferous pig. The work is proceeded with as for the manufacture of steel, and after partial or complete decarbonisation, according to the quality of the metal to be obtained, metallic manganese or ferro-cyanide

of manganese is added, and at the moment of tapping the aluminium is added either in the furnace or in the casting ladle. For 500 kilogrammes of alloy the proportions are as follows:—

	Kilos.
Pig with 25 per cent. nickel	100
Soft iron or steel	400
Ferro-manganese with 75 per cent. of manganese ..	3
Aluminium	0.25
Total	503.25

The character of the various alloys is as follows:—

These metals possess a much more perfect homogeneity than that of iron or steel obtained by the usual processes, and consequently they have the qualities of malleability, ductility, tenacity, elasticity, &c., to an altogether superior degree. The coagulation of the ingots is very rapid, and bubbles are avoided. Ferro-nickel, with 25 per cent. of nickel, whatever the quantity of carbon, does not take tempering, but according as the proportion of nickel diminishes, the property of being tempered reappears, and goes on asserting itself until with proportions of 7, 5, and 3 per cent. and below, we obtain alloys capable of being tempered according to laws analogous to those which govern the tempering of ordinary kinds of steel. The proportion of carbon, the distribution and special forms of the carbon in the cement and the metallic core (modification due to the presence of the nickel), the fall of temperature between the heating and the cooling, and the rapidity of the cooling, combine to produce various degrees of hardness, as could be predicted by the complete analysis made according to the very exact methods recently discovered, and by the remarkable investigations into the constitution of steel which have appeared of recent years. The influence of the agents of malleabilisation in the application of these processes is demonstrated by the fact that, when these agents are employed without the intervention of nickel, the products obtained present much superior qualities to those of iron and steel treated by the ordinary processes.

The Specific Heat of Aluminium. J. W. Richards. Journ. Franklin Inst. 1891, **133**, 121–124.

In 1855 Regnault calculated the specific heat of pure aluminium from observations on the crude metal to be 0.2181 between 25° and 97°, and later on as 0.2143 between 14° and 97°. In 1882 Mallet determined the mean specific heat of chemically pure aluminium between 0° and 100° as 0.2253. Recently Naccari obtained the following values:—

15°	50°	100°	200	300
0.2135	0.2164	0.2211	0.2306	0.2401

These values show an increase in the specific heat of 0.0095 per 100° and lead to the formulae—

$$S = 0.2116 + 0.000095 t$$

$$Sm = 0.2116 + 0.0000475 (t_1 + t_2)$$

in which 0.2116 is the true specific heat at 0°. The mean value between 0° and 100° would be 0.2164, agreeing well with Regnault's results, but much lower than Mallet's. The author has determined the specific heat of some aluminium made by the Hall process which consisted of—

	Per Cent.
Aluminium	99.93
Silicon	0.07
Iron	Trace.

Three methods of procedure were used. First, a large weight of aluminium (100–200 grms.) was put into an empty calorimeter, the water equivalent of which had been accurately determined by experiment, and allowed to stand several hours. When the temperature was nearly constant,

a known weight of water at a higher temperature was run in, and the total loss of heat calculated from the observations. This method gave mean specific heats between about 16° and 22°.

Secondly, the aluminium was suspended in steam and dropped into the water in a calorimeter. This gave values from 20° to 100°. Thirdly, two exactly similar calorimeters were used. The aluminium and a platinum ball weighing 52 grms. were placed on a platinum support, and heated together either in an air-bath to 120°, or in a small furnace up to 400°, 500°, and 600°. The platinum ball was dropped into one calorimeter and the lump of aluminium into another. From the heat given out by the platinum its temperature was calculated, and the aluminium was assumed to have been at the same temperature.

The third method gave the most concordant results. The first method was used for such a small range of temperature that the experimental errors were large; the second method was defective in default of suitable apparatus to secure the instant transfer of the metal from the steam into the calorimeter. The third method had the advantage that since the platinum and aluminium were taken out of the furnace together and were dropped almost simultaneously into the calorimeters, it could fairly be assumed that they would cool to about the same extent in the two or three seconds during which they were exposed to the air. The author made two experiments by the first method, five by the second, and 16 by the third. By selecting the most satisfactory experiments and combining the results by the method of least squares the following formulae were arrived at—

$$S = 0.2220 + 0.0001 t$$

$$Sm = 0.2220 + 0.00005 (t_1 + t_2)$$

in which 0.2220 is the true specific heat at 0° C.

From these formulae the following data were calculated:—

Temperature.	True Specific Heat.	Range of Temperature.	Mean Specific Heat.
0°	0.2220	0–100°	0.2270
20°	0.2240		
100	0.2320		
625 (melting point)	0.2845	0–625°	0.2533
Total calorie capacity to the melting point.....			158.3

The author's results thus confirm Mallet's determinations of the true specific heats and Naccari's figures for the rate of its increase with the temperature.—S. B. A. A.

Bearing-Metal Alloys. C. B. Dudley. Journ. Franklin Inst. 1892, **133**, 81–93 and 161–172.

In this paper an account is given of analyses and experiments carried out in the laboratories of the Pennsylvania Railway Company during the last 15 years with the object of determining the most advantageous alloy for use in the construction of bearings for axles, crank-pins, &c. for locomotives and other rolling stock.

Bearings made of alloys have the following advantages over those made of cast iron or of the metal of which the journal is composed:—(1.) The friction between the bearing and journal is in general less. (2.) The alloys melt at a lower temperature, and can be more easily shaped. (3.) The alloys take up the wear and thus save the more valuable journals. A good bearing metal should have the following characteristics:—(1.) It should be strong enough to hold up the load, which in railroad practice is often 350–400 lb. per square inch, without distortion, and it should be able to resist the breaking strain to which the bearings are subjected when they are fitted on worn journals. (2.) It should not heat readily. (3.) It should

be susceptible of treatment in the foundry on the large scale and yield sound castings without requiring great care to prevent oxidation. The addition of 1 to 2 per cent. of zinc or of a small amount of phosphorus in the form of phosphor-tin or other alloy generally leads to this result. (4.) Under given conditions of lubrication, &c. the friction should be comparatively small. (5.) The wear of the bearing with reference to the mileage run should be small. The average bearing loses 1 lb. in weight for every 25,000 miles it has been in use. The common metals from which alloys are made for bearings are copper, tin, lead, zinc, antimony, iron, and aluminium. Sometimes manganese, silicon, bismuth, mercury, cadmium, nickel, cobalt, sulphur, arsenic, and phosphorus, occur either as essential or accidental constituents. The following analyses represent samples of various bearing metals submitted to the Pennsylvania Railway Company during the last 15 years:—

CAMELIA METAL.

Copper.....	70.20
Tin.....	4.25
Lead.....	14.75
Zinc.....	10.20
Iron.....	0.55

ANTI-FRICTION METAL.

Tin.....	98.13
Copper.....	1.60
Iron.....	Trace.

WHITE METAL.

Lead.....	87.92
Antimony (by diff.).....	12.08

METAL FOR LINING CAR-BRASSES.

Lead.....	84.87
Antimony.....	15.10
Tin.....	Trace.

SALGEE ANTI-FRICTION METAL.

Zinc.....	85.57
Tin.....	9.91
Copper.....	4.01
Lead.....	1.15

GRAPHITE BEARING METAL.

Lead.....	67.73
Tin.....	14.38
Antimony.....	16.73
Iron.....	Not determined.
Graphite.....	None.

ANTIMONIAL LEAD.

Lead.....	80.69
Antimony (by diff.).....	18.85

CARBON BRONZE.

Copper.....	75.47
Tin.....	9.72
Lead.....	14.57
Carbon.....	Possible trace.

CORNISH BRONZE.

Copper.....	77.83
Tin.....	9.60
Lead.....	12.40
Zinc.....	Trace.
Iron.....	Trace.
Phosphorus.....	Trace.

DELTA METAL.

Copper.....	92.39
Tin.....	2.37
Lead.....	5.10
Iron.....	0.07

MAGNOLIA METAL.

Lead.....	83.55
Antimony (by diff.).....	16.45
and traces of iron, copper, zinc and possibly bismuth.	

AMERICAN ANTI-FRICTION METAL.

Lead.....	78.44
Antimony.....	19.60
Zinc.....	0.98
Iron.....	0.65

TOBIN BRONZE.

Copper.....	59.00
Zinc.....	38.40
Tin.....	2.16
Iron.....	0.11
Lead.....	0.31

GRANEY BRONZE.

Copper.....	75.80
Lead.....	15.06
Tin.....	9.20

DAMASCUS BRONZE.

Copper.....	76.11
Tin.....	10.60
Lead.....	12.52

MANGANESE BRONZE.

Copper.....	90.52
Tin.....	9.58
Manganese.....	None.

AJAX METAL.

Copper.....	81.24
Tin.....	10.98
Lead.....	7.27
Phosphorus or arsenic.....	0.37

ANTI-FRICTION METAL.

Lead.....	88.32
Antimony.....	11.93

HARRINGTON BRONZE.

Copper.....	55.73
Zinc.....	42.67
Tin.....	0.97
Iron.....	0.68

CAR BOX METAL.

Lead.....	84.33
Antimony.....	14.38
Iron.....	0.61
Zinc.....	Trace.

HARD LEAD.

Lead.....	94.40
Antimony.....	6.03

PHOSPHOR-BRONZE.

Copper.....	79.17
Tin.....	10.22
Lead.....	9.61
Phosphorus.....	0.94

EX. B. METAL.

Copper.....	76.80
Tin.....	8.00
Lead.....	15.00
Phosphorus.....	0.20

Metallic lead and many of the white metal alloys are disadvantageous on account of their inability to resist the breaking strain caused by journals of smaller diameter than the bearings (*i.e.* worn journals) and generally on account of their want of strength.

In copper-zinc alloys the wonderful influence of the addition of a small amount of iron is well seen in the so-called Harrington bronze, the analysis of which is given above. After rolling it had a tensile strength of 75,000 lb. per square inch, and an elongation of 20 per cent. in a two-inch section. The method adopted in testing the wear of the different alloys was to have a certain number of bearings made of a standard alloy, and the same number made of the experimental metal placed on the same axes either on locomotive tenders or on cars, one half of the standard and experimental bearings being on one side of the car and the other half on the other side, so that in all cases a standard and an experimental bearing were on opposite ends of the same axle. The bearings were all carefully weighed before going into service, and after a sufficient lapse of time taken out and reweighed. In this way a sufficiently constant ratio could be obtained between the loss of metal in the experimental alloy and that in the standard, whereas attempts made to determine the wear of an alloy absolutely in terms of the mileage gave unsatisfactory results on account of the variations in the load and state of lubrication of each axle. The Phosphor-Bronze Smelting Company's "S bearing metal," containing approximately 79.7 per cent. of copper, 10 per cent. of tin, 9.50 per cent. of lead, and 0.80 per cent. of phosphorus was used as a standard, and 16 bearings of each kind were, in the first instance, attached to locomotive tenders as a preliminary experiment, and if the metal proved favourable, 50 or 100 bearings of each kind were put in service. In the first test the old copper-tin alloy was compared with the standard with the following result:—

COPPER-TIN v. PHOSPHOR-BRONZE.

	Composition Copper-Tin Alloy.	Composition Phosphor-Bronze.
Copper	87.50	79.70
Tin	12.50	10.00
Lead	None	9.50
Phosphorus	None	0.80

Wear.—First experiment, copper-tin wore 48 per cent. faster than phosphor-bronze; second experiment, copper-tin wore 53 per cent. faster than phosphor-bronze; third experiment, copper-tin wore 47 per cent. faster than phosphor-bronze.

It was also found that a much larger percentage of the copper-tin bearings heated than of the phosphor-bronze. The value of the copper-tin alloy is thus seen to be far inferior to that of the phosphor-bronze. It was then observed that arsenic may practically take the place of phosphorus in a copper-tin alloy.

The following experiments were accordingly made with arsenic-bronze:—

ARSENIC-BRONZE v. PHOSPHOR-BRONZE.

(First Experiment.)

	Composition Arsenic-Bronze.	Composition Phosphor-Bronze.
Copper	80.20	79.70
Tin	10.00	10.00
Lead	None	9.50
Phosphorus	None	0.80
Arsenic	0.80	None

Wear.—Arsenic-bronze wore 42 per cent. faster than phosphor-bronze.

(Second Experiment.)

	Composition Arsenic-Bronze (?).	Composition Phosphor-Bronze.
Copper	79.20	79.70
Tin	10.00	10.00
Lead	7.00	9.50
Phosphorus	None	0.80
Arsenic	0.80	None

Wear.—Arsenic-bronze wore 15 per cent. faster than phosphor-bronze.

(Third Experiment.)

	Composition Arsenic-Bronze.	Composition Phosphor-Bronze.
Copper	79.70	79.70
Tin	10.00	10.00
Lead	9.50	9.50
Phosphorus	None	0.80
Arsenic	0.80	None

Wear.—Arsenic-bronze wore 1 per cent. faster than phosphor-bronze.

It will be observed that the first experiment was practically on a copper-tin alloy containing some arsenic, and that this wore nearly as fast as the ordinary alloy (seven of copper to one of tin), and it may be inferred that the utility of arsenic (and phosphorus) is principally confined to the foundry. In the second experiment the introduction of lead effects a marked diminution of the rate of wear; whilst in the third experiment, in the presence of an equal amount of lead in the two alloys the wear is almost the same, the substitution of arsenic for phosphorus having little influence on the rate of wear or on the heating of the bearings. Accordingly an alloy containing more lead than the standard was prepared and tested with the following results:—

"K"-BRONZE v. PHOSPHOR-BRONZE.

	Composition "K"-Bronze.	Composition Phosphor-bronze.
Copper	77.00	79.70
Tin	10.50	10.00
Lead	12.50	9.50
Phosphorus	None	0.80

Wear.—First experiment, "K"-bronze wore 8 per cent. slower than phosphor-bronze; second experiment, "K"-bronze wore 7.30 per cent. slower than phosphor-bronze, "K"-bronze behaves like phosphor-bronze with respect to heating, &c., the only difference being in the rate of wear. During the progress of the experiments it became apparent that there was a law governing the composition of bearing metal alloys which may be stated as follows:—"The alloy which can endure the greatest amount of distortion without rupture will give the best results in wear." Experiments were accordingly made, first with copper and tin to ascertain what proportions of these metals an alloy capable of enduring a maximum amount of distortion should contain, and then to find how much lead could with advantage be added to this alloy. The proportions selected were 9½ parts

of copper to 1 of tin, but it is now doubtful whether 12 or 15 parts of copper to 1 of tin would not have been preferable. It was then observed that the addition of lead has much the same influence on a copper-tin alloy that a diminution of the tin would have, but that as the amount of tin is diminished and the amount of lead increased the tendency of the metal to yield more readily under pressure increases. As a result of several trials, an alloy "B" was made, which gave the following tests:—

ALLOY "B" c. PHOSPHOR-BRONZE.

—	Composition Alloy "B."	Composition, Phosphor-bronze.
Copper	77·00	79·70
Tin.....	8·00	10·00
Lead.....	15·00	9·50
Phosphorus.....	None	0·80

Physical Properties.

—	Alloy "B."	Phosphor-bronze.
Tensile strength, pounds per square inch.....	21,000	30,000
Elongation per cent.....	11	6

Wear.—Alloy "B" wore 13·50 per cent. slower than phosphor-bronze.

This alloy is now, with a slight modification, the standard bearing metal of the Pennsylvania Railway Company, but it is probable that a still further diminution in the amount of tin and increase of the lead would give even better results; a certain amount of tin is, however, necessary to hold the lead alloyed with the copper. In order to utilise phosphor-bronze scrap and to obtain sound castings, the formula actually in use by the Company is the following:—

	Lb.
Copper.....	195
Phosphor-bronze, new or scrap.....	60
Tin.....	9½
Lead	25½

The product is the Ex. B. metal of which the analysis has been given. By using ordinary care in the foundry, keeping the metal fairly well covered with charcoal during the melting, it is quite possible to get perfectly successful castings in car-bearings with the above formula. The whole of the copper and phosphor-bronze can be charged into the pot before placing in the melting-hole; the tin and lead are added after the pot is removed from the fire.

In conclusion, the author points out that besides a high elongation and tensile strength which are required in an alloy to impede the removal of particles by attrition, there is a third hitherto unconsidered factor which affects the wear, namely, the granular structure of the alloy or the size of the particles which may be torn off. This is probably the most important factor, but there are no data on this point, beyond certain observations, that case-hardened iron wears better than either the wrought iron from which it is made or ordinary hammered steel of approximately the same carbon. Theoretical considerations, however, indicate that a finely granular structure is desirable in a bearing metal.—S. B. A. A.

PATENTS.

An Improved Method of Extracting Copper from Ores or Compounds containing the same. T. D. Nicholls, C. James, Swansea, and the Cape Copper Company, Limited. Eng. Pat. 18,898, November 21, 1890.

The process depends on the reduction of oxides of copper by means of cupric sulphide in a reducing furnace.

One portion of copper matte, preferably containing 76—78 per cent. of copper, is roasted in a current of air until the copper is converted into either cupric oxide or cuprous oxide or a mixture of the two, but preferably into cuprous oxide which is more economical, and this is then mixed with an equivalent quantity of raw copper matte, previously ground so as to pass through a $\frac{3}{4}$ -th screen. The mixture of sulphide and oxides of copper is then heated in a close furnace, when the sulphur unites with the oxygen, sulphurous anhydride passing away, and the copper thus obtained is run into ingots direct.

It is claimed that the process may be worked at about one-half the cost of the usual one, that the volatile impurities contained in the matte are expelled more readily during the evolution of the sulphurous anhydride, than is usually the case, and that by employing a flux, the non-volatile impurities are readily separated. Moreover less copper remains in the slags and in the furnace bottoms than is found in the usual process. Although rich ores are preferred, good results are also obtained when working poor ores containing but 30 per cent. of copper.—J. W. L.

Improvements in the Manufacture of Refractory Materials or Articles. J. B. Alzugaray, London. Eng. Pat. 21,212, December 30, 1890.

It is recommended to make the inner wall or lining of crucibles of a layer of finely ground coke, plumbago, graphite or other form of carbon, whilst for the outer coat, mixtures of different infusible materials are recommended.

The different mixtures named are made up of several of the following materials: finely pulverised emery, asbestos, chalk, limestone, graphite, retort-coke, bauxite, quartz, magnetic oxide of iron, kaolin, fire-clay, magnesite. The materials are all finely ground and mixed with about 10 per cent. of their weight of tar or oil, or other carbonaceous material. If desired, on account of economy, to insert between the outer coat and the inner lining a third layer of some cheaper material, this may be done, for which purpose any infusible material that is without action on the other materials may be used.—J. W. L.

Improvements in the Process of Coating or Cleaning Metals. R. Heathfield, Darlaston. Eng. Pat. 500, January 10, 1891.

In order to avoid the use of acids in cleaning the surface of metals before galvanising, the objects to be cleaned are immersed in a solution of ferrous sulphate or chloride, and connected with the positive pole of a dynamo, whilst another set of objects are connected with the negative pole. Metal is dissolved off the surfaces of the objects acting as the anode, and a corresponding quantity deposited on those of the objects which constitute the cathode, a great saving of expense being thus effected.—J. W. L.

Improvements in Treating Waste Liquor from Galvanising Works and other similar Liquors to obtain Ferric Chloride. J. W. Wilson, Manchester, and C. H. G. Harvey, London. Eng. Pat. 6509, April 16, 1891.

See under VII., page 433.

A Process of Using Galvanisers' Wastes. R. J. Brice, London. Eng. Pat. 15,288, September 9, 1891.

The two products which constitute galvanisers' waste, are "sal-ammoniac skimmings" and "zinc-ashes." In order that the skimmings may be economically worked, they should be preserved in casks until required.

The sal-ammoniac skimmings are fused, preferably in an iron pot, the metallic zinc melts and is drawn off at the

bottom, the "waste" is then transferred to boiling water, when it becomes reduced to a fine state of subdivision. Milk of lime is now added to the water containing the waste, in quantity equal to about 20 parts of quicklime to 100 parts of skimmings operated upon. Calcium chloride and zinc oxychloride are thus formed. The solution containing the former is separated, and any ammonia it may contain is separated by the addition of a little more milk of lime and then distilling.

The precipitated zinc oxychloride may be pressed from the liquid, and used as a pigment by itself, or it may be mixed with zinc ashes in quantity equal to the weight of skimmings operated upon, when the pasty mass is dried and calcined, when it becomes much lighter coloured, and forms paint of more than ordinary body and durability. Before mixing the zinc ashes with the precipitated zinc oxychloride, they are screened from the rough particles of metallic zinc.

—J. W. L.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Quantitative Analysis by Electrolysis. F. Rüdorff.
Zeits. f. angew. Chem. 1892, 3—7.

See under XXIII., page 459.

Hoeftner's Electrolytic Copper Process. Eng. and Mining J. April 30, 1892, 471.

This process differs very materially from that of Siemens, in that the copper is precipitated from a cuprous chloride solution, wherein is a great advantage, for the same current will deposit copper from a cuprous chloride solution just twice as fast as from a sulphate solution.

While copper sulphate solution is used in the Siemens and Halske process for the electrolytic separation of copper, Dr. Hoeftner, of Giessen, uses in his process a cuprous chloride solution which deposits 2.36 grms. of copper per ampère hour. The liquid, which is a solution of cuprous chloride in strong brine, or in a concentrated solution of chloride of lime, and which contains 120 grms. of copper per litre, flows through an electrolytic bath with vertical electrodes, in which the anodes and cathodes are separated by diaphragms, but in such a way that there is nevertheless a constant circulation of the solution along both electrodes. At the cathodes metallic copper is deposited from the solution.

If the separate cathodes of such a bath have each a surface of one square metre and the current be 50 amperes per square metre, then there will be deposited on that surface, according to theory, 2.76 kilos. of copper per 24 hours, and Hoeftner asserts that with careful work he can obtain 90 per cent. of the quantity. The loss of 10 per cent. is due to diffusion of the cupric chloride from the anodes through the diaphragm to the cathodes.

The solution flows continuously from the cathode cells after having passed a large number of them and after having deposited its copper. That portion of the cuprous chloride solution which has been flowing during the same time continuously through the anode cells retains its copper entirely, but, owing to atomic changes, free chlorine is generated at the carbon anodes naturally proportionate in quantity to the amount of copper deposited at the cathodes. The nascent chlorine, of course, attacks the cuprous chloride, changing it to cupric chloride, and thereby developing positive electromotive force; that is, electromotive force tending to precipitate more copper at the cathodes, so

that the electrolysis will take place even if there be more than 0.6 to 0.8 volt for each bath, while double that potential would be not necessary if there were no such chlorine depolarisation.

The cupric chloride at the end is mixed with the cathode solution now freed of its copper, and this mixed solution then should contain, according to the theory of the process, only one-half as much copper as before electrolysis, or about 60 grms. of copper per litre.

The copper is now, however, no longer in the form of cuprous chloride, but is present as cupric chloride. It is well known that this latter chloride, heated as a dry powder, will lose half its chlorine, which goes off as free chlorine gas. In solution this salt is well adapted, notably when heated, to dissolve sulphides, especially that of copper from its ores, precipitating free sulphur. On the sulphides of silver it acts in the same way, and of this dissolving power Hoeftner makes practical use.

The copper ores, which may also contain silver, are ground very fine in a Gruson mill, either crude or after having been roasted. They are then raised by an elevator to a platform above the leaching barrels, to which they are afterwards transferred as needed.

The leaching barrels are of wood, of a capacity of 10,000 litres each, and rotate on fixed iron wheels, the rotary motion being obtained by sprocket wheel and chain. There must be three or four such barrels. Each of them is filled with 8,000 litres of the heated solution and a corresponding amount of the ore to be treated, and is then set in motion. The time necessary for the leaching varies of course with the character of the ore. It takes from two to six hours to reduce the cupric chloride solution to the cuprous chloride. In practice the so-called "Methodical Leaching" is resorted to, that is, every portion of ore is leached out twice, first by a solution containing a smaller amount of the cupric chloride, and then by another very rich in that salt, which latter solution takes out the remainder of the copper completely.

When the solution has been sufficiently regenerated, the rotation of the barrel is stopped, the particles of ore fall to the bottom, and the clear solution is drawn off. The solution is then cleaned both mechanically and chemically in special apparatus.

Besides holding copper, the solution contains silver, and certain small quantities of such impurities as lead, iron, arsenic, &c. These are first removed, so as to obtain in the electrolysis afterwards a perfectly pure copper. The silver can be precipitated either chemically or electrolytically. An analysis of the copper deposited by the process of Dr. Hoeftner from very impure ores showed only very small quantities of impurities, which were not sufficient to influence in any way the quality of the product.

The advantages of this product are, according to the inventor: 1. The process yields per unit of current just twice as much copper as a sulphate process. 2. The silver in the ore, which often is of great value, will also be obtained. 3. The conductivities of the solutions are very good and their dissolving power is great.

After having been cleaned the solution goes to the baths for electrolysis, passes through them, and comes out again as a cupric chloride solution, which is again used as a solvent. It is therefore a continuous process, in which the solution circulates constantly, dissolving and precipitating copper in its various stages.

The ore is forced from the barrel in the form of a thick mush, which is washed in a filter-press. It is due to this latter circumstance, i.e., the use of the filter-press, and to the compactness of the plant, that the process requires very little room.

The electrolytic plant for a daily production of 2,000 kilos. of copper needs only 800 square metres, while the entire plant, including machinery and all, would require not more than twice that area.

Since the foregoing article was written, many improvements have been made, one of the most important of which is the abandoning of the carbon anodes. These being so expensive, Hoeftner tried to replace them by another substance, and was finally successful last summer in finding a very cheap anode, and which, like the carbon anodes, does

not dissolve. The analysis of the copper obtained from very impure ores, which is referred to near the end of the article, was made in Fresenius' laboratory in Wiesbaden. The results were as follows:—Sulphur, 0.0004 per cent.; iron, trace; arsenic, trace; antimony, trace; lead, trace; nickel and cobalt, 0.0012 per cent.; molybdenum, 0.0023 per cent. In other words, this copper was as pure as the best copper.

PATENTS.

Improvements in Cells for the Electrical or Storage Batteries, and the Manufacture of Lead for the same. T. W. Bush, Broseley, and M. Doubleday, Nottingham. Eng. Pat. 2471, February 11, 1891.

THE process consists in pouring molten lead into water, or acid, or alkali diluted with water. The material so obtained, named "hydrolised lead," may be placed in vessels separated by porous partitions, each compartment forming a plate. Grids may be placed in the liquid, and then the material is reduced by pressure into uniform thickness; or the grids may be replaced by cocoa-nut matting. This material is also used for separators after being impregnated with plaster of Paris. The plates are held together by wood or vulcanite screw-bolts, thus avoiding the use of binding frames.—G. H. R.

Improvements in Voltaic Cells. H. H. Lake, London. From E. Weston, New Jersey, U.S.A. Eng. Pat. 22,482, December 23, 1891.

THE object of this invention is to provide a standard cell whose electromotive force shall be practically independent of temperature. This may be accomplished in one of three ways: firstly, by using as an electrolyte a saturated solution of cadmium salt with electrodes of other material; secondly, by using an electrode containing cadmium opposed to mercury in a solution of some salt other than cadmium; thirdly, and this is best for a permanent standard cell, cadmium amalgam in a saturated solution of cadmium sulphate opposed to mercury in mercurous sulphate.

—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

The Solid Fatty Acids of Palm Oil. H. Nördlinger. Zeits. f. angew. Chem. 1892, 110—111.

STATEMENTS of text-books point to the possibility of easily obtaining pure palmitic acid by crystallising the palm oil acids from alcohol. The author did not succeed by proceeding in this way, and undertook, therefore, the examination of a specimen of pure Lagos oil, melting at 38° C., and containing 50.8 per cent. free fatty acids (calculated for oleic acid). The oil was saponified and the fatty acids separated by means of sulphuric acid and washed repeatedly with water. The fatty acids were divided into two parts. (Although the author speaks only of the solid fatty acids of the palm oil, he does not state whether and how he separated the solid fatty acids from the liquid acids of the palm oil.)

The author claims the existence of a heptadecylic acid in palm oil, which may be identical with Gerard's daturic acid (this Journal, 1889, 1137), melting point 55° C.

The solid fatty acids of palm oil consist, according to the author, of 98 per cent. palmitic acid, 1 per cent. stearic acid, and 1 per cent. heptadecylic acid.—J. L.

PATENTS.

Manufacture of Fatty Matter from Wool-Fat. F. C. Glaser, Berlin. From O. Braun and O. Liebreich, Berlin, Germany. Eng. Pat. 4992, October 20, 1882. (Second Edition.)

A DESCRIPTION of this process has already appeared in this Journal, 1883, 182; (Braun and Liebreich, U.S. Pat. 271,192). The inventors obtain from the wash-waters of wool-seouring works or from impure commercial wool-fat by means of a hydro-extractor a purified wool-fat, which has the property of combining with water, thus forming a white inodorous, neutral unguent. This purified wool-fat has been termed by the inventors "Lanolin."—J. L.

Improvements in Lubricants for Heavy Machinery. C. H. Ridsdale, Guisborough, and A. Jones, Middlesbrough. Eng. Pat. 3782, March 3, 1891.

IN order to avoid the waste attending the usual method of applying the lubricant to heavy machinery, such as necks of rollers in iron or steel rolling mills, the patentees prepare the lubricant in solid form as blocks, bars, slabs, &c. They use ordinary soap, or an alkali or alkaline earth, or a mixture of both, and add to this mixture saponifiable oils or fats in quantities suitable to produce the hardness required for the special purposes, if the soaps are mixed with mineral oils or mineral lubricants, such as black lead, sulphur, mica, &c. Two recipes will illustrate the composition of these lubricants:—

	Per Cent.
Hard Lubricant:—	
Lime or magnesia.....	3
Ordinary soap.....	6
Rendered suet.....	75
Fine black lead.....	16
Soft Lubricant:—	
Lime or magnesia.....	2
Rendered suet.....	45
Sulphur (fine).....	14
Black lead.....	19
Heavy petroleum oil.....	30

—J. L.

Improvements in the Manufacture of Soap, and in the Utilisation of the Residue of the Substances used therein. R. Stone, London. Eng. Pat. 4454, March 12, 1891.

THE novelty of this invention consists in the use of a combination of fruits or of vegetables. The inventor soaks these materials in 10 per cent. of glycerin or almond oil or palm oil, and mixes the juice expressed from these substances "of a nutritious and skin-healing nature" with soap. For such a soap the property is claimed of being "especially soothing and healing to the skin."

The residues obtained from the soaked material are baked or dried and ground up. This material is to be used as a substitute for coffee, being alleged to be "far more nutritious for the human system than ordinary coffee."—J. L.

Improvements in the Thickening of Oil. W. N. Hartky, Dublin, and W. E. Blenkinsop, Wandsworth Common. Eng. Pat. 7251, April 27, 1891.

LINSEED oil may be thickened and thereby converted into a suitable material for manufacturing oil-skin, oil-silk, oil-cloth, floor-cloth, linoleum, linerusta, &c., by adding a solution of one part of manganese soap or manganese linoleate—as prepared in the manner described in Eng. Pat. 11,629, 1891 (this Journal, 1891, 263)—in two parts of turpentine to the oil to be thickened. Two or five volumes of this soap solution are used for 100 volumes of the oil to be treated. Insoluble matters are allowed to settle out and are removed. The mixture is raised to a temperature of

212° F. (in an apparatus described in Eng. Pat. 11,629) and a current of air or oxygen passed through the oil until it acquires any desired degree of thickness. Thus, *e.g.*, from a linseed oil, sp. gr. 0.937, a clear transparent oil of a pale amber colour, sp. gr. 0.997 (at 70° F.), has been obtained.

Cotton-seed oil may be thickened in the same manner; the patentees use for this oil one volume of linoleate solution to 400 volumes of cotton oil.—J. L.

A New or Improved Method of Treating Oils used for Lubricating and Tempering Purposes, to render the same Incombustible or Fireproof. R. R. Graf, Baltimore, U.S.A., Eng. Pat. 29,512, November 25, 1891.

THE object of the "inventor" is to render lubricating oils incombustible and fireproof, and he proposes to do this by triturating 32 parts of sodium tungstate, 32 parts of sulphate of ammonia, 18 parts of phosphate of ammonia, 12 parts of sal-ammoniac, and 24 parts of sodium monocarbonate in a mortar with sufficient linseed oil to obtain a paste of even consistency, and finally mixing this paste with 520 parts of any suitable heavy oil. It is claimed that this mixture has all the good properties of a lubricant, "the oil being in all respects just as good as before treatment," and can be applied not only to fast-running machinery, as dynamos and electric motors, but also be used with great advantage in tempering steel tools.—J. L.

An Improved Manufacture of Superfatted Soap. C. L. Field, London. Eng. Pat. 21,438, December 8, 1891.

THIS improvement in the manufacture of superfatted soaps consists in adding to soap, made by the cold process, milk, cream, or butter in such quantities that any alkali in excess is saturated and an excess of cream is left.—J. L.

Improvements in Candles or Tapers for Fumigating or Perfuming or Evaporating Purposes. J. Ryder, Manchester. From E. A. Weidemann, Liebenburg, Germany. Eng. Pat. 22,742, December 30, 1891.

CANDLES or tapers for fumigating purposes are manufactured in such a way that the substances, the vapours of which are to perfume or disinfect the air of a room, are closely enveloped by the ordinary material of the candles or tapers. This is effected by either incorporating the perfuming substances with the material of the candles or filling them into tubes which are embedded in the candle material.—J. L.

Improvements in Cauldrons for Melting Pitch and Fatty Substances. B. D. Healey, Bamber Bridge. Eng. Pat. 324, January 7, 1892.

THE invention relates to a mechanical improvement of an apparatus previously patented by the same inventor (Eng. Pat. 11,443 of 1891), and consists essentially in an improved method for drawing off gas and air from the cauldrons and for making the bogie or swivel box for the front wheels of the cauldrons. For details the drawings accompanying the specification must be consulted.—J. L.

Improvements in Process and Apparatus for Extracting Glue or Gelatin and Grease out of Hide and Skin Waste and of Bones at comparatively Low Temperature. L. Bertram, Berlin, Germany. Eng. Pat. 951, January 18, 1892.

See under XIV.—page 447.

Improvements in Cages for Oil Presses. A. Estrayer, Marseilles, France. Eng. Pat. 2264, February 5, 1892.

THE improvement consists in building up the interior of the cage of eight sections which are made to open and close by means of a vertically moving outer cylinder. For details the sheet of drawing should be consulted.—J. L.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

PATENTS.

An Improved Waterproofing and Rust-Preventing Composition, applicable also in the Manufacture of Ink. F. L. Beech, Middleton Junction, and A. Horrobin, Hollinwood. Eng. Pat. 1616, January 29, 1891.

THIS invention has for its object the providing of a solution by which paper, leather, &c., can be waterproofed. The liquid is also applicable as a coating for walls, as a rust-preventer for machinery, and, mixed with colour, as an indestructible ink. The ingredients used are turpentine, asphaltum, resin, alum, and bees'-wax.—E. G. C.

Improvements in the Manufacture of Copying Ink. E. Corn, Turin. Eng. Pat. 3247, February 23, 1891.

THE following are the ingredients of this ink:—Ordinary ink, 690 parts; candied or twice refined sugar, 225 parts; and pure glycerin, 85 parts.—E. G. C.

Improvements in or relating to Sulphuretted Solutions and Compounds used for the Production of Films or Coatings. J. S. Fairfax, London. From F. Crane, New York, U.S.A. Eng. Pat. 3345, February 24, 1891.

THE object of this invention is to produce a substance or compound which is not injuriously affected by exposure to the air, and is waterproof. Such a substance has many applications, as a coating for paper, leather, textile fabrics, or as a substitute for india-rubber in some of its applications. For the purpose, a combination of soluble pyroxylin with sulphuretted oil is employed by the inventor; and good results are stated to have been yielded by the following formula:—Butyl acetate, 7 gals.; petroleum naphtha, 3 gals.; pyroxylin, 15 lb.; sulphuretted oil, 30–40 lb.; and any desired pigment, 1–2 lb.—E. G. C.

Improvements in the Method of and Apparatus for Manufacturing Inlaid Linoleums or Floor Cloths. W. G. Thomson, Halifax, and J. S. Powell, London. Eng. Pat. 4240, March 10, 1891.

See under VI., page 431.

Improvements in the Manufacture of Coloured Rubber Goods or Rubber-Coated Goods, and a Material or Preparation to be used in the said Manufacture. C. Dreyfus, Clayton. Eng. Pat. 17,566, October 14, 1891.

THE inventor states that hitherto colours produced on rubber-coated fabrics have been mechanically mixed with the rubber solution, or with the "swelled" rubber, prepared in the usual way with so-called solvent naphtha. The

novelty claimed is the use of a coloured solvent for the rubber, the lakes produced by treating an aqueous solution of resin soap with metallic salts, or salts of an alkaline earth, and a basic coal-tar dye, being dissolved in the "dissolving naphtha" of commerce, or in benzene. The rubber is then added.—E. G. C.

Improvements in Mucilages, Sizes, and Adhesive Compounds. C. M. Higgins, Brooklyn, U. S. A. Eng. Pat. 22,679, December 29, 1891.

DEXTRIN, 7—9 lb., is dissolved in water, 1 gal., at a temperature of 60°—100° F., and after the solution is cool, half a pint to one pint of 15 vol. hydrogen peroxide solution is added. The patentee claims the production of an "adhesive compound" and the application of hydrogen peroxide as above. The effect of the last-mentioned ingredient is to increase the solubility of the dextrin and to prevent the separation of "dense grayish sediment" which usually takes place when it is not used. "Yellow dextrans act better than white dextrans, but either may be used."

—A. R. L.

Improvements in Mucilages, Sizes, and Adhesive Compounds. C. M. Higgins, Brooklyn, U.S.A. Eng. Pat. 22,682, December 29, 1891.

THE patentee claims the production of an adhesive compound by heating a solution of dextrin and borax in water, and the thickening of the same with an alkali. His invention differs from that specified in U.S. Pat. 244,200 of 1881, in that a larger quantity of borax relatively to that of dextrin, viz., $\frac{1}{16}$ — $\frac{1}{4}$ the weight of the latter, is used, and the mixture is heated or boiled to effect chemical combination. For an ordinary "strong mucilage," the following proportions are used:—Dextrin (preferably white dextrin) is dissolved in an equal weight of water (at 60°—150° F.), together with $\frac{1}{2}$ its weight of borax; to the cool solution $\frac{1}{16}$ — $\frac{1}{4}$ its volume of ammonia (20° B.) or caustic soda lye (40° B.) is stirred in, when the solution suddenly thickens, accompanied by a rise in temperature of about 6° F., and the adhesive qualities of the mixture become considerably enhanced; the order in which the ingredients are mixed cannot be varied. When a saturated solution of alum is added to the solution of borax and dextrin, and subsequently an alkali, the mucilage becomes extremely viscous and adhesive. The mucilage may be dried into a solid granular gum, which is dissolved in water as required. In certain cases dextrin and borax may be mixed together in powder, and when this mixture is dissolved in hot water it yields a very adhesive mucilage on addition of ammonia or other alkali. "The improved compound may be used for sizing paper or textile fabrics, also for size in kalsomine or other washes or paints."—A. R. L.

Improvements in Mucilages, Sizes, and Adhesive Compounds. C. M. Higgins, Brooklyn, U.S.A. Eng. Pat. 22,685, December 29, 1891.

THE patentee describes the production of an "adhesive compound" formed by dissolving dextrin and borax in water, as specified in the last abstract, and stirring into the cool solution $\frac{1}{16}$ — $\frac{1}{8}$ of its volume of 15 vols. hydrogen peroxide which clarifies it. After a few days or weeks, the clear supernatant liquid is drawn off and bottled, or in some cases $\frac{1}{16}$ — $\frac{1}{4}$ its volume of ammonia (20° B.) or of soda lye (40° B.)—a mixture of alum and sodium carbonate may also be used—is added to thicken it. He claims that the mucilage thus obtained is equal or superior to that produced from natural gums, at the same time being much less costly. The "improved compound" may be used for the same purposes as that described in the preceding abstract, and "for any similar uses where a size,

fixative, stiffening, or adhesive substance is required. Sometimes a second addition of hydrogen peroxide is made, which has the effect of rendering the mucilage still clearer and purer.—A. R. L.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Analysis of "Eggio." C. S. Boyer. Journ. Franklin Inst. 1891, 133, 205—206.

"Eggio" is a preparation of the yolk of eggs, and is used for the dressing of fine leathers. Only the ingredients valuable for this purpose, namely, water, ash, and fatty acids, were determined. The results were as follows:—

	I.	II.	III.	IV.	V.
Water	55.64	$\left\{ \begin{array}{l} 56.81 \\ 56.06 \end{array} \right.$	$\left\{ \begin{array}{l} 56.91 \\ 56.45 \\ 56.79 \end{array} \right.$	54.20	$\left\{ \begin{array}{l} 53.75 \\ 53.62 \end{array} \right.$
Ash	$\left\{ \begin{array}{l} 11.73 \\ 11.80 \end{array} \right.$	19.25	$\left\{ \begin{array}{l} 9.46 \\ 9.47 \end{array} \right.$	13.67	16.35
Fatty acids ..	14.66	..	..	16.00	15.23

The water was determined by mixing with ignited sand and drying for 2—4 hours at 110° C.; the ash left on igniting the residue was light grey to white in colour and free from lime.

From a comparison of the analyses with values obtained from pure egg yolk it appears that commercial "eggio" contains from 2 to 5 per cent. more water, and from $3\frac{1}{2}$ to 6 per cent. less fatty acids. The high ash is due to sodium salts added to prevent putrefaction.—S. B. A. A.

PATENT.

Improvements in Process and Apparatus for Extracting Glue or Gelatin and Grease out of Hide and Skin Waste and of Bones at comparatively Low Temperature. L. Bertram, Berlin, Germany. Eng. Pat. 951, January 18, 1892.

GLUE or gelatin of the best quality are only obtained when the extraction is carried out at a low temperature. The inventor proposes for this purpose an apparatus in which the raw material is extracted at a temperature of 75° to 85° C. The apparatus consists essentially of a water-bath which can be heated either by a steam coil placed inside the water-jacket or by a separate steam compartment fastened to the bottom of the vessel. Inside the water-bath the inventor places a vessel made of sheet iron and tinned inside and furnished with a false bottom made of the same material on which the raw material to be extracted is placed and covered with water. By two or three extractions the most valuable parts are obtained; the last quantities are recovered by boiling the material with direct steam, for which purpose the innermost vessel is provided with a lead steam coil. To increase the heating surface of the water-bath hot water tubes communicating with the water-jacket protrude into the inner vessel, in which the extraction is carried out.

There are six claims and one sheet of drawings.—J. L.

XV.—MANURES, Etc.

Formation and Behaviour of Basic Calcium Phosphates and their Relationship to Thomas-slag. O. Foerster. *Zeits. f. angew. Chem.* 1892, 13—22.

See under XXIII., page 460.

XVI.—SUGAR, STARCH, GUM, Etc.

The Technical Analysis of the Calcined Vinasse from Beetroot Molasses. C. Heyer. *Chem. Zeit.* 1891, 15, 1489—1490, 1523—1524 and 1557. (Compare this Journal, 1891, 861.)

The Technical Analysis of the Calcined Vinasse from Beetroot Molasses. Alberti and Hempel. *Chem. Zeit.* 1891, 15, 1623—1624.

See under XXIII., page 462.

A Method of Inversion and Estimation of Raffinose. Koydl. *Oesterr. Zeits. Zuckerind.* 1891, 20, 700.

See under XXIII., page 463.

PATENTS.

Improvements in the Refining or Extraction of Sugar from Raw Sugar Solution, Juice, or Molasses. A. Schneller and W. J. Wisse, The Hague, Holland. Eng. Pat. 5236, March 24, 1891.

A SCRUBBER in the form of a tower is packed with broken brick, earthenware, china, or glass, and the solution containing the raw sugar juice or molasses is thrown in a spray upon the top portion of it. As it trickles over this surface in a downward direction, ozonised air, produced according to the process specified (Eng. Pat. 5222 of 1891; this Journal, 1892, 354), is caused to enter at the lower part of the scrubber, and coming into close contact with the solution, oxidises the impurities contained therein. The solution afterwards collects in a reservoir at the bottom of the scrubber, and is again (as often as necessary) treated in a similar manner in the same, or preferably another scrubber. With more than one scrubber the process may be carried on without interruption. The spent ozonised air may be used for bleaching or other suitable purpose, but if it be desired to destroy the ozone in it, it is led into a furnace.

—A. R. L.

Improvements in and Apparatus for Converting Amylaceous Substances into Soluble Products. W. P. Thompson, Liverpool. From A. H. J. Bergé, Brussels, Belgium. Eng. Pat. 7272, April 27, 1891.

THE patentee claims an improved process for the conversion of amylaceous substances such as "starch, flour, or farina, ground, bruised, or even whole grain" into dextrin-like products in a dry state by means of gaseous sulphurous anhydride; the products being soluble in either warm or

cold water. This may be effected in a closed vessel containing the substances, together with sulphurous anhydride, heated by an oil-bath, but a more uniform action is insured by the use of an apparatus described in the specification. It consists of a cylindrical vessel supported at its extremities by two hollow trunnions in pedestals, and capable of revolving on its longitudinal axis; a steam coil, fed by a tube branching from one of the trunnions, the steam escaping by two pipes provided with valves having an exit at the other trunnion, is placed within the vessel; the trunnions are fitted with stuffing boxes to avoid the escape of steam. A man-hole is attached, capable of being easily opened and hermetically sealed. The vessel is half filled with the amylaceous substance, and gaseous sulphurous anhydride passed in until the air is displaced, when the exit tube is closed, and when the vessel is full of sulphurous anhydride, the temperature is raised from 120° to 190° C., according to the nature of the desired product. When the conversion is complete, the sulphurous anhydride is allowed to escape.—A. R. L.

Improvements relating to the Manufacture of Cube-, Loaf-, and Similar Sugar. W. P. Thompson, Liverpool. From J. Hirsch, Grünau, Germany. Eng. Pat. 21,477, December 8, 1891.

THE patentee claims that his invention provides a method of directly preparing the sugar obtained by the Steffen washing process, or by any other process of refining for table cubes, loaves, &c., without dissolving, clarifying, or filtering such sugar.

A warm mash is prepared in a receptacle above a vacuum apparatus, and in the mash white sugar is mixed with a clarifying liquid or water to a thick paste, and carefully warmed. The vacuum pan is then charged with the mixture, closed, and the air pump applied; the liquid sugar is then brought to the required temperature and finally drawn off. "Blued clear, or blued pure water" is then added to it, and it is boiled down until of the necessary firmness, the masseculite thus obtained being put into moulds to be made into cubes, loaves, &c.—A. R. L.

Improvements in Mucilages, Sizes, and Adhesive Compounds. C. M. Higgins, Brooklyn, U.S.A. Eng. Pats. 22,679, 22,682, and 22,685, December 29, 1891.

See under XIII., page 447.

Improvements in Refining Sugar. E. Langen, Cologne, Germany. Eng. Pat. 420, January 9, 1892.

THE patentee claims that his invention provides a method whereby the total sugar obtainable by crystallisation from the after-products of the refining process is led back into the circuit of this process in the form of an almost chemically pure sugar solution.

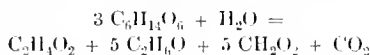
A filtered solution of raw sugar is boiled down to a granular filling mass in the usual manner to obtain No. 1 product of the refining process. The first so-called green syrup is concentrated to a granular consistency, and the resulting mass is agitated with sugar crystals to induce crystallisation, according to the Wulff or Boek process; it being then divided according to Steffen's process of "fractionated washing" into a whitish crystalline magma, consisting of No. 11. product, and low-grade syrup. After pumping off the low grade syrup (see below) from the magma, water is distributed uniformly over its surface in thin streams, whereby all the sugar passes into solution. If the first portion of the solution issuing from the washing vessel be coloured, it is used as boiling liquor for No. 1. product; whilst that subsequently pumped out is employed for the preparation of the clear liquor. The low-grade syrup from No. 11. is concentrated and made to crystallise as described above, the mass produced being subjected to

centrifugal action, and the yellowish granular sugar (No. III. product) used for inducing the crystallisation of No. II. product. The syrup obtained from No. III. product is, as a rule, sufficiently low for treating as molasses, but when this is not so, it may be again subjected to the crystallisation process and No. IV. product obtained, the latter being used to induce the crystallisation of either No. II. or No. III. products.—A. R. L.

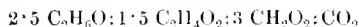
XVII.—BREWING, WINES, SPIRITS, Etc.

The Decomposition of Manitol and Dextrose by the Bacillus Ethacetius. P. F. Frankland and J. S. Lumsden. Proc. Chem. Soc. 1892 [110], 70—72.

The products of the fermentation of both these compounds consist of ethyl alcohol, acetic acid, carbonic anhydride, hydrogen, and traces of succinic acid. When the fermentations are conducted in a closed space there is invariably also a considerable quantity of formic acid produced, whilst in fermentations in an open space (flasks plugged with cotton wool) formic acid, except in traces, is a most exceptional product. The same phenomenon has been already pointed out by one of the authors in the case of a fermentation with another organism (*B. ethacetosuccinicus*), and it is doubtless due to formic acid being one of the primary products of the fermentation, and then breaking up, more or less completely, into equal volumes of carbonic anhydride and hydrogen; this decomposition is, however, retarded when the products—carbonic anhydride and hydrogen—are prevented from escaping, as is the case in fermentations conducted in a closed space. Indeed, the proportion in which the carbonic anhydride and hydrogen were found coincides almost exactly with that in which they are present in formic acid. The proportions in which the several products are obtained from manitol is approximately represented by the equation—



whilst in the case of the dextrose the products occur in the proportions—



Thus, there is more acetic acid in proportion to alcohol and formic acid produced in the case of dextrose than in that of manitol. The carbon dioxide given among the products really represents that liberated from the calcium carbonate present in excess by a fixed acid insoluble in ether, the nature of which could not be determined.

The fermentations conducted in a closed space are always found to be markedly less complete than those which take place in an open one.

There is a close qualitative and quantitative resemblance between these fermentations by the *B. ethacetius* and those previously described by one of the authors as taking place through the agency of the *Pneumococcus* (Friedländer), which renders it probable that this ethacetic decomposition is a very general and typical form of fermentative change.

In reply to a question by Dr. Kipping, he added that it was very remarkable that, notwithstanding both alcohol and acetic acid were formed, no trace of ethylic acetate could be detected among the products.

PATENT.

Improvements in the Process of and Apparatus for Brewing Beer. D. Quertain, Lobbes, Belgium, and H. Becker, Charleroi, Belgium. Eng. Pat. 654, January 13, 1891. (By International Convention), June 14, 1890.

THE "invention consists of a new process for the brewing of beers by one continuous work and by natural decantation by means of new or improved apparatus, and the object of the invention is to obtain a more rapid manufacture to prevent evaporation, to prevent the formation of a head, and to obtain a beer as strong as those now manufactured, at the same time employing a less quantity of malt." In details of this invention the original specification must be consulted.—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A).—CHEMISTRY OF FOODS.

On the Chemistry of the Preserve Industry. W. Renss. Chem. Zeit. 1891, 15, 1522—1523, and 1583.

THE author noticed the presence of lead in some preserves put up in tinned-iron canisters, the latter were constructed by bending the sheet-metal together, thereby avoiding contamination with lead by means of solder and hermetically sealed by india-rubber bands. He subsequently traced the lead to these bands, which contained this metal in the form of minium. On examining red india-rubber bands of French, German, and English manufacture, he found them to contain as much as 60 per cent. of minium.

—A. R. L.

On the Estimation of Fatty Matters in Milk Products. Lézé and Allard. Compt. Rend. 1891, 113, 654—656.

See under XXIII., page 465.

PATENTS.

Improvements in Means for Storing and Preserving Food for Domestic Uses. L. Smith, Chicago, U.S.A. Eng. Pat. 2444A, February 10, 1891.

IT is a well established fact that canned goods undergo a change, and that their delicate flavour is either entirely destroyed or sufficiently altered to render them more or less unpalatable. The cold-storage system also has its disadvantages, apart from the great expense, as food thus preserved must not be kept for any length of time after removal from the cold storage, as it is known to perish very rapidly.

The invention consists in storing the goods in an air tight receptacle from which the air can be exhausted, while carbonic acid is allowed to take its place. This gas, as is well known, has little or no effect upon articles of food, and does not alter their flavour or impart to them an unpalatable taste to any great extent. For further particulars the original specification must be consulted.—L. de K.

Improvements in the Manufacture of Soap and in the Utilisation of the Residue of the Substances Used therein. R. Stone, London. Eng. Pat. 4454, March 12, 1891.

See under XII., page 446.

A New Chemical Food. A. D. McKay, Liverpool. Eng. Pat. 279, January 6, 1892.

To be utilised as food by young children or aged persons who are unable otherwise to retain or assimilate it, milk is subjected to special treatment. The invention consists in adding to the milk, which is preferably first condensed, a large proportion of sugar and pure dextrin, a small quantity of albumen, and a very small amount of both sodium and calcium hypophosphites.—L. de K.

(B.)—SANITARY CHEMISTRY.

Drinking Water and Disease. W. P. Mason. Jour. Franklin Inst. 1891, 132, 356—365.

The author comments on the prevalent ignorance of the pathogenic significance of the presence of fresh-water algae in our city water supplies; he is also inclined to regard water polluted by sewage from healthy persons as less harmful than sewage from pathological sources. Referring to the self-purification of polluted water in running streams, he is of opinion that a very considerable self-purification does take place in running streams, but that what holds good for dilute sewage does not necessarily apply to waters as they approach the limit of potability; in fact, he believes that the rate of self-purification varies directly as the amount of sewage contamination, and therefore, given a stream with a certain amount of pollution, the percentage of this disappearing per mile should continually decrease as the stream flows on. His views find support in the analytical investigations of Dr. Long on the water of the Illinois and Michigan canal. This canal receives its supply of water, or rather dilute sewage, at Bridgeport; it then flows along the level to Lockport, 29 miles below, requiring about a day for its passage. It receives no dilution on the way, but is frequently agitated by passing boats, and it is distinctly shown, by a great number of analyses of samples taken on various dates, but at both Bridgeport and Lockport on the same days, that when the free ammonia, the albuminoid ammonia, and oxygen consumed were very high, the amount of reduction was considerable, and that when they were low the amount of reduction was insignificant. Taking two sets of analyses for example, the numbers obtained are:—

	Free Ammonia.	Albuminoid Ammonia.	Oxygen consumed.
June 6, at Bridgeport.	2.6	0.64	12.0
Aug. 25, at Bridgeport	29.2	1.90	35.2
June 6, at Lockport.	2.8	0.56	11.35
Aug. 25, at Lockport.	13.0	0.88	12.10

This result is better shown in the paper by diagrams giving the numbers mapped in curves. The author points out that even the best of the water samples from this canal are very far from being potable, and he is of opinion that the self-purification of large streams contaminated with city sewage is exceedingly slow, and quotes his experience with the Hudson River water in support of this opinion. He took the precaution, when examining the water supply of Albany, to examine the river both above and below the place where the contamination entered, and although it showed a great improvement between the latter place and Albany, yet when comparison was made with the samples taken above the influx of contamination, the results led the author to condemn the river as a water supply. In another instance he traces an outbreak of typhoid fever in various cities using Hudson River water which had received contamination, whilst cities in the immediate proximity and using Hudson River water taken above such contamination were practically exempt from the outbreak.—D. A. L.

PATENTS.

Improvements in the Method of and Apparatus for Treating Towns' Slaughter-house and other Refuse or Substances or Materials. R. Cunliffe and E. Barlow, Manchester. Eng. Pat. 19,967, December 8, 1890.

The invention consists chiefly in filtering off any solid matter or sludge, or cutting up any animal refuse before subjecting to heat and destructive distillation. The hot gases are withdrawn and burnt; the residue is discharged. The special apparatus, figured, is claimed.—L. de K.

Improvements in Means or Apparatus for Sterilising Water. J. Y. Johnson, London. From "La Société Générale, Herscher and Co.," Paris, France. Eng. Pat. 2051, February 4, 1891.

This invention relates to an apparatus for completely sterilising water under pressure, so as to avoid the loss of the dissolved gases on which its palatability depends. The apparatus is complete in itself and is arranged to work continuously. The water to be sterilised is forced by a steam pump successively through two closed cylinders, each of which is provided with a coil through which hot and already sterilised water circulates. The latter is thus cooled down, whilst at the same time the fresh water in the outer cylinders is fore-warmed. The water then passes on to a sterilising vessel in which it is heated to 120°—130° C. by means of steam pipes and a steam coil supplied with steam from a small boiler. Subsequently the water passes through a filter, and finally is cooled by its passage through the cooling worms mentioned above. The sterilised water leaves the apparatus by a valve-tap which opens at a suitable pressure. The various valves, &c., are so arranged that the pump automatically ceases working until the water in the steriliser has attained the right temperature; or whenever the boiler pressure falls below a certain limit.—H. T. P.

Improvements in the Disinfection and Deodorisation of Sewage, and in the Apparatus for Preparing and Applying the Disinfectant. A. McDougal, Southport, and J. J. Meldrum, Manchester. Eng. Pat. 2846, February 17, 1891.

The prejudicial and offensive products of the decomposition of sewage matter are mainly compounds of sulphur and phosphorus with hydrogen and sulphur, or phosphorus compounds with alkalis, or ammonia. Sulphurous acid decomposes these products with the formation of odourless products, such as hypophosphites or thiosulphates, and on this fact the inventors have based their process. The sulphur dioxide is generated by the combustion of sulphur, pyrites, or spent oxide in a suitable furnace, and as a rule the termination of the action of the gas is conveniently indicated by the change of the liquid from an alkaline to an acid reaction. The sulphurous acid is supplied to the sewage, &c. by a steam injector fitted to the furnace generating the gas.—L. de K.

Improvements in Apparatus for Purifying Water. F. C. Nunn, London. Eng. Pat. 4619, March 14, 1891.

This invention relates to Anderson's revolving purifiers in which water is brought into intimate contact with metallic iron under high atmospheric pressure. The improvement consists in forcing the air into the cylinder through a pipe passing through one of the trunnions. On entering it branches out into four or more perforated pipes running side by side in the form of a grid to the other end of the cylinder. The air escaping from these pipes rises through the water to the top of the cylinder, and escapes through a pipe taken down and out through the other trunnion. The water is led out of the purifier through a long box with a perforated top, and suspended in a fixed position in the cylinder underneath the air pipes as low down as may be to allow the shelves to pass under it as the cylinder revolves. One end of the box is connected by a chamber

to the ordinary outlet pipe. The other box is closed so that the water cannot escape from the cylinder save through the box. The action will be readily understood. As the cylinder revolves, a large quantity of the purifying material is brought up by the shelves fixed in the cylinder and showered down on to the box, covering both box and air pipes and forming a heap by which means the bubbles of air are broken up. At the same time the water is thoroughly brought into contact with both the air and the purifying material on its way to escape through the box. The material is prevented from caking by the revolving of the cylinder.—L. de K.

Improved Process for Purifying Sewage Effluents and other Impure Liquids, and Apparatus therefor. E. E. Seruby, Epping. Eng. Pat. 5330, March 25, 1891.

THE invention consists in first removing as far as possible by the usual processes of settling, filtering, &c. all solid matters. By means of the inventor's apparatus the liquid is then saturated with oxygen, which may be generated in any suitable and convenient manner.—L. de K.

An Improved Mode of and Apparatus for Clarifying Muddy Liquids. R. Dervaux, Brussels, Belgium. Eng. Pat. 5340, March 25, 1891.

THE improved apparatus described is intended to facilitate the deposition of suspended particles from muddy liquids. It consists of a number of superimposed chambers, separated from each other by slanting or conical partitions. The water to be clarified is charged into these chambers from below, either from a common main or by means of separate supply pipes. The mud which settles out passes through holes in the centre or near the lower edge of each partition, to the bottom of the apparatus; whilst the clear liquid flows from the top of each compartment into a vertical collecting pipe. Finally, if necessary, the liquid is forced upwards through a filter, and thus further clarified. Details and drawings of various forms of the apparatus are given.—H. T. P.

A New or Improved Filter-Pump. H. Nordmeyer, Breslau, Germany. Eng. Pat. 7155, April 25, 1891.

See under L., page 422.

Improvements in Apparatus for Purifying or Treating Water. E. Devonshire, London. Eng. Pat. 11,735, September 1, 1891.

THE invention relates to apparatus for purifying water by bringing it into intimate contact with iron "or other chemically acting material," and aerating the water, and especially for "producing uniform contact between all the water and the purifying material, and air or gas." The invention consists in a vessel, chamber, or tank having a water inlet and outlet and grids or open-work partitions at intervals in the chamber with means for polishing them.

An elaborate description of the apparatus is given, but it cannot be well understood without the accompanying drawings.—L. de K.

Improvements in the Disposal of Sewage, and Apparatus connected therewith. J. Norris, Egham. Eng. Pat. 20,726, November 28, 1891.

THE inventor proposes a new method for the disposal of sewage without the ordinary cesspool, and for the prevention of the accumulation of sewer gas. A chamber called the fresh air inlet chamber has its sides and ends lined with glazed bricks. Its slopes at the bottom are of concrete, lined with white glazed tiles, and at the bottom is an enamel overflow pipe to carry off the liquid portion of the soil. The chamber is covered in by a hinged iron grating. The soil drain from the water-closet enters the chamber about one foot from the bottom. Underneath its orifice

is placed a strainer, the sides and ends of which are made of galvanised iron wires about $\frac{1}{2}$ in. apart, the top of the strainer being open. The bottom of the strainer is made of galvanised sheet iron punctured all over with holes of about $\frac{1}{2}$ in. in diameter, and turned up about 2 in. all round. A handle is fitted to the strainer so that it may be daily taken out and replaced, and it is also kept in its proper position by means of two iron rods. When the soil enters the strainer, its solid portion is retained, but the liquid portion passes into the chamber and is carried off by the overflow pipe. The solid contents should be daily removed and mixed with earth. A current of fresh air passes through the iron grating of the inlet chamber through the soil drain, which is connected with an ordinary ventilating shaft.—L. de K.

A New or Improved Method or Process for Purifying Sewage or Foul Waters. J. T. Wood, Rochdale. Eng. Pat. 22,747, December 30, 1891.

ACCORDING to this process, sewage is purified by subjecting it, in a finely-divided state, to the action of a current of air, air and oxygen, ozone, or other suitable gas. In practice the sewage to be treated flows through a screening chamber, and from thence passes over a suitable distributing mechanism into an oxidising chamber. During its descent into the latter, the sewage encounters a blast of air, &c. under pressure, with the result that it is converted into spray and becomes saturated with the gas. At this stage, any chemical precipitant that it is desired to add is projected into the spray by means of a hopper with revolving rollers. Subsequently the sewage flows into tanks where the suspended matters are allowed to settle. The clear supernatant liquid is then further purified by passing it over an "oxidising stairs" the "risers" or "faces" being provided with openings which communicate with tubes conveying air, &c. under pressure. It is claimed that by this process the oxidation will be more vigorous and complete than by any other means, that it will require less area for its operation, and can be applied indiscriminately in all cases. Modifications of the air-blast process, applicable to filter-beds and to weirs of rivers, are described. For details and drawings of the apparatus the original specification must be consulted.

—H. T. P.

(C).—DISINFECTANTS.

PATENTS.

Improvements in Supplying Disinfectants to the Flushing Pipes of Urinals, Water-Closets, and the like. T. Panario, London. Eng. Pat. 4287, March 10, 1891.

BY this invention simple and efficacious means are provided whereby disinfectants can be supplied to the flushing pipes of urinals and water-closets in a definite quantity. Various disinfectants can be used in and with the apparatus. Any solid disinfectant soluble in water, such as permanganate of potash, or any heavy liquid such as carbolic acid may be employed. The disinfectant is put into a receptacle which is tightly attached to the outer end of an elbow block in a preferably vertical position. When a flush is given, the rush of water will create a vacuum and so draw a portion of the disinfectant from the receptacle and cause it to mingle with the water.—L. de K.

A New or Improved Manufacture, being a Disinfectant, Antiseptic, Deodoriser, Vermin and Insect Destroyer, and also applicable for use as an Ingredient in and as Fire-lighters. A. Lutschannig, Liverpool. Eng. Pat. 4352, March 11, 1891.

THE leaves (needles) and young branches or shoots of pine or other resinous trees are broken, shredded, and dried, or pulped or otherwise reduced to a small condition and dried. If desired the material may further be teased and the dust separated from it by sifting. This preparation constitutes a valuable disinfectant for sick rooms, hospitals or similar places. When desired it may be

mixed with other disinfectants. It is also a good vermin or insect destroyer, and the inventor particularly recommends to spread it over the floors of dwelling rooms before sweeping these. In the application of the substance as a fire-lighter it must be mixed with an equal weight of rosin or like inflammable material. After melting the mixture it must be moulded by pressure into blocks of suitable form and size.—L. de K.

Improvements in the Method of Vaporising Carbolic Acid and other Disinfectants, and in Apparatus therefor. C. Scott, Belfast. Eng. Pat. 9083, May 29, 1891.

For the purpose of disinfection, carbolic acid or any other volatile disinfectant is subjected to the action of heat in a vessel having a large surface internally and a small bell-shaped mouth or aperture to admit the disinfectant and allow the vapour thereof to escape, by which means large quantities of the disinfectant volatilise in a moderate space of time.

After the vessel has been placed in the fire and made red hot it is removed into the room where the persons, animals or their belongings are to be disinfected, and after external air has been as far as possible excluded, the carbolic acid is poured into the vessel.—L. de K.

Improvements in and relating to Soluble Quinoline Antiseptics. A. Lembach, U. Schleicher, and C. J. Wolff, Biebrich, Germany. Eng. Pat. 18,913, November 3, 1891.

It has been proved that quinoline and toluquinoline possess great antibacterial properties, but the complete insolubility of these substances in non-acid fluids presented a serious obstacle to their becoming available for general use.

The inventors have at last succeeded in finding a suitable solvent, and there is now nothing in the way of the technical and commercial application and use of the said substances as antiseptics. The invention consists in using soap in the nascent state. For instance, to 50 kilos. of a suitable oil, such as castor oil, is added 50 kilos. of quinoline, and also 15 kilos. of hydrate of potash in 50 kilos. of water. The mixture is boiled until the saponification is quite complete, which stage is indicated by the perfect clearing of the liquid, which must then be diluted with another 85 kilos. of water.—L. de K.

Improvements in Candles or Tapers for Fumigating or Perfuming or Evaporating Purposes. J. Ryder, Manchester. From E. A. Weidemann, Liebenburg, Germany. Eng. Pat. 22,742, December 30, 1891.

See under XII., page 446.

XIX.—PAPER, PASTEBOARD, Etc.

Determination of Mechanical Wood Pulp in Paper. R. Godeffroy. Mitt. k. k. Techn. Gew. Museums, 1891, 295.

See under XXIII., page 464.

On the Quantitative Determination of Mechanical Wood Pulp in Paper. J. Bandisch. Papier Zeitung, 1891, 16, 2414–2415.

See under XXIII., page 464.

Bisulphite Process: Boiler Tests. Papier Zeitung, 1891, 16, 2699.

The progress of the treatment in the digesters is best followed according to A. Harpf, by the results of the "ammonia test," precipitation of neutral sulphite, together with those of the iodine titration, of samples of the liquor withdrawn from time to time. Such purely empirical evidence as colour, smell, and viscosity are adopted by the "practical man" often as his only guide, and it must be admitted with satisfactory results.—C. F. C.

Straw Boiling. Papier Zeitung, 1891, 16, 2700.

In boiling straw for straw boards it is recommended to introduce the quicklime directly into the boiler: and in districts where only inferior lime is obtainable, a proportion of soda ash should be added. The mixed lime and soda boil is an economical variation of the ordinary treatment in the case of refractory straws, or where the supply of water for washing purposes is not abundant.—C. F. C.

On Cellulose and its Forms: Cellulose Gum. W. Hoffmeister. Landw. Versuchsstat. 1891, 39, 461.

THE author formerly held the view that the cellulose might be dissolved out of plant-tissues by dilute alkalis when certain substances, "incrustations" are removed; his present experiments prove that this is not exclusively the case. He confirms the observation, however, that the cellulose can be quantitatively extracted in the pure state on treatment with "chlorine mixture" and ammonia. By direct treatment gum-like compounds are obtained; whilst to isolate these previous extraction with soda-lye is necessary. They may also be obtained by treating the tissues with glacial acetic acid and ammonia in the warm; and by dissolution in ammoniacal cupric oxide solution, but the form of the cellulose undergoes alteration by these methods. The author names that form of cellulose which is soluble in caustic alkali in accordance with Tollens' proposal "cellulose gum." This has, however, various forms which may be spoken of collectively as cellulose gum-like substances. To prepare "cellulose gum" in the pure state the raw material is necessarily extracted with ether, alcohol, water, and dilute ammonia; the residue is either extracted with ammoniacal cupric oxide solution to separate the cellulose from the lignin, or when this is not needful digested direct with dilute ammonia on the water-bath. If starch be present it is removed by digestion on the water-bath with glacial acetic acid and a few drops of hydrochloric acid, or better still with malt extract. After digesting the residue for a long time with ammonia and washing it, it does not give the lignin reaction, but this substance is still present. The cellulose is then extracted with ammoniacal cupric oxide solution, more or less "cellulose gum" can then be separated from the cellulose thus obtained, by extraction with 5 per cent. soda-lye. Hard woods may be initially extracted with hot glacial acetic acid. The "incrusting substances" or their decomposition products may be obtained from the glacial acetic acid and ammoniacal extracts. A. R. L.

The Influence of Moisture on the Vegetable Sizing of Paper. P. A. Hasselkuss. Chem. Zeit. Rep. 1891, 15, 326.

THE more humid the air is during the sizing of paper the less successful is the operation; slow drying is better than quick. It cannot be stated for all descriptions of paper beyond what limit of humidity deficient sizing is produced. There is however for all kinds of paper a certain maximum, and the thicker the paper is the more water can it take up without deleterious influence on the sizing; 5–8 per cent. may be placed as an average amount of water for paper to contain. When paper is sized in a too moist condition its defects can be remedied by keeping it for three weeks to three months in dry air; whereas even a well-sized paper

is spoiled by keeping it in a damp room. The alternating action of dry and moist air (containing more than 80 per cent. of moisture) appears to be exceedingly harmful. Paper containing a large quantity of "cellulose or straw-pulp" is not affected by moisture, i.e., as regards its sizing.

Letter or post-card paper which require well sizing, and where the tinting is not of so much importance, should contain 15—30 per cent. of "cellulose or straw-pulp." Better and more durable papers to which the addition of "cellulose" is inadmissible should only be stored in dry rooms.

—A. R. L.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

On "*Phenocoll*," an Antipyretic and Antirheumatic. Schmidt. Pharm. Zeit. 1898, 36, 585.

(1) (4)
 "*Phenocoll*," $(C_2H_5O)_6C_6H_4 \cdot (NH \cdot CO \cdot CH_2 \cdot NH_2)_2$, is prepared by treating *p*-phenetidine with acetyl chloride, whereby chlorophenacetine is produced, and then treating this product with ammonia. It has the antipyretic properties of phenacetine, while by reason of its superior solubility and better resorption, its action is more prompt. It is a monacid base; the acetate forms interlaced needles, and is soluble in $3\frac{1}{2}$ parts of water; the salicylate crystallises from water in long needles, and combines the therapeutic properties of phenocoll and salicylic acid. The following tests are given for the hydrochloride:—0.5 grm. dissolves to a clear solution in 15 cc. of water, which should not give a reaction with red litmus paper; on addition of caustic potash a white crystalline precipitate of the base separates; it leaves no residue when ignited on platinum foil. When the base is heated with a little water it melts, but resolidifies to a crystalline mass on cooling.—A. R. L.

On *Pental*, C_5H_{10} , an Anæsthetic. Holländer Therapeut. Monatsh. 1891, 5, 509.

PENTAL is the name given to the amylene $CH_3 \cdot CH_2 \cdot C(CH_3)_2$ boiling at 38° . It is prepared by heating "amylene hydrate" with acids, and is a colourless liquid, which is insoluble in water, but miscible in all proportions with alcohol, chloroform, and ether, and is extremely volatile; when inhaled it does not in any way injure the mucous membrane of the mouth and breath passage. The narcosis produced by pental comes on by degrees, and headache or vomiting are not produced during the narcosis nor afterwards; the author could observe no effect either on the heart's action or on the respiration. It acts quicker than chloroform, and it has the advantage over "bromether" that the narcosis lasts longer, that unpleasant after-actions are not produced, and that even in large doses it appears innocuous.—A. R. L.

Lupanine. C. Leibeck. Arch. Pharm. 1891, 531.

LUPANINE from the blue lupin yields a hydrochloride of the composition $C_{15}H_{24}N_2O \cdot HCl + 2H_2O$.—D. A. L.

Sophorine. C. Plugga. Arch. Pharm. 1891, 561.

ACCORDING to the author, sophorine from *Sophora tomentosa* is presumably identical with cytisine.—D. A. L.

Atropine and Hyoscyamine. W. Schütte. Arch. Pharm. 1891, 192.

HYOSCYAMINE in solution, even in the form of auro salt, it is found is converted into atropine by repeated crystallisation, or by frequent evaporation, or by prolonged storage. In roots of young plants of *Atropa belladonna* hyoscyamine only is found; in those of old plants atropine is also found. The percentage of alkaloid varies according to the season.

	Percentage in Young Roots.	In Old Roots.
Spring.....	0.13	0.17
Summer.....	0.45	0.36
Autumn.....	0.46	0.28

The leaves contain besides a little atropine much hyoscyamine. Atropine and hyoscyamine are both found in the ripe berries of cultivated *Atropa belladonna nigra*, but in the berries of the wild plant atropine only is found; the ripe fruit of the yellow atropa also only contains atropine, whilst the unripe fruit of the wild black nightshade, the leaves of both the yellow and black wild plants and both fresh and old seeds of *Datura stramonium* contain principally hyoscyamine with a small quantity of atropine. *Datura stramonium* seeds also yield a small quantity of skopolamine.—D. A. L.

Further Researches on Ash-free Albumen. E. Harnack. Ber. 1892, 24, 204—209.

THE author has succeeded in preparing a form of albumen which differs in many respects from the modifications hitherto described. It is prepared by treating an alkaline albumen solution (free from corpuscles) with copper sulphate solution, re-dissolving the filtered precipitate in a little alkali (soda), and re-precipitating with dilute acetic acid, decomposing the precipitate with strong caustic potash solution, and after allowing the solution to stand for 24 hours it is treated with excess of hydrochloric acid, and the precipitate is washed. When the excess of hydrochloric acid is removed the substance becomes soluble in water, is free from ash, but still retains from 1 to 2 per cent. of hydrochloric acid, which can be removed by dialysis. As the last portions of acid leave the albumen solution, it becomes a transparent jelly, which on boiling with water becomes compact and white with a crystalline appearance and character, especially on drying. Alcohol brings about a similar transformation of the jelly. The crystalline powder is insoluble in pure water, but dissolves at once on the addition of a trace of hydrochloric acid. An excess of the acid would re-precipitate the albumen from this solution. The dialysed substance is of course soluble in presence of a trace of free alkali. The change produced by boiling seems to be a transformation of the colloid into the crystalline modification, but the question whether changes have thereby taken place in the albumen molecule must be left for further elucidation. The possibility of the soluble hydrochloric acid compound being identical with acid albumen is negatived on a comparison of their reactions.

	Acid Albumen.	Ash-free Albumen.
In water.....	Not soluble	Soluble.
In dilute hydrochloric acid...	Soluble	Not soluble.
On adding alcohol ether, &c. to the solution.	Precipitated	Not precipitated.
On adding excess of hydrochloric acid to the solution.	Not precipitated	Precipitated.
On adding neutral salts to the solution.	Partially precipitated.	Precipitated.

—G. H. B.

On the Testing of Liquor Ammoniac. J. Hertkorn.
Chem. Zeit. 1891, **15**, 1493.

See under XXIII., page 457.

Researches on Digitalin. J. Houdas. Compt. Rend.
1891, **113**, 648—651.

THE existence of this substance which is characterised like saponin by the property of causing water to froth, was first noticed in the *Digitalis* by Horndle and Quevenne in 1840. It was isolated by Walz in the amorphous state (Jahresh. f. prakt. Pharm. **14**, 20), and has been studied by Nativelle (Journ. de Pharm. et Chim. **20**, 81), Goerz (Dupat thesis, 1873), Kausmann (Journ. de Pharmacie, **20**, 427), and finally by Schmiedeberg (Arch. f. Experiment. Pathologie, **3**, 16). Schmiedeberg admits the existence of two digitalines soluble in water, which he calls *digitouin* and *digitalin*. The author showed in a memoir read before the French Academy of Medicine in 1891 that Schmiedeberg's products consist almost entirely of one substance, for which he keeps Nativelle's name, *digitalin*. The aqueous solution obtained in the preparation of digitalin was treated with absolute alcohol according to Schmiedeberg's directions, and then fractionally precipitated with ether. The precipitates, after repeated fractionation, yielded the same body as that precipitated by absolute alcohol. Digitalin cannot be crystallised from an aqueous solution, but if an alcohol of the fatty series, e.g., methyl, ethyl, or amyl alcohol be added to this solution a crystalline compound of hydrated digitalin and the alcohol is obtained. The solubility of the crystals thus found decreases as the molecular weight of the added alcohol increases. If amyl alcohol be added to a concentrated solution of digitalin, the solution rapidly crystallises out if the solution be sufficiently concentrated the mass may become solid. Phenols act in the same way as alcohols. Digitalin crystallised from ordinary alcohol is obtained in the form of fine needles radiating from a centre, which lose their alcohol and water of crystallisation at 110°. Digitalin is slowly soluble in cold, rapidly soluble in hot, water; the solution froths on agitation, and on evaporation yields a glassy mass. It is a glucoside. It is only slightly soluble in absolute alcohol, and almost insoluble in chloroform, ether, and ligron. The aqueous solution is levo-rotatory $[\alpha]_D^{25} = -49.25^\circ$. On heating the substance it does not distinctly melt; about 250 degrees it agglomerates; at 270°, froths; at 280°, is converted into caramel. It appears to be unalterable in the air, both in the solid and dissolved states. It is soluble without colouration in cold hydrochloric acid, and the solution on heating turns to a red violet colour with a slight green fluorescence. With sulphuric acid diluted with an equal bulk of water it gives a yellow colouration in the cold which turns first red then black on heating. The solution yields a precipitate with tannin and ammoniacal lead acetate. Analysis suggests a formula $C_{31}H_{52}O_{17}$, but this can only be looked on as tentative until the decomposition products are better known. The author rejects Kiliani's formula (Ber. **23**, 1555, and **24**, 339; this Journal, 1890, 820; and 1891, 567) $C_{27}H_{44}O_{13}$. By cautiously acting on digitalin with dilute acids it has been split up into two new glucosides without any liberation of glucose. These products and a new glucoside derived from the amorphous digitalin of the Codex will be described shortly.—P. J. H.

Coca Leaves. J. Holmes. Chem. and Druggist, **40**, 580.

IN commerce there are two kinds of leaves, the dark green, strong Bolivian, or Huanoco, and the light green, Peruvian, or Truxillo leaf. A third variety of leaf is that cultivated in the island of Java, which is occasionally met with in the markets of the world, and has the reputation of being a very carefully dried article. About four years ago Mr. Morris, of Kew, in an exhaustive paper on coca, described a variety which he called "Novogranatense," which has narrower leaves and is of a paler green colour than the Bolivian leaf, and this is the variety which appears to yield the

Java leaf of commerce. With regard to the respective alkaloidal values of the various leaves, Peruvian and Bolivian leaves yielded cocaine and isotropyl-cocaine in almost equal parts, whereas the Java leaves gave less cocaine than the two former. In this country, cocaine was generally prepared by purifying the crude cocaine manufactured in Peru, and the Java leaves were therefore all used by the German cocaine makers. So far as cocaine manufacture is concerned the leaves of the *Erythroxylon Bolivianum* are preferred, and of this variety the pale brown leaves are the best. The leaves of young plants contain more than double the quantity of alkaloid found in the leaves from old shrubs, and moisture caused a considerable loss in the yield of alkaloid. The variety described by Mr. Morris tapers at the base and the flowers have a short stigma. The cultivated Java leaves are not so long as Mr. Morris's "Novogranatense" leaf. They are broader in the middle, the flowers have longer stigmata, and the habit is different from that of the others. The brown Bolivian leaf, finally, has a more leathery appearance and the midrib shows a distinct ridge.

Cinchona. J. Holmes. Chem. and Druggist, **40**, 580—581.

At a meeting of the Pharmaceutical Society nine varieties of bark were exhibited and described. Mr. Thomson, a Colombian planter, had discovered some of these barks in the central range of the Colombian Andes while travelling in that region a few years ago; others were cultivated by him upon his plantation. Analyses of the barks showed them to be of remarkable average richness, the following being the figures given:—

	Quinine Sulphate.	Quinine.	Cinchonidine.	Cinchonine.	Quinidine.	Amorphous.
Thomsoniana	5.94	4.45	0.27	0.82	0.26	0.74
Ledger Verde	4.90	3.68	0.00	0.01	0.20	0.44
Negra	7.30	5.48	0.00	0.10	Trace	0.78
Morada	3.06	2.30	0.00	0.04	0.50	0.38
Tuna	9.04	6.18	0.40	0.38	0.18	0.42
Pombiana...	5.88	4.41	0.34	0.02	Trace	.26
Orcinalis....	6.32	4.74	1.23	0.10	0.07	0.42
Succirubra .	5.93	4.15	2.77	0.12	0.02	0.36
Hybrid	3.32	2.49	1.92	0.04	Trace	0.52

The three last named kinds are well-known varieties, and not natives of Colombia, any more than the Ledgeriana Verde and Morada. The tree yielding the bark marked "Negra" was discovered by Mr. Thomson in 1883. It grows at an altitude of 8,000 feet, attains maturity with singular rapidity, resembling, in this respect, the Succirubra variety, and is exceedingly rare. Both flowers and leaves are very large; the latter have a rich brown colour and hairy undersurface. They are without the scrubby leaves, or little warts, the existence of which has been held to indicate alkaloidal richness. Whether, as a matter of fact, rich barks are always collateral with scrubby leaves may be doubted. The microscopical structure of the *Negra* bark indicates a relationship to that of the *Lancifolia*. The tree grows slowly and does not appear to prosper so well under cultivation as in the wild state. It received from Mr. Thompson the name of "Negra" (black), because of its deep claret-coloured petioles, by which the peons are able to distinguish it from other kinds. In the Tuna bark ("tuna" is a native word of uncertain meaning), the richest of all Mr. Thompson's varieties, the resemblance to the Ledger species is very evident. Like all other kinds belonging to the *Lancifolia* group, the bark of this species contains numerous stone cells, fairly well distinguishable under the microscope; in the soft or middle layer there are no stone cells; in the other layers the cells are now arranged in solitary lines, now in clusters. The Pombiana variety was discovered in 1883 in Ecuador by a

gentleman living in that country, and whose name had been given to it. The *Pombiana* does not in histological structure resemble any of the cinchonas, but it is like the myrtaceous plants. Its leaves are small and glossy, and its foliage is very dense. The capsules also are small (a fact which, in cinchonas, is held to presage richness in quinine). The wood fibres form distinct oblong groups like those of the *C. lancifolia*, the leaves are leathery and narrower than those of the *C. pitayensis*, the flowers are hairy on the under-surface of the corolla, the petals are hairy all over, whereas in nearly all true cinchonas the petals are only fringed with hair. In *C. pitayensis* there are no stone cells in the middle layers of the bark. The *Pombiana* may be said to form a link between the Pitayo and the *Lancifolia*, or "soft Colombian," species.

Eucalyptus Oil. J. Holmes. Chem. and Druggist, 40, 581.

THE author referred to the introduction of *Eucalyptus Globulus* oil, and the great differences which were noted in the qualities of commercial oils as soon as eucalyptus began to be popular. Within the last two years a new kind of oil had appeared in the market under the name of *E. oleosa*, which had a cuminalike odour, very different from that formerly known as *oleosa* oil. The fact was that the oil which formerly went by that name was the Mallee scrub oil, a mixture distilled from four species which grew together, and the new *oleosa* is a distinct variety. He expressed the opinion that although the original reputation of eucalyptus oil was based on the *Globulus* variety, it had, in reality, happened that for years the *amygdalina* oil was the only one which came on the market, and even yet, this oil is preferred for inhaling in lung-diseases.

Artificial Salicylic Acid. Chem. and Druggist, 40, 590—591.

THE investigation completed about two years ago by Messrs. Dunstan and Bloch, and supplemented by Professor Charteris, left it somewhat uncertain as to whether artificial salicylic acid can be obtained absolutely identical with the natural product—at least, on a commercial scale. Apart from the work of these investigators, which undoubtedly served to call special attention to the salicylic acid question in this country, much has been done to show that a determination of the melting point of the acid is the best criterion of its quality, and it has been admitted that the boiling point figure, 155° C., is too low. In this connexion Messrs. Helbing and Passmore have just completed an examination of a well-known brand of salicylic acid and its sodium salts, the result of which, as published in "Helbing's Record," contains several interesting points. The investigators confirm previous observations, in stating that the melting point of the pure acid is slightly below 157° C.—to be exact 156·85°—156·86° C.—and they find that fractionation of the silver salt is the quickest and surest means of determining the purity of the acid, since any cresol derivatives which may be present accumulate and come out in the last fractions. In one respect, it is a matter of regret that Messrs. Helbing and Passmore were not dealing with a less pure acid than they had, for in the worst sample, melting at 156·4°—156·75°, the amount of impurity was only about 0·1 per cent., whilst Messrs. Dunstan and Bloch dealt with acids melting at 154° C., and the like. In fractional crystallisation with silver, a known weight of the acid is first converted into the sodium salt, and freed from carbonic acid by adding a trace of nitric acid, and boiling. During ebullition a 10 per cent. solution of silver nitrate is added in quantity sufficient to precipitate from a tenth to a fifth of the salicylic acid. Silver salicylate is practically insoluble in hot water, and, unlike lead salicylate, has no tendency to the formation of basic salt, a disadvantage which gave Messrs. Dunstan and Bloch much trouble, and to which is probably due the want of regularity in the melting points of their fractions. After the first fractionation with silver,

a second, third, and fourth, or even more may be made using increased quantities of silver nitrate until 50 or 60 per cent. of the acid has been precipitated, and then decreasing the size of the fractions. Much depends upon the initial melting point of the acid; should this be low, it is advisable to keep the larger fractions towards the end, so as to accumulate the impurities in them. The acid is regenerated from the silver salicylate by digestion with boiling water and an excess of hydrochloric acid, the mixture filtered, the salicylic acid crystallised twice and dried. The melting point of each fraction is then determined. In one case Messrs. Helbing and Passmore found four fractions from a "physiologically pure" acid melted at the same temperature, viz., 156·85° C., the residuum melting at 156·84° C. The sample was, therefore, "chemically identical with the natural acid from oil of wintergreen." As showing the delicacy of this method of testing, it is observed that the last fraction of another specimen (7 per cent. of the quantity taken) melted at 156·3° C., the others being normal, and the last of another (10·5 per cent.) melted at 155·9° C. As Fischer found that the presence of 1 per cent. of cresotic acids reduces the melting point of salicylic acid by about 1° C., it is obvious that these last fractions give a very critical indication of quality, especially when the initial melting points only vary from the normal by fractions of a degree. It is demonstrated then that silver fractionation ensures true separation of salicylic acid from its objectionable contaminants. Another point brought out by the investigation is that sodium salicylate in crystals is anhydrous, or practically so, the loss on drying at 104° C. being only 0·24 per cent., the boiling point formula ($\text{NaC}_6\text{H}_5\text{O}_3$), H_2O requiring 5·3 per cent. The loss of scale salicylate was 0·23 per cent. and of powder 0·19 per cent. The obvious conclusion is that sodium salicylate does not contain water of crystallisation, the little which there is present being mechanically retained after drying.

Safrol. Chemist and Druggist, 40, 592.

THE importation into Europe of the waste product, camphor oil, from the distillation of camphor in Japan, has turned out to be a veritable mine of industrial, if not monetary wealth. At first the oil had solely a medicinal application, but the study of its constituents resulted in the discovery of several valuable components. The most important of these is safrol—the sassafras-like body to which the peculiar odour of the oil is due. This was first isolated by Schimmel, and has since been used extensively to cover the odour of the fatty bases of soap. The discoverers report that the use of the article for this purpose is as great as ever, and that, mixed with citronella or cassia oil, it is also extensively employed, such mixtures being made more lasting by the addition of a little cedar-wood oil. One part of the mixture is sufficient to add to 1,000 parts of common household soap basis. Under the name of "safrine," safrol has been introduced in America as artificial oil of sassafras. The specific gravity (1·108) indicates its source; ol. sassafras, U.S.P., having a specific gravity about 1·090.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

The Chemical Changes attending Photographic Operations. H. E. Armstrong. Chem. News, 65, 181—184.

THE author describes the electrolytic action of the De La Rue-Müller cell and compares it with the similar action which attends development. He discusses the influence of bromide as a restrainer, and the accelerating effect of alkalis. In the case of ammonia being used as the accelerator, the addition of bromide prevents the solution of silver bromide in the ammonia; and the image is probably not

composed entirely of silver, but of a species of pigment, possibly formed by the dissolved silver and the colouring matter from the oxidised developer, to which also the formation of the peculiar fog which often occurs with ammonia and pyro-developers may be attributable. In the case of alkalis being used as accelerators, the bromide has a different action, probably that of neutralising the hydrobromic acid formed and thus preventing the reversal of the action which would otherwise take place. Also, as a silver haloid in the presence of an alkali and reducing agent tends to undergo reduction, the accelerating effect of adding alkali may be understood, as well as the restraining influence of bromide which tends to reverse the action. The author, contrary to Meldola's view, suggests that the invisible image is not the same as the darkened product formed on development, i.e., an oxyhaloid compound of silver; that there are perhaps two latent images formed, one by the blue and the other by the yellow rays, these behaving differently during development. The blue image being silver and the yellow silver oxyhaloid, the former being comparable with the silver wire in the De la Rue-Müller cell, whilst in the case of the latter the silver bromide undergoes electrolysis in a circuit which includes oxygen, the halogen which is liberated converting the silver formed by the action of the blue rays into silver haloid; but in gelatin plates this halogen is taken up, still after a time depending on the exposure, the gelatin will become saturated, and the silver would tend to become rehalogenised; this view being borne out by the phenomena of over-exposed plates flashing out on development, owing to the richness in oxyhaloid. If sufficient bromide was present the oxyhaloid may be converted into haloid, and so the flashing out prevented. Finally, the author compares the sensitiser to oxygen as influencing the solution of copper in sulphuric acid.—J. C. C.

PATENT.

Improvements in Photographic Printing Processes. W. W. J. Nicol, Birmingham. Eng. Pat. 7312, April 28, 1891.

THE use of silver salts for the developing mixture described in the inventor's previous patent (this Journal, 1890, 413) is connected with certain inconveniences. In order to obviate these, the silver solution is employed for the preparation of the sensitising solution, along with suitable proportions of certain organic iron salts (citrate, oxalate, or tartrate), and if desirable, with the potassium and ammonium salts of these acids. The material thus prepared is exposed to light under a screen and the ferrous image then developed with an alkaline salt of carbonic, acetic, or any other of the above enumerated organic acids. In certain cases addition of potassium chromate will be necessary. The resulting prints are washed in dilute ammonia and finally in water.

In an alternate method the print may be developed at once with dilute ammonia, which may hold in solution any of the enumerated developing salts.

In a third method the paper may be prepared with a mixture of ferric salt, silver salt, and a developing salt; the sensitised surface is then exposed to the action of the light and the print washed in ammonia.—H. A.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENTS.

Improvements relating to the Manufacture of Nitro-substitution Compounds of Cellulose. H. Maxim, Crayford. Eng. Pat. 4129, March 7, 1891.

The object of this invention is to produce nitrocellulose of a high grade with a less consumption of acids than has hitherto been necessary. In carrying out the invention two immersion baths are employed, the first containing the

usual mixture of strong acids. In this, the cotton is immersed for 5–6 minutes and conveyed with about six times its own weight of acids to the second bath, which contains a large excess of slightly weaker acid mixture. The partially nitrated cotton remains for 16–48 hours in this bath until the nitration is completed, and the large excess of acids prevents any fuming off through heating. The strength of this second bath is maintained by the portion of stronger mixture introduced with each batch of cotton from the first.—W. M.

New or Improved Explosive Compositions. E. von Brank, Boppard-am-Rhein, Germany. Eng. Pat. 5027, March 20, 1891.

This invention relates to the manufacture of powders containing potassium chlorate, for shooting and blasting purposes. The composition of the powders is as follows:—

SHOOTING.

Potassium chlorate.....	100 parts.
Boiled linseed oil.....	40 parts.
Lead oxide.....	1·5 parts.

BLASTING.

Potassium chlorate.....	100 parts.
American resin.....	15 parts.

In the blasting powder the ingredients are mixed to a stiff paste with a decoction in water or vinegar of a gum-giving plant, the mass being afterwards dried and granulated.—W. M.

Improvements in Explosives. C. H. Curtis, London, and G. G. Audriè, Dorking. Eng. Pat. 5821, April 4, 1891.

THE object of this invention is to obtain an explosive the explosiveness of which can be regulated at desire, and at the same time to render it proof against atmospheric changes, and producing greater cohesion between the fibres. Gun-cotton or other nitrocellulose compound is taken wet and treated with a warm solution of gelatin, whereby its fibres or particles become coated with a thin film of gelatin. The material is then further treated with tannic acid for the purpose of rendering the film of gelatin insoluble and imputrescible.

The thickness of the film should be such as to increase the weight of the nitrocellulose about 5–10 per cent. according to the degree of explosiveness desired.—W. M.

Improvements in the Manufacture or Production of Gun-powder or like Explosives. J. Y. Johnson. From "The Dynamite Actiengesellschaft Nobel," Vienna, Austria. Eng. Pat. 6129, April 9, 1891.

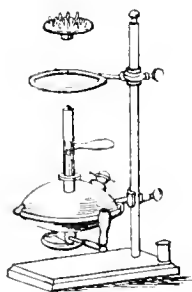
THE object of this invention is the manufacture of a smokeless powder from nitrocellulose without the addition of substances which dissolve or gelatinise the nitrocellulose. Nitrocellulose in a state of fine meal is mixed with di- or tri-nitro derivatives of benzene, toluene, xylene, or naphthalene, the proportions of nitrocellulose to the said nitro-derivatives depending on the projective force required, varying from 99 to 70 parts by weight of the former to 1 to 30 parts by weight of the latter.—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

Spirit Blast-Lamp. Chem. Zeit. 1891, 15, 1494.

The lamp consists of a brass reservoir or kettle with a copper bottom, and is filled with commercial spirit. The side tubulus terminates with a safety valve. A small quantity of spirit is placed in the dish under the kettle and ignited, whereby the spirit contained in the kettle is boiled and its vapour escapes by two tubes, one terminating at the bottom



SPIRIT BLAST LAMP.

of the kettle, and the other having the form of a Bunsen burner extending from the top portion of it. The vapour escaping from the lower tube is ignited by the flame from the dish, and it serves to keep the evolution of vapour continuous. On now igniting the vapour escaping from the upper tube, a flame resembling that of a Bunsen burner is produced, which melts 2 mm. copper wire with ease, and brings 1 litre of water to the boiling point in eight minutes. The two flames are regulated by cocks shown in the Figure.

—A. R. L.

INORGANIC CHEMISTRY.—
QUANTITATIVE.

On Volumetric Estimations and Methods of Separation by Means of Potassium Ferro- and Ferriyanide.
C. Luckow. Chem. Zeit. 1891, 15, 1491—1492.

In the titration of zinc with potassium ferriyanide any iron present must be previously removed as ferric oxide, or the titration must be made in an ammoniacal solution, the iron having been previously oxidised to the ferric state; certain metals, however, as, for example, silver, do not form ferriyanides insoluble in ammonia. The author finds that many metals may be titrated with potassium ferriyanide in acid solution, even in the presence of ferric salts, and that with the exception of gold, platinum, antimony, and arsenic, those metallic salts which do not form insoluble compounds with the ferriyanide may be estimated with the ferriyanide, these are mercuric, ferric, manganic, uranic, stannic, and lead salts. For the estimation of zinc and lead in the presence of one another, the former is titrated in a solution acidified with nitric or acetic acids with ferriyanide (the zinc ferriyanide may also be weighed), and the latter in the filtrate from this with ferriyanide. Stannic oxide is evaporated with oxalic acid, the solution acidified with dilute sulphuric acid and estimated either gravimetrically or volumetrically with ferriyanide, the separation from antimony and arsenic being thus effected. The ordinary impurities in commercial potassium ferriyanide—chlorides, sulphates and sodium salts—need only be removed in dealing with such metallic salt solutions as precipitate them. The solution of the ferriyanide undergoes slight changes in direct sunlight; whilst the ferriyanide is influenced both in the dry state and in solution by temperature and light. In recrystallising the latter the temperature should not be raised above 50°—60°, and the solution is cautiously treated with chlorine to oxidise any ferriyanide produced; it should not give a precipitate with lead salts.

The indicators, which cannot be added to the solution, may be either such as react with the metal or with the precipitant. Of the former kind a mixture, zinc salt, ammonia, ammonium sulphide, and rosolic acid, is conveniently employed with those metals forming dark sulphides, it being easy to determine the complete precipitation of the metal by the appearance of the rosolic acid colour in the place of the sulphide; whilst of the latter kind copper acetate solution acidified with acetic acid or ferric chloride is used for ferriyanide, and cobaltous, or better, ferrous salts for ferriyanide.—A. R. L.

On the Testing of "Liquor Ammoniac." J. Hertkorn.
Chem. Zeit. 1891, 15, 493.

ACCORDING to the German Pharmacopœia "spirits of ammonia" should only give a slight turbidity on addition of an equal volume of lime water. When, however, a current of carbonic anhydride is passed over the surface of this liquid or it is allowed to remain in the presence of carbonic anhydride, it frequently still only gives a slight turbidity with lime water which cannot be removed by filtration; if, however, the liquid be boiled a copious white precipitate falls. Since this cannot be due to the presence of ammonium carbonate, the author ascribes it to the formation of ammonium carbamate which also pre-exists in the solution; this compound, as is known, breaks up on heating into ammonia and carbonic anhydride. Commercial ammonia solution (100 cc.) sp. gr. 0.921 was diluted with an equal volume of water (free from CO₂), lime water (200 cc.) added, and the mixture placed aside for an hour, when it was slightly turbid. On boiling the mixture for one hour 0.031 grm. CaCO₃ was precipitated, and the same quantity when the ammonia solution was boiled alone for an hour and the lime water subsequently added. As such an ammonia solution might on the above given official test be taken as free from carbonic anhydride, and used for determinations which are vitiated by its presence, the author recommends that the directions of the German Pharmacopœia for the testing of "liquor ammoniac" be altered to the following:—"A mixture of equal parts of spirits of ammonia and lime water should only show a slight turbidity after boiling."—A. R. L.

On the Estimation of Manganese by the Chlorate Method.
W. Hampe. Chem. Zeit. 1891, 15, 1579—1580.

A COMMITTEE appointed by the "Verein von deutscher Eisenhüttenleute" recently stated in their report on the estimation of manganese (Stahl und Eisen, 1891, 11, 373) that the chlorate method devised by the author (Chem. Zeit. 1883, 7, 1106; 1885, 9, 1083 and 1513; this Journal, 1885, 690) only gives good results when used in a modified form, and when the titre of the solutions are determined exactly as the actual titration is carried out. The author contends, and gives most cogent reasons, that the proposed modifications add nothing to the accuracy of the method.—A. R. L.

Quantitative Analysis of Sulphides. P. Jannasch and V. Wasowicz. J. Prakt. Chem. 1892, 45, 94—102. (See also this Journal, 1890, 769.)

This paper gives an account of the working out of a method for analysing quantitatively molybdenum glance, realgar, and orpiment; in the determination of the sulphur ignition in oxygen is effected and the sulphur dioxide formed is collected, not in bromine water as usual, but in hydrogen peroxide solution.

Analysis of Molybdenum Glance.—The finely powdered mineral was heated in a platinum boat in a current of oxygen, and the evolved gas was bubbled through a three per cent. solution of hydrogen peroxide (free from sulphuric acid), contained in three flasks, or better, two flasks, and a cylinder as the final vessel, the cylinder being merely a check, need not contain so much peroxide as the others

The combustion lasted an hour and a half, an excessive temperature having to be guarded against to prevent the possibility of sublimation of molybdic acid.

The boat was removed from the combustion tube while still hot and the contents found to be, as is necessary, perfectly white. When cold the boat and its contents, which were proved to be free of sulphuric acid, were weighed, and then warmed on a water-bath for an hour with ammonia in a porcelain dish; the reddish insoluble residue was filtered off and washed with ammonia, and finally with ammoniacal water. To the filtrate (after heating for some time on a water-bath to remove ammonia) a solution of mercurous nitrate was added; the precipitate was filtered off after 24 hours, washed with a very dilute solution of mercurous nitrate, then dried at 110°C ., and as completely removed from the filter-paper as possible. What remains on the paper is dissolved by extremely dilute nitric acid and run into a Rose's crucible in which it is taken to dryness on a water-bath, after which the dried precipitate previously removed from the paper is added, and the whole reduced to metallic molybdenum in a current of hydrogen, heating being at first performed by a Bunsen flame, afterwards by aid of the blow-pipe. Complete reduction occupied two hours.

The reddish residue insoluble in ammonia was shown to contain merely oxide of iron and silica; the iron was removed by sulphuric acid and precipitated by ammonia.

For determination of the sulphuric acid the hydrogen peroxide solutions were evaporated on a water-bath to small bulk, a few cc. of dilute hydrochloric were then added, and the sulphuric was precipitated with barium chloride in the usual way.

A number of results obtained show close agreement with each other.

Analysis of Realgar and Orpiment.—These were burnt in oxygen as in the foregoing case of molybdenum, and the products passing away were bubbled through hydrogen peroxide. The hydrogen peroxide was subsequently evaporated to a smaller bulk on a water-bath, and then excess of ammonia was added and magnesia mixture free from sulphates. The whole was allowed to stand 24 hours, then filtered and washed, and dissolved in hydrochloric acid. The precipitate was again brought down, a few drops of magnesium chloride being added, filtered off, washed, dried at 100° , and ignited like the molybdenum precipitate. The sulphuric acid was determined in the filtrate after evaporation of the ammonia.

Results obtained are very good. In a note Jannasch remarks that no priority can be claimed for the method, and all that is claimed is the proof that the method is applicable generally to inorganic sulphides (besides organic). The mode of carrying out the analysis is simpler than the method used by Sauer (see this Journal, 1890, 330).—T. L. B.

The Determination of Sulphur in Galena, and in Minerals containing Lead. P. Jannasch and K. Aschoff. J. Prakt. Chem. 1892, **45**, 103—109.

AFTER trial of a number of methods for oxidising the sulphide by means of oxygen, the following was adopted as the only one capable of giving complete oxidation. The galena is very finely powdered and introduced into a porcelain boat, which is then placed in a combustion tube; the whole is then heated, a quick current of oxygen containing oxides of nitrogen (obtained by bubbling the oxygen through fuming nitric acid) being passed the while. Hydrogen peroxide is used in the receivers (see foregoing abstract). For about 20 minutes a dull red heat only is necessary, then a higher temperature is used for an hour. The nitric acid bottle is replaced by a flask containing ammonium carbonate, which is gently warmed, and the current of oxygen is replaced by a current of air. After half an hour's strong heating the chief reaction begins, and is evidenced by fusion of the material in the boat; completion of the reaction takes place in less than an hour from this point. The residue in the boat is now completely oxidised and contains no sulphate, the whole of it having passed as ammonium sulphate to the receivers.

The replacement of oxygen by air during the second part of the operation is rendered necessary owing to the liability to explosions; during the use of the ammonium carbonate it is likewise absolutely necessary to watch all passages, as blocking may occasionally occur.

Comparative analyses show:—

—	Dry Way.	Wet Way.	Theory.
S	13.32	13.50	13.40
Pb	85.99	85.47	86.60
Gangue	0.42	0.42	..
	99.73	99.39	100.00

The method as described is perfectly easily applicable to the analysis of the mineral boumonite; it is to be noted, especially in this latter case, that the temperature must be raised to redness quite gradually, after which heating at a strong red heat for an hour and a half in a current of air and ammonium carbonate takes place as before.—T. L. B.

Wet Methods of Analysis of Galena. P. Jannasch and K. Aschoff. J. Prakt. Chem. 1892, 110—111; and P. Jannasch and T. Bickes, J. Prakt. Chem. 1892, **45**, 111—113.

THE use of chlorine may be conveniently replaced by bromine as follows:—

The powdered mineral is treated in a large crucible with tolerably strong nitric acid, and the sulphur thereby separated is oxidised by bromine. The lead sulphate is dissolved in caustic soda and the whole is largely diluted with hot water, so that the gangue may be filtered off. Now, instead of chlorine being passed into the solution, bromine is added and allowed to act in the cold, heating on the water-bath being resorted to finally for purposes of driving away the bromine.

Another convenient method of analysis is as follows, the lead being precipitated by hydrogen peroxide in ammoniacal solution. Half a gram. of the finely-powdered mineral is oxidised as before in a large porcelain crucible and the whole is then taken to dryness. The residue is evaporated three or four times with concentrated hydrochloric acid, so as to decompose the small quantities of lead bromate formed, and the lead sulphate then got into solution by aid of 10 cc. of ammonia and 10 cc. of glacial acetic acid together with the necessary amount of water. This solution, covered, is warmed on the water-bath and filtered from gangue, the filter being washed thoroughly with a hot dilute solution of ammonium acetate. Lead is precipitated in the filtrate by addition, in the cold, of a mixture of ammonia and hydrogen peroxide; at the end of an hour filtration may be performed, the washing being done with cold water. In order to obtain a good result precipitation must be performed in the well-cooled solution. The sulphur may be determined in the usual way by precipitation with barium chloride, in the filtrate.—T. L. B.

Employment of Cadmium in Gold Bullion Assays. C. Whitehead. Jour. Franklin Inst. 1891, **132**, 365—369.

GREAT difficulties are encountered when it is desired to determine a small percentage of silver in bullion containing platinum or copper or both. Making an alloy containing added silver and lead is unsatisfactory, inasmuch as the comparative insolubility of lead nitrate renders it impossible to extract all the silver-lead alloy from the gold. The author recommends as successful the following modification of Balling's cadmium treatment:—0.5 gram. of the refractory bullion is heated with 10 grms. of potassium cyanide; when the latter is well fused 1 gram. of cadmium is dropped in and the molten mass is poured on a slab to cool. After washing, the alloy, being very brittle, is pulverised and

treated with nitric acid, sp. gr. 1.278, along with 1.004 grm. of silver; the total silver is then determined either as chloride or thiocyanide, neither of which determinations are interfered with by the cadmium nitrate. The result is compared with a proof assay made with 1.004 grm. of pure silver dissolved in the same amount of acid.—D. A. L.

Quantitative Analysis by Electrolysis. F. Rüdorff.
Zeits. f. angew. Chem. 1892, 3—7.

In reference to this branch of analytical chemistry, the author remarks, that proposed methods for the estimation of particular metals by means of electrolysis are not only very numerous but to some extent contradictory, so that it is difficult for chemists to make a selection. The author has therefore submitted all the proposed methods to comparative practical tests, in order to ascertain which are the most suitable for use in an ordinary laboratory where costly and exceptional apparatus are not readily accessible. The requirements, in his opinion, are:—A cheap source of electricity, which must be always available and simple to handle; and a method as exact and as reliable as the ordinary gravimetric methods now in use. Of all the sources of electricity investigated by the author, including dynamos, accumulators, Daniell's cells, Bunsen's elements, &c., the Meidinger elements are accepted as the most generally suitable for the purpose under consideration. These elements are neither dear to purchase nor to keep in order, and when properly charged their activity remains for months almost unaltered. The strength of current obtainable from them, as indicated by cc. of water-gas per minute in a voltameter is as follows:—

	Cc.
8 elements.....	2.6
6 "	1.9
4 "	1.2
3 "	0.8
2 " about.....	0.02

The apparatus employed by the author consists of a platinum dish 60 mm. high, 75 mm. diameter at the top, about 40 grms. weight and 170 cc. capacity, and a piece of thick platinum wire bent into a helical form at one end. The condition of the precipitated metal is greatly influenced by:—1. The intensity of the current; 2. The concentration of the solution; and, 3. The substances added to the solution undergoing electrolysis. It is in this latter point that most of the proposed methods vary. In the estimation of copper, for instance, by the Luckow method, so much nitric acid is added that the precipitated metal has to be washed while the circuit is still closed, which is undesirable; and Classen's suggestion of adding an excess of ammonium oxalate does not improve matters. The following is a successful method:—A solution containing 0.1 to 0.4 of copper as nitrate or sulphate, after any free acid has been neutralised with ammonia or soda, is mixed with 5 drops of nitric acid, sp. gr. 1.20, diluted to about 100 cc. and electrolysed with 2 to 6 Meidinger elements over night. When the electrolysis is complete, about 10 drops of a saturated solution of sodium acetate are added, the circuit is then broken and the bright pale red precipitate of copper adhering firmly to the dish is well washed, drained, dried at 100° and weighed.

The presence of chlorides would cause the metal to form a spongy deposit, but this is prevented by adding 2 to 3 grms. of ammonium nitrate, 20 cc. of ammonia, sp. gr. 0.91, and water to make volume up to 100 cc., then electrolysing with 4 to 6 Meidinger cells, and when precipitation is complete, saturating any free ammonia with acetic acid, before opening the current. In the presence of iron, 2 or 3 drops of concentrated sulphuric acid are added instead of the nitric acid, the precipitated copper has not then such a good appearance, but the estimation is nevertheless trustworthy. Mercury is readily estimated in a solution containing 0.1 to 0.3 grms., any free acid being first neutralised by alkali, to which any of the following additions are made:—5 drops of nitric acid, sp. gr. 1.20; 5 drops of dilute (1:10) sulphuric acid; 1.5 grm. of tartaric acid, and 10 cc. of ammonia, sp. gr. 0.91; 5 cc. of nitric acid;

10 cc. of a saturated solution of sodium pyrophosphate, and 13 cc. of ammonia, or about 1 grm. of potassium cyanide, making up to 100 cc. with water, and electrolysing over night with 2 to 6 cells. Then adding 10 cc. of the saturated solution of sodium acetate, disconnecting, and washing the bright mirror or adhesive lustrous globules of deposited mercury first with water, then with alcohol, allowing to drain and ultimately to dry over sulphuric acid. For the electrolytic estimation of silver, the addition of ammonium sulphate and ammonia has not proved satisfactory in the hands of the author, but excellent results are obtained by using a solution containing 0.1 to 0.3 grm. of silver, neutralising any free acid with soda, adding slight excess of potassium cyanide, making up to 100 cc., and electrolysing over night with 3 to 6 Meidinger cells. The dull white adhesive precipitate of silver is washed with water and dried at 100°. The best process for estimating nickel, in the absence of chlorine, is by adding 25 cc. of a saturated solution of ammonium sulphate and 25 cc. of ammonia, sp. gr. 0.91, to a solution containing from 0.1 to 0.3 grm., diluting to 100 cc., and electrolysing with 3 to 6 elements over night. The moderately bright, platinum like, adhesive deposit of nickel is washed with water, dried at 100°, and weighed. With 20 cc. of a saturated solution of sodium pyrophosphate instead of the ammonium sulphate the nickel separates out dull and grey. Cobalt is estimated in the same way as nickel, using six to eight cells; the deposit is dull and grey. In the case of cadmium various additions give unsatisfactory results, and as sodium acetate and acetic acid, or oxalates, in ammonia, or sodium pyrophosphates and ammonia, the following treatment is, however, efficient: The neutral solution, containing from 0.1 to 0.4 of the metal is mixed, until clear, with potassium cyanide, made up to 100 cc., and electrolysed with three to six cells over night. The dull grey adhesive precipitate of cadmium is washed first with water, then with alcohol, and dried at 70°—80°. Of the numerous suggestions for estimating manganese, the author selects the following:—The manganese must be present only as sulphate, and must not exceed 0.04 grm. in quantity. To such a solution three drops of dilute (1:10) sulphuric acid are added, and the volume is made up to 100 cc.; two cells only are used for the electrolysis, or six cells may be divided between three dishes working simultaneously, and the dish is connected with the positive electrode and not the negative as in all the cases hitherto considered. The precipitate is washed with water, drained, dried over sulphuric acid, and then at 60°, inasmuch as at this temperature the composition remains constant as $MnO_2 + H_2O$, and the author considers this mode of procedure more trustworthy than ignition to Mn_2O_3 ; the numbers obtained multiplied into 0.523 give the proportion of manganese in the precipitate. The dry precipitate is brown with metallic lustre and adheres well to the dish. The dish in this instance is best cleaned by dissolving the precipitate in very dilute sulphuric acid, to which some hydrogen peroxide is added; in the other instances the same object is effected by the use of dilute nitric acid. Further communications on the fifth subject are forthcoming.—D. A. L.

Estimation of Aluminium in Ferro-Aluminium. E. Donath.
Zeits. f. angew. Chem. 1892, 13.

The author, referring to F. Regelsberger's paper on the estimation of aluminium in its alloys (this Journal, 1891, 1033), points out that he investigated the cyanide method in 1880, and found that the presence of much iron was unfavourable. Therefore, when small quantities of aluminium are to be determined in the presence of large quantities of iron, it is considered preferable to precipitate all the aluminium with a little of the iron, and proceed with the estimation in this precipitate. Moreover, for the reduction, the author prefers using sodium sulphate to either sodium hydrogen sulphite or ammonium cyanide suggested by Regelsberger; working with boiling ammonium cyanide is any way not agreeable.—D. A. L.

A Quick and Reliable Method for the Decomposition and Analysis of Ferrochrome. H. N. Warren. Chem. News, 65, 186.

The finely powdered substance is treated in a flask with strong sulphuric acid and gently heated, SO_2 is evolved, and the heat is raised until the sulphuric acid begins to volatilise. In this way the ferrochrome is completely dissolved in a few minutes. A few drops of hydrochloric acid are added, the solution is diluted, filtered, and made up to a known volume. An aliquot portion is titrated with standard bichromate for iron; and the chromic and ferric hydrates precipitated in another portion, from these the percentages of iron and chromium may be obtained.

—J. C. C.

Formation and Behaviour of Basic Calcium Phosphates and their Relationship to Thomas-slag. O. Foester. Zeits. f. angew. Chem, 1892, 13—22.

The proneness of calcium and phosphoric acid to form basic salts has long been realised. Thus it is known that tricalcium phosphate is decomposed and yields up some of its phosphoric acid to hot solutions of sodium or potassium carbonate, or when ignited with these salts; and, moreover, when the hydroxides of these metals are used in moderately strong solution, a residue remains containing calcium oxide and phosphoric acid in the proportions of 10 mols.:3 mols., and to which the formula $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaO}$ has been ascribed. The same compound is obtained whether mono-, di-, tri-, or pyrocalcium phosphate is employed. With very strong alkali and prolonged boiling the proportion of phosphoric acid remaining in the residue can be reduced to 1 mol.:4 mols. of lime. The compound $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaO}$, prepared by igniting di- or tricalcium phosphate with calcium dihydroxide or carbonate, although not attacked by dilute alkali, can be brought to yield a residue of 1 CaO :1 P_2O_5 with very strong alkali. Whilst basic cinder and tetra-calcium phosphate, obtained by strongly igniting di- or tricalcium phosphate with the requisite proportion of lime, yields up their phosphoric acid more readily still, and leaves a residue in which the proportion of phosphoric acid to lime is 1 mol.:5 mols. Sugar solution does not extract lime from the products, $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{Ca}(\text{HO})_2$, of the decomposition of di- or tricalcium phosphates, thus showing that all the lime in this compound is in combination, but as long as any water is retained by it it is soluble in citric acid. On the other hand, by drying at a high temperature it becomes almost insoluble, owing to the formation of the anhydrous compound. This is the compound which is found in ordinary blowpipe ignitions, but at the temperature of the softening of wrought iron tetra-calcium phosphate is formed, for even if the quantity of lime present is insufficient to convert the whole of the phosphoric acid into tetra-compound, a mixture of it with tricalcium phosphate and $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaO}$ is obtained. The products of the decomposition of calcium phosphates containing a large proportion of lime appear by their behaviour not to be chemical compounds, but mixtures of $\text{Ca}_3\text{P}_2\text{O}_8$, $\text{Ca}(\text{OH})_2$ with free $\text{Ca}(\text{HO})_2$.

The phosphoric acid can be abstracted from calcium phosphates far more readily and more completely by fusion with alkalis; in fact, by repeated and continued fusion the whole of their phosphoric acid can gradually be extracted, especially when there is free access of carbonic anhydride. All calcium phosphates give by fusion with alkalis a mobile, transparent, and molten mass, which becomes opaque when solid, and by treatment with water leaves a residue containing all the lime mostly as carbonate, but some free, and the remainder not as $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaO}$, but as tricalcium phosphate. It is assumed that really all the calcium phosphate undergoes decomposition, but that during the treatment of the fused mass with water a partial re-combination takes place resulting in the formation of some tricalcium phosphate.

In order to ascertain the composition of the various products of these and subsequent experiments, the products are: 1. Ignited with ammonium carbonate; 2. Suspended in water and exposed for some time to a current of carbonic anhydride to remove any carbonate of lime; 3. The lime

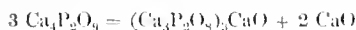
soluble in a solution of sugar is estimated and extracted; 4. The products are treated with dilute acetic acid in quantity insufficient for solution; 5. They are also digested at 40° — 60° for 10 hours with 100 parts of 5 per cent. citric acid solution. In both the latter cases the composition of the insoluble residue is ascertained, and in almost all cases the residue from the citric acid treatment is $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaO}$. The author has made numerous experiments on the action of these various solvents on the different calcium phosphates, examining in all cases intermediate products; with carbonic anhydride and water, for instance, tricalcium phosphate is partially decomposed into dicalcium phosphate and calcium carbonate, whereas $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaO}$ is converted into $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaCO}_3$ and tetra-calcium phosphate remains unaltered. By dilute acetic acid tricalcium phosphate is very slowly half changed into dicalcium phosphate, whilst $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaO}$ after some time only gives up its extra molecule of calcium oxide, but tetra-calcium phosphate is quickly and completely converted into dicalcium phosphate by this reagent. By treatment with a 5 per cent. solution of citric acid, which also gives a measure of the solubility, of the phosphoric acid in the soil, in proportions of 100 cc. to one gm. of phosphate, and at 40° to 60° for about 10 hours, both unignited tricalcium phosphate and tetra-calcium phosphate pass completely into solution; ignited tricalcium phosphate leaves a residue which contains somewhat more lime than the preparation employed, but $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaO}$ undergoes no change.

Similar products to those obtained with the alkaline lye are produced by heating dried mixtures of aqueous phosphoric acid, mono-, di-, or tricalcium phosphate with the proportion of lime, quick or slacked, or calcium carbonate, required to form the basic salt. In these cases the extent of the decomposing action on the tricalcium phosphate, first formed or already present, depends on the degree of heat and the duration of the heating. The mixtures were therefore ignited:—1. Many days in a potter's kiln. 2. Many hours in a good drawing reverberating furnace, fired with wood, charcoal, and coke. 3. Two hours at a temperature sufficiently high to render wrought iron plastic without melting it. The first two temperatures occasioned considerable shrinkage of the mixtures and yielded a caked, but not sintered, friable product; whilst the product of the third and highest temperature employed was a strongly sintered partially fused mass, with a distinctly stallate, crystalline structure, but of slight hardness.

With regard to the chemical behaviour of these mixtures under these conditions, a noteworthy formation of tetra-calcium phosphate only regularly occurred at the highest temperature used, although it was observed occasionally in the reverberatory product; but, in fact, at the lower temperatures the greater part of the tricalcium phosphate combined with the excess of lime to form $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaO}$. The products in which the saturation of the phosphoric acid had only arrived at this stage, yielded only traces of phosphoric acid to boiling alkalis, but when heated with ammonium carbonate, no matter what the proportion of lime to phosphoric acid had been employed in the original mixture, they absorbed so much carbonic anhydride that after the removal of the calcium carbonate, $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaO}$ alone remained. Under the simultaneous action of water and carbonic anhydride things were different, for then so much carbonic anhydride is absorbed that, after the removal of the calcium carbonate, tricalcium phosphate remains. Perhaps, in this instance, the apatite-like compound, $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaCO}_3$, is formed, which is the preponderating mineral constituent of limes.

The products of the higher temperature behave quite differently, for, although in no case consisting entirely of tetra-calcium phosphate, owing probably to the fact that the mixtures never fused, yet in all these experiments evidence of its presence in large quantities is obtained; they yield plenty of phosphoric acid to boiling alkali, also to citric acid, and are readily and completely changed to dicalcium phosphate by dilute acetic acid, &c.; in fact, the citrate insoluble portion consists of $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaO}$. Moreover, they are not acted on by prolonged exposure to water and carbonic anhydride, and they do not contain any lime soluble in sugar solution.

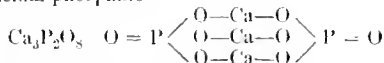
The author reviews, criticises, and discusses the various opinions which have been advanced for and against the existence of the tetra-basic calcium phosphate in basic cinder, the ultimate conclusion being that not alone does it exist, but that all the phosphoric acid in basic cinder ought to be there as tetracalcium phosphate, in fact, under the conditions of its formation, could not be present in any other state of combination. Nevertheless, chemical examination of different samples of basic cinder always indicates the presence of a certain irregular amount of phosphate, which is not soluble in citric acid or ammonium citrate, and which, therefore, cannot be tetracalcium phosphate. This has hitherto been very generally, but in some cases erroneously, attributed to admixture with some adulterant. The author has, however, investigated the point, and finds that when tetracalcium phosphate is exposed to a temperature somewhat below its temperature of formation that it undergoes reversion with the setting free of lime and the formation of $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaO}$ or in the presence of much silica, $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaSiO}_3$. The free lime has been extracted by means of sugar solution, and found to be present in the proper proportions required by—



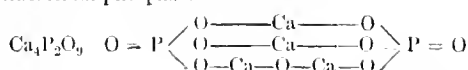
This change takes place more readily in the presence of air. The author is, therefore, of opinion that the presence of citrate insoluble calcium phosphate in basic cinder is to be ascribed to the treatment the cinder undergoes after leaving the converter, and that, in fact, it is the result of the re-conversion of some of the tetracalcium phosphate, in the manner just set forth, during the slow cooling of the mass of heated cinder in the air; the comparatively small proportion of insoluble phosphate found in slag may be accounted for by the reasonable assumption that in such a complex environment the free lime, as well as the phosphates, would probably enter into some other state of combination; and this assumption has been to some extent experimentally confirmed. Moreover, $(\text{Ca}_3\text{P}_2\text{O}_8)_3\text{CaO}$ is not absolutely insoluble in citrate, and therefore in the fine state of division in which it exists in basic cinder, it may probably pass into solution in larger quantities than might be anticipated. The presence of citrate in soluble calcium phosphate may also, perhaps, in part be ascribed to lime being present in insufficient quantity to change all the phosphoric acid into the tetracalcium salt. It seems, however, worth while trying if more rapid evolving of basic cinder will prevent the formation of the inferior calcium phosphate.

Taking into consideration the much greater facility with which tetra-basic phosphate undergoes decomposition in the soil, and conversion into di-calcium phosphate, as compared with tri-calcium phosphate, the author suggested that the two of the lime molecules must be in looser state of combination. The following formulæ are furnished to give a graphic representation of such an arrangement:—

Tri-calcium phosphate—



Tetracalcium phosphate—



—D. A. L.

Properties of Ammoniacal Copper Hydrate. Prud'homme, Monit. Scient. 1891, 5, 681.

See under V., page 427.

The Cornish Assay. Engineering and Mining Journal.

See page 470.

The Separation of Arsenic, Antimony, and Tin. John Clark. Proc. Chem. Soc. 1892 [110], 68—70.

The mixed sulphides of arsenic, antimony, and tin obtained in the ordinary course of analysis are dissolved in a strong solution of ferric chloride in chlorhydric acid, and the arsenic is distilled off and weighed as trisulphide. The residual liquid contains the antimony as trichloride, and the tin as stannic chloride, also ferrous and ferric chlorides. The author corroborates Loveton's statement that antimony and tin can be separated by taking advantage of the difference in solubility of their sulphides in solutions of hydrogen chloride of certain strengths, but thinks the proportion of acid should be reduced from a half to a third, to ensure the complete precipitation of the antimony, and to avoid the necessity of filtering through cotton wool. He recommends a combination of Loveton's and W. F. Clarke's processes, and without removing the iron salts he precipitates the antimony with hydrogen sulphide in a tepid solution containing from one-third to one quarter of its volume of chlorhydric acid and a considerable quantity of oxalic acid. The precipitate, which is free from tin, is washed first with water, then with alcohol, and finally with carbon bisulphide, and weighed as Sb_2S_3 after being heated at a temperature of about 130° to ensure the complete expulsion of water. He considers this temperature sufficiently high to dry the Sb_2S_3 . He points out that when Sb_2S_3 is dried at 130° , it suffers little or no further loss in weight till it is raised to the temperature at which it is converted into the black sulphide, and his experiments indicate that the loss in weight observed at this stage is not due to water, but to oxidation, as after heating between 200° and 230° for several days there was a continuous loss, the black sulphide becoming brown, and it was found by analysis to consist chiefly of oxide of antimony.

When the Sb_2S_3 precipitate is large it is necessary, after drying, to digest it in carbon bisulphide to extract the whole of the sulphur. To obviate this objection the author reduces the excess of ferric chloride with thin sheet iron, and as soon as the yellow colour has disappeared the undissolved iron is removed and the antimony which has come down is redissolved with the aid of a little ferric chloride, which is added drop by drop till the solution is distinctly yellow to ensure that all the tin is in the stannic state; a warm solution of oxalic acid containing about one-third of its volume of chlorhydric acid is then added, and the antimony is precipitated as Sb_2S_3 , together with traces of sulphur, and washed with water, alcohol, and carbon bisulphide.

After the removal of the antimony the hydrogen sulphide is expelled by boiling, the oxalic acid decomposed with potassium permanganate, and the tin precipitated in a hot solution with hydrogen sulphide, and allowed to stand till cold. The SnS_2 obtained in this way can be filtered off and washed with water without passing through the filter. It is then converted by ignition into SnO_2 , in which form the tin is weighed. The test analyses are very satisfactory.

For qualitative purposes in distilling off the arsenic a condenser is not necessary, a bent tube dipping into water being sufficient. It is advisable, however, to use a safety-tube to prevent the distillate coming back.

In the case of alloys the metal is dissolved in strong chlorhydric acid with the aid of ferric chloride, and the arsenic distilled off at once. The antimony and tin after being separated from the other metals of the group are then estimated in the manner described above.

ORGANIC CHEMISTRY.—QUALITATIVE.

A Colour Reaction of Acid Anilides. J. Tafel. Ber. 1892, 25, 412—413.

MANY acid anilides give with concentrated sulphuric acid and potassium bichromate, or lead peroxide, colourations similar to those obtained with alkaloids under like conditions: unlike acid hydrazides, phenylhydrazones, and phenylselenozones, the acid anilides give no colouration with sulphuric acid and ferric chloride.

The reaction is best carried out by dissolving a few milligrammes of the anilide in sulphuric acid and then adding a little powdered potassium bichromate; under these conditions the anilide and the hydrazide of one and the same acid give the same colouration. The reaction is given by all simple anilides and by all phenylcarbamides, but not by the products of the interaction of acetic anhydride and benzoic chloride with ethyl- and methyl-aniline.

Acetylparatoluidine gives no colouration but acetylorthotoluidine does; the acetyl and benzoyl derivatives of α - and β -naphthylamine give a dirty brown colouration.

The following compounds give the reaction:—Acetanilide, reddish-violet; propanilide, blood red; ethyl oxanilate, magenta red; oxanilide, violet; oxalacetanilide, magenta-red; benzanilide, violet; symmetrical diphenylcarbamide, bluish-violet; symmetrical ethylphenylcarbamide, rose-red; asymmetrical ethylphenylcarbamide, cherry-red; acetylhydrazobenzene, blood-red; acetylorthotoluidine, cherry-red; dibenzoylmecaphenylenediamine, blood-red; benzoyltetrahydroquinoline, blood-red; acetyltetrahydroquinoline, rose-red.—F. S. K.

ORGANIC CHEMISTRY—QUANTITATIVE.

Action of Nitric Acid on Silk. L. Vignon and P. Sisley. Compt. Rend. 1891, **113**, 701—704.

See under VI. page 430.

The Rotatory Power of Silk. L. Vignon. Compt. Rend. 1891, **113**, 802—804.

See under V. page 427.

The Technical Analysis of the Calcined Vinasse from Beetroot Molasses. C. Heyer. Chem. Zeit. 1891, **15**, 1489—1490, 1523—1524, and 1557. (Compare this Journal, 1891, 861.)

The author gives the following scheme for the analysis of this substance. The sample is pulverised, mixed and stored in a dry bottle fitted with a caoutchouc stopper. (1.) *Moisture*:—5.12 grms. are heated in a drying oven at 110° until of constant weight. (2.) *Insoluble matter*:—20 grms. are slowly added to 250 cc. of boiling water contained in a beaker, boiled, and after well stirring and allowing to remain for 15 minutes, collected on a tared filter previously dried at 110° C., washed with boiling water and finally dried at 110° C. until of constant weight; the filtrate and washings are made up to 500 cc (see below). After ascertaining the weight of the insoluble matter dried at 110° C., it is ignited, and the amount of fixed matter determined by reweighing this. (3.) *Alkali salts*:—Four 25 cc. portions of the filtrate and washings mentioned above (each corresponding to 1 gm. of vinasse) are evaporated to dryness in tared dishes on the water-bath, the residue carefully calcined, ignited, and weighed; the numbers deviate from one another at most 0.1 per cent. (4.) *Potassium chloride*:—One of the last-mentioned residues is dissolved in water exactly neutralised with nitric acid, boiled to remove hydrocyanic acid when present, and titrated with $\frac{N}{10}$ silver solution, employing potassium chromate as indicator. (5.) *Potassium sulphate*:—Another of the residues is dissolved in 100 cc. of water, an excess of hydrochloric acid added, and after boiling the solution with a small quantity of nitric acid or bromine water, it is precipitated with a boiling solution of barium chloride, the barium sulphate being collected as usual and weighed; it is calculated to K_2SO_4 . (6.) *Potassium phosphate*:—To 250 cc. of the standard solution an excess of nitric acid and ammonium nitrate (40 grms.) are added, it is then precipitated with molybdenum solution, and finally converted in the usual manner into magnesium pyrophosphate, weighed as such and calculated to $K_4P_2O_7$. (7.) *Potassium carbonate*:—A portion of the ignited residue from 25 cc. of the solution is dissolved in water in a 100 cc. flask, boiled with an excess of hydrochloric acid, and exactly precipitated with the quantity of barium chloride calculated

from (5); then cooled, made up to the mark, and filtered through a dry filter. 20 cc. of the filtrate are evaporated on the water-bath with platinum chloride solution (10 cc., containing 1 gm. P₂O₅), 80 per cent. alcohol poured over the residue, and allowed to remain for half an hour; then washed by decantation with 80 per cent. alcohol, brought on to a tared filter previously dried at 120°, and finally, after drying at the same temperature, weighed. This is calculated to K_2CO_3 and represents the total potassium, the amount of potassium carbonate in the sample being arrived at by deducting from it that of the other potassium salts as found, likewise calculated to K_2CO_3 . It is unnecessary to correct for the volume of the barium sulphate precipitate, as the slight raising of the results occasioned thereby is compensated by the lowering of the same due to the co-precipitation of a small quantity of potassium chloride with the barium sulphate. (8.) *Sodium carbonate*:—This is obtained by deducting the sum of the percentages of K_2CO_3 , KCl, K_2SO_4 , and K_3PO_4 found from that of the total alkali salts (3), and may be controlled by determining the alkalinity, calculating this to K_2CO_3 , deducting the K_2CO_3 found from it, and calculating the difference to Na_2CO_3 . (9.) *Alkalinity*:—This is determined by dissolving the residue from 25 cc. of the standard solution in water and titrating with normal sulphuric acid; or 25 cc. of the solution may be directly titrated with normal nitric acid, and this used for the chlorine estimation (4). The following analysis of a sample of the calcined vinasse by the above scheme is given:—

	Per Cent.
K_2CO_3	59.03
KCl.....	15.18
K_2SO_4	4.26
K_3PO_4	0.29
Na_2CO_3 (from alkalinity 15.06 per cent.).....	15.14
Insoluble matter (organic, 1.15 per cent.; inorganic, 3.95 per cent.).....	5.10
Moisture.....	0.87
Total.....	99.87

The ordinary way of determining the amount of potassium and sodium, viz., precipitating the solution acidified with hydrochloric acid with an excess of barium chloride, rendering alkaline with ammonium carbonate, filtering, washing with ammoniacal water, evaporating, igniting, extracting with water and filtering from silica, then again evaporating, igniting, weighing the soluble chlorides, and finally separating them with platinum chloride gives good results, but the author contends that the same accuracy is attainable by the method given above (7 and 8), which is much more expeditious. The strength of the alcohol employed to wash the platinochlorides (80 per cent.) is that recommended by Fresenius, and the author makes use of the factor (0.2832) adopted by this chemist for calculating potassium platinum-chloride to the carbonate. (Compare following abstract).—A. R. L.

The Technical Analysis of the Calcined Vinasse from Beetroot Molasses. Alberti and Hempel. Chem. Zeit. 1891, **15**, 1623—1624.

The authors point out that Heyer (preceding abstract) has not taken into account the estimation of silica, and they disagree with him in calculating the total sulphur as potassium sulphate. They propose the following alterations in (5) and (7) *loc. cit.*:—The ignited residue from a 25 cc. portion of the solution is acidified with an excess of hydrochloric acid, evaporating to dryness, and heated at 105°—110° for 1—2 hours; it is now extracted with water containing a few drops of hydrochloric acid and filtered from silica, the filtrate being made up to 250 cc. The sulphuric acid is determined in 50 cc. of this; whilst 100 cc. are introduced into a 200 cc. flask exactly precipitated with barium chloride, made up to the mark, and the potassium determined in 25 cc. of the filtrate by the platinum method. The authors further propose to determine the amount of sulphuric acid before and after ignition and in the vinasse, and to calculate the difference as potassium sulphide.—A. R. L.

A Method of Inversion and Estimation of Raffinose.
Kaydl. Oesterr. Zeits. Zuckerind. 1891, 20, 700.

THE method is that of Herzfeld (Deutsch. Zuckerind. 1890, 15, 466), but instead of dissolving the semi-normal weight of sugar in 100 cc. of water, that weight of sugar is dissolved in 250 cc. of water in order that 75 cc. of the solution contains exactly the semi-normal weight in grms. of dry substance. It is applicable to all kinds of products. Herzfeld's constant (~ 32.66) has been fully confirmed. It will be seen that with products of different sugar percentage, but giving the same quotient

of purity, the same quantity of sugar will be inverted, and the influence of the quotients of purity have therefore to be determined. As all experiments show that the (optically inactive?) organic matters (*Nichtzucker*) are without influence, and as all salts raise the constants about the same amount, the amounts of organic matters (*Nichtzucker*) have been neglected, and the inversion-constants determined for pure sugar in the presence of various weights of a mixture of sodium chloride, potassium nitrate, and anhydrous sodium acetate.

The following table was constructed from the results obtained:—

INVERSION-CONSTANTS AT 20° C. FOR THE QUOTIENTS.

Quotients.	95	90	85	80	75	70	65	60	55	50	45	40
Percentage of Ash in the Dry Substance.												
1	32.68	32.66	..	..	..	..	..	..	..	..	..	..
2	0.69	0.67	..	..	..	..	..	..	..	..	..	..
3	..	0.68	32.65	32.62	..	..	..	..	..	..	..	..
4	..	0.70	0.67	0.64	..	..	..	..	..	..	..	..
5	..	0.74	0.70	0.67	32.62	32.58	..	..	..	..	..	..
6	..	0.77	0.73	0.70	0.65	0.61	..	..	..	..	..	..
7	..	0.82	0.77	0.73	0.68	0.64	32.55	32.47	..	..	..	..
8	0.82	0.76	0.71	0.67	0.59	0.52	..	..	..	..
9	0.87	0.80	0.75	0.71	0.64	0.57	32.56	32.56	32.52	32.46
10	0.94	0.84	0.79	0.75	0.68	0.62	0.62	0.62	0.59	0.56
11	0.89	0.84	0.79	0.73	0.67	0.67	0.68	0.66	0.64
12	0.94	0.89	0.84	0.77	0.71	0.72	0.73	0.72	0.71
13	0.99	0.94	0.89	0.82	0.76	0.77	0.79	0.79	0.79
14	33.05	0.99	0.94	0.87	0.81	0.83	0.85	0.85	0.86
15	0.11	33.05	33.00	0.93	0.87	0.89	0.91	0.93	0.94
16	0.11	0.06	0.99	0.92	0.94	0.97	33.00	33.02
17	0.18	0.13	33.05	0.98	33.00	33.03	0.06	0.10
18	0.25	0.19	0.12	33.05	0.07	0.09	0.13	0.17
19	0.32	0.26	0.19	0.12	0.13	0.15	0.20	0.25
20	0.33	0.25	0.18	0.19	0.21	0.27	0.33
21	0.41	0.32	0.24	0.25	0.27	0.34	0.41
22	0.49	0.39	0.30	0.31	0.33	0.40	0.48
23	0.57	0.47	0.37	0.38	0.39	0.47	0.56
24	0.54	0.44	0.44	0.45	0.54	0.63
25	0.62	0.51	0.51	0.51	0.61	0.71

The author has directly determined the influence of the organic matters (*Nichtzucker*), and found it to be nil. By precipitating the total sugar and raffinose from a technical product by strontia and lime, he obtained a solution polarising slightly to the right, the optical activity not undergoing any alteration when treated with acids. Lead chloride was used as clarifying agent in these experiments, and subsequently three grms. of extracted bone charcoel was added (when necessary); three grms. of this charcoel occupy 1.95 cc., and flasks having two marks (100 cc. and 101.95 cc.) were used. In the analysis of molasses it is preferable to employ Herzfeld's method (semi-normal weight—100 cc.).

The dextro-rotation in the above solution of the organic matters (*Nichtzucker*) and in some other technical products was found to be due to dextrin. The author states that syrups have been obtained by the diffusion process having a purity quotient of 112, which contained as good as no raffinose, but large quantities of dextrin. It is therefore a matter of importance not to make use of the raffinose formula

unless the presence of raffinose is known, in all other cases to calculate the results by Clerget's formula.

A portion of the raffinose present in raw beet sugar is contained in the crystals themselves, and the amount thus occurring is in some cases considerable; it appears to be less dependent on the form of the crystal than upon the quantity of raffinose contained in the solution from which the sugar was crystallised.

To prepare raffinose, a solution of molasses is precipitated with basic lead acetate, filtered and the filtrate reprecipitated with ammonia, again filtered and this filtrate concentrated to a syrup. It is dissolved in strong methyl alcohol, and saturated with carbonic anhydride, and the filtrate from this after distilling off the methyl alcohol, is evaporated to a syrup, a crystal of pure raffinose added, and left in a cool place for 7—8 days.—A. R. L.

On the Quantitative Determination of Mechanical Wood Pulp in Paper. J. Baudisch. *Papier Zeit.* 1891, 16, 2414—2415.

THE method of Godeffroy and Coulon and its importance for the above purpose has already been discussed in this Journal. (See this Journal, 1888, 863—864; 1889, 574—576; 1891, 576—577.) As this test, with the exception of Bamberger's method, is the only one which if properly made gives reliable results, and as Godeffroy and Coulon have only published their preliminary results, the author describes the operation of the method in full. As shown in the notices already referred to, the method is based on the fact, that the incrusting substances of the mechanical wood-pulp reduce certain metal salts, e.g., gold chloride, and that from the quantities reduced we may ascertain the quantities of mechanical wood-pulp that are present in the paper. But also pure wood and straw cellulose, have to a certain extent the same reducing properties, and therefore it is necessary to nullify their influence by a preliminary extraction. The reduction is unaffected by different concentrations of the gold chloride, as long as only weak solutions are employed, and also uninfluenced by the time during which the mechanical wood-pulp is treated by the reagent. From the previously published results (see this Journal, 1889, 576), it is evident that on an average 100 parts of mechanical wood-pulp reduce about 14 parts of gold chloride. This property of mechanical wood-pulp seems to be uninfluenced by the various compositions of different papers, and therefore the same reduction number may be used for all sorts of paper. But the sizing, especially vegetable sizing, does affect this property of mechanical wood-pulp, and it must therefore first be removed. Papers to be tested by this method should first be examined by one of the qualitative reagents for the presence of mechanical wood-pulp, preferably by phloroglucinol and hydrochloric acid. Then three strips, about 2.5 or 3 cm. broad, must be cut from a sheet of the paper in question, in a diagonal direction. One of them is used for the determination of moisture, and then reduced to ash for finding the quantity of mineral substances in the dry paper. The second is used for finding the quantity of ash after the aforesaid extraction has been made; and the third serves for the determination of mechanical wood-pulp. The second and third strips must be freed from animal and vegetable sizing, before the examination is made. To effect this, they are rolled together, placed on glass funnels as filter-papers are, and there washed first with cold, and subsequently with hot distilled water. The presence of animal size is ascertained by the usual test with oxide of mercury. After all animal size has been removed in this way, the resinous sizing substances are extracted with pure absolute alcohol, to which a little tartaric acid is added. Hydrochloric acid must not be used, because of its influence on the fibres as well as on the gold chloride. This mixture of alcohol and tartaric acid must be used hot, and the paper treated with it, until every trace of resinous substance is removed. Finally, traces of tartaric acid are removed by washing with hot water, until the paper ceases to show an acid reaction. The paper strips thus freed from animal and vegetable size, must now be dried absolutely at a temperature of 100 to 110 C., and then weighed. One of them is then treated with pure absolute alcohol, and subsequently with pure ethyl-ether for 24 hours each, in order to remove straw and wood cellulose if present. The residue is dried and weighed again, and afterwards reduced to ash which is weighed. The third strip, after having been absolutely dried and weighed, is torn into small pieces, which are put into a beaker, and some diluted gold chloride solution added, which, however, should not be too weak. It is then boiled for 10 or 15 minutes, allowed to cool, filtered and washed with distilled water. The filter and its contents are then absolutely dried at 100 to 110 C., and both reduced to ash and the latter weighed. The weight of the filter ash is now known, the weight of the ash of the paper strip is likewise known, and therefore the weight of the reduced gold is found by subtraction, and by means of the above proportion the quantity of mechanical wood-pulp contained in the paper is discovered.—H. S.

Determination of Mechanical Wood-pulp in Paper. R. Godeffroy. *Mitt. k. k. techn. Gew. Museum*, 1891, 295.

THE reducing action of the lignocelluloses upon gold chloride has been shown by Godeffroy and Coulon (*ibid.* 1888, 18, 62; 1889, 9; this Journal) to be available as the basis of a quantitative method of estimation of mechanical wood-pulp in paper. Pulp from the fir, willow, elm, acacia and pine, were found to be approximately equal in reducing power, the quantity of gold reduced in the boiling solution of the chloride being 14 per cent. of the weight of the lignocellulose. In applying the method to papers, it is necessary to eliminate sizing constituents before applying the tests. With the view of simplifying the process of purification previously given (*loc. cit.*) the author has investigated a number of treatments, of which the most satisfactory is to boil with 10 per cent. aqueous ammonia. By this treatment, the reducing power of the lignocelluloses investigated, viz., pine, fir, poplar, maple and hazel, was found to be increased by exactly 50 per cent.

The simplified method consists in the following operations:—

(a) boiling in 10 per cent. aqueous ammonia for 10 minutes, followed by an exhaustive wash. Two portions of the paper are treated simultaneously. They are then dried, one is reduced to ash, and the quantity of the latter estimated; the other is subjected to (b) boiling for ten minutes with the solution of gold chloride, washing, drying, and burning. From the weight of ash obtained, that in the untreated paper is deducted giving the weight of gold which, multiplied by 100 and divided by 21.2, gives the percentage of lignocellulose in the paper.

Investigations with the view to substitute for the gold salt, less expensive reagents, viz. alkaline solutions of copper and bismuth oxides, were attended with negative results, the reduction numbers obtained with these reagents being variable.—C. F. C.

Analysis of Sealing Wax. C. Mangold. *Zeits. f. angew. Chem.* 1892, 75—76.

AN attempt was made to ascertain the composition of sealing wax by aid of the iodine equivalent of its alcoholic solution. Boiling alcohol dissolved 66 per cent., the remaining 34 per cent. being taken as the total mineral matter. From the iodine equivalent it is calculated that the 66 per cent. of soluble matter consists of colophonium (formed by heating the shellac and turpentine together), and shellac in the relation of 36 to 30.—T. L. B.

The Testing of Indigo.

See under *Indigo and its Applications, &c.*

Class VI., page 428.

On the Estimation of the Organic Substances in the Air by Potassium Permanganate. J. Areharow. *Arch. Hyg.* 1891, 13, 229.

THE author's experiments prove that the difference in the amount of organic matter in the air of different dwelling rooms can be estimated by potassium permanganate, when this difference amounts at least to 25 per cent. He employs a specially constructed apparatus by which the air is in complete contact with the permanganate solution.

The following precautions are necessary:—(1.) The air must pass through the solution which is heated to a fixed temperature (43 C.) in very small bubbles. (2.) In order that the end reaction shall be sharp, the solution must be strongly acidified. (3.) All the glass or porcelain apparatus employed in the determination must previously be boiled with permanganate solution. (4.) The whole process must always be conducted in the same manner in order that the unavoidable errors may be kept constant. (5.) Strong solutions are not so accurate as dilute ones. The best concentration is 0.026 mgrms. of potassium permanganate to a litre of water.—A. R. L.

On the Estimation of Fatty Matters in Milk-products.
Lézé and Allard. *Compt. Rend.* 1891, **113**, 654—656.

LÉZÉ described in 1890 (*Compt. Rend.* **110**, 647; see this Journal, 1890, 660) a method for estimating fatty matter in milk, which consisted in adding 4—5 vols. of pure concentrated hydrochloric acid (enough to redissolve the casein precipitated at first) saturating with ammonia, and diluting till all the fatty matter was raised into the neck of the flask in which the operations were executed, which was graduated into tenths of a cc. The flask was then heated for some hours to 40° in an oven. The authors have improved the method and generalised it. The separation of fatty matter from casein solution takes place more satisfactorily if the flask be left at the ordinary temperature, or better at 25°—30°. It is, however, to be heated finally to 40° on the water-bath, this temperature being necessary to unite the drops of fatty matter. The neutralisation with ammonia is unnecessary. The hydrochloric acid used must be absolutely free from chlorine, as otherwise a flocculent precipitate is produced and gas is given off which renders it difficult to read off the volume of butter. The fatty matter is pure milk butter.

By this action of hydrochloric acid, it is easy to isolate completely, and estimate easily, the fatty matter of milk, cream, cheese, &c., and also of margarine. When the substance is too pasty to be introduced at once into the flask with the graduated neck, it is first treated in an evaporating dish, and then transferred to the flask. In all cases it is treated with hydrochloric acid until it is dissolved to a liquid, which becomes brown in colour on warming, but remains limpid, while the fatty matter separates out. Many bodies have been examined and an estimation of fat in a sample of Gruyère cheese is quoted.

	Per Cent.
Water.....	28.20
Fatty matter extracted with ether.....	31.84
" " carbon disulphide .	32.04
" " by the new method	31.75

In this case the operation was carried out by treating 10 grms. of cheese with 50 cc. of pure hydrochloric acid, leaving it to digest for a quarter or half an hour, and then warming on the water-bath till the liquid turned brown. Lukewarm water was then added till the fat could be read off on the divided scale on the neck of the flask. The density of butter at 40° is 0.90, so that to obtain the weight, the volume must be multiplied by this number; if 9 grms. of the substance be taken the volume read off in tenths of a cc. gives directly the percentage of butter in the products.

—P. J. H.

ANALYTICAL AND SCIENTIFIC NOTES.

On the Existence of Acid and Basic Salts in very dilute Solutions. D. Berthelot. *Compt. Rend.* 1891, **113**, 641—643.

This is a study of the constitution of dilute solutions by means of their electric conductivity. Gradually increasing quantities of a solution of a strong acid, such as hydrochloric acid, are added successively to an equivalent solution of a strong base, such as potash, and the variation of the conductivity with the composition is represented graphically by plotting the conductivities of the solutions as abscissæ and the relative proportions of one of the bodies (e.g. the alkali) as ordinates. The figure obtained (whether the acid be added to the alkaline solution, or the reverse), consists of a system of two straight lines whose directions are inclined to each other at an acute angle, and which are joined by a short curved line. The one straight line corresponds to the solutions in which there is an excess of alkali, the other to those in which there is an excess of acid. But the fact that both in acid and alkaline solutions the variation of the conductivity with the composition ceases to be linear in the immediate neighbourhood of the point of neutralisation proves that a small quantity of a second salt (acid or basic, as the case may be), is formed; in many cases these salts are known in the solid state, e.g., the oxychlorides and the hydrochlorides of the chlorides. To avoid

all suspicion that the curved position of the system may be due to the presence of dissolved carbonate, the author has experimented with a solution of baryta (1 litre = $\frac{1}{217}$ gramme-molecule) to which were added gradually increasing quantities of hydrochloric acid (1 litre = $\frac{1}{100}$ gramme-molecule). A second series of experiments was performed with a solution of crystallised barium chloride (1 litre = $\frac{1}{217}$ gramme-molecule) to which small quantities of above-mentioned solution of baryta were successively added. The difference between the ordinates observed and those calculated, on the supposition that only a neutral compound is formed and that the system should consist only of two straight lines, amount to as much as about 1 per cent. of their value. The curve becomes a straight line more quickly in the case of acid than of alkaline solutions.—P. J. H.

Lecture Experiment to show the Absorption of Hydrogen by Palladium. T. Wilm. *Ber.* 1892, **25**, 217—219.

3—4 grms. of palladium sponge, made by heating palladium ammonium chloride ($\text{PdCl}_2 \cdot 2\text{NH}_3$) first in the air and then in hydrogen, are placed in a bulb blown at the end of a U-tube. The tube is connected on the one side with a Kipp's hydrogen generator, and on the other with a glass tube provided with a good stop-cock, special care being taken that the connexions are tight. Pure dry hydrogen is then passed through the tube, the exit tap being open, whilst the bulb of the U-tube is heated by an ordinary burner. In order to remove the water formed in the tube the two limbs are also carefully heated. After the hydrogen has passed through the tube for a considerable time, and long after the whole of the air has been replaced, it is found that the gas coming through the exit tap only burns intermittently, unless the tap be turned when the increased pressure in the tube allows a small flame to burn continuously. If now the heating be discontinued and the exit cock closed, the occlusion of the hydrogen will be shown by the fact that the current of hydrogen continues to pass through the wash-bottles. When no more gas is absorbed the palladium is again heated and the exit tap opened (the current of hydrogen being still allowed to pass) when the issuing hydrogen burns with a long continuous flame, which immediately goes out when the heating is discontinued. By this means the occlusion of the hydrogen can be readily shown to a large audience.—C. A. K.

New Books.

GAS WORKS. Their Construction and Arrangement, and the Manufacture and Distribution of Coal Gas. Originally written by SAMUEL HUGHES, C.E. Re-written and much enlarged by WILLIAM RICHARDS, C.E. Eighth edition, revised, with Notices of Recent Improvements. London: Crosby Lockwood and Son, 7, Stationers' Hall Court, Ludgate Hill. 1892.

8vo volume bound in cloth, with frontispiece representing plan of Gas Works for town of 10,000 inhabitants, Preface, Table of Contents, Subject-matter covering 410 pages, and an Alphabetical Index. The text is illustrated by 75 well-executed wood engravings. The subdivision of the subject into chapters is as follows:—Chapter I. Historical Sketch of Gas Lighting. II. The Chemistry of Gas Lighting. III. The Composition of Coal Gas. IV. Coal used in Gas Making. V. Carburation. VI. General Construction. VII. Retorts and Retort Settings. VIII. The Hydraulic Main and Valves. IX. The Exhauster. X. The Purification of Gas. XI. Gas Holders. XII. The Station Meter. XIII. The Photometer. XIV. The Governor, Regulator, Pressure Gauge, and Pressure register. XV. Application and Manufacture of Residual Products. XVI. Distribution. XVII. Consumers' Meters. XVIII. Burners and Glasses. XIX. The Various Applications of Gas for Heating, Cooking, and other Purposes. XX. Gas Explosions. XXI. Various Methods of Producing Light. XXII. The Various Con-

trolling Influences which affect the Quality and Volume of Gas. XXIII. Public Lighting. XXIV. General Remarks. XXV. The Sliding Scale. The price of the work is 6s.

FARMYARD MANURE. Its Nature, Composition, and Treatment. By C. M. AIKMAN, M.A., B.Sc., F.R.S.E., &c., Lecturer on Agricultural Chemistry, West of Scotland Technical College. William Blackwood & Sons, Edinburgh and London. 1892.

SMALL 8vo. volume, bound in cloth, limp. It contains Preface, Table of Contents, Introduction, and 65 pages of Subject-matter. There is no Alphabetical Index, but the Table of Contents is both clear and well arranged. The sub-division of the matter is as follows:—**INTRODUCTION.** On what fertility of soil depends. Function of manures. **FARMYARD MANURE.** Solid Excreta. Urine. Horse manure. Cow manure. Pig manure. Sheep manure. Methods of calculating the amount of manure produced on the farm. Fermentation of farmyard manure. Analyses of farmyard manure. Comparison of fresh and rotten manure. Methods of application of farmyard manure to the field. Value and function of farmyard manure.

The price of the book is 1s. 6d.

CHEMISCH-TECHNISCHES REPERTORIUM. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der Technischen und Industriellen Chemie, mit Hinweis auf Maschinen, Apparate, und Literatur. Herausgegeben von DR. EMIL JACOBSEN, 1891. Erstes Halbjahr. Zweite Hälfte. Berlin, 1892. R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder, S.W. Schönebergerstr. 26. London: H. Grevel and Co., 33, King Street, Covent Garden.

THE Repertorium of Chemical Technology for the latter quarter of the first half of 1891 has just appeared. Its pages run from 153 to 307, and the following branches of chemical industry are treated of:—Food Stuffs; Paper; Photography; Residuals, Manures, Disinfection, and Sanitation; Soaps; Explosives; Preparation and Purification of Chemicals; Chemical Analysis; Apparatus, Machinery; Electro-Technology; Thermo-Technology, and Appendix. Special Preparations, Adulterants of Trade Products, &c. New Books. The text is interspersed with numerous woodcuts representing apparatus and plant.

FUELS, SOLID, LIQUID, AND GASEOUS. Their Analysis and Valuation. For the Use of Chemists and Engineers. By H. JOSHUA PHILLIPS, F.I.C., F.C.S. Second Edition. Revised and Enlarged. London: Crosby Lockwood and Son, 7, Stationers' Hall Court, Ludgate Hill, E.C. 1892.

SMALL 8vo. volume, bound in cloth. It contains Prefaces, Table of Contents, and Text covering 108 pages. The pages are illustrated with 14 wood engravings, and the work concludes with an Alphabetical Index.

The work is subdivided into the following branches:—**METHODS OF ANALYSIS:** Characteristics of Fuels. Estimation of Ash and Moisture; of Coke and Volatile Matter; of Sulphur, Nitrogen, Carbon, Hydrogen, and Oxygen. Estimation of Specific Gravity and Flash-point. Analysis of Gaseous Fuel. Ashes of Fuels. **METHODS OF VALUATION:** Calorific Values. Tables of Practical Results and Analyses. In his Preface to the Second Edition the author proclaims that in 12 months he has been called on for a second edition by a demand from both chemists and engineers. The enlargement is considerable and the improvements very manifest. Thus, amongst the additions, methods for the analysis of the ashes of fuels, practical methods for obtaining the calorific value and specific gravity of gaseous fuel, and for the determination of sulphur in gaseous fuel, &c. &c.

The price of the work is 3s. 6d.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

(From the Board of Trade Journal.)

SWITZERLAND.

Note.—Quintal = 220·4 lb. avoirdupois. Franc = 9⁶/₁₀d.

The following decisions affecting the classification of articles in the Swiss Customs tariff were given by the Swiss Customs authorities in the month of March last:—

Oil of amber.—Category 13. Duty, 10 francs per quintal.

Sulphate of benzidine.—Category 46. Duty, 60 cents. per quintal.

Electric accumulators of every kind and detached pieces of the same, such as plates, fitted or not, frames, &c.: telephones and detached parts of the same, such as boxes, registers, &c.—Category 215. Duty, 6 francs per quintal.

Plates (frames), of lead, perforated, for electric accumulators are removed from Category 240 to Category 215, and now pay a duty of 6 francs per quintal.

FRANCE.

Note.—Kilog. = 2·204 lb. avoirdupois. Franc = 9⁶/₁₀d.

The following decisions affecting the classification of articles in the new French Customs tariff have recently been given by the French Customs authorities:—

Myrobolams, properly so-called, dry, whole or crushed, and libi-divi or divi-divi.—Category 156. Free of duty.

Dry colours composed of sulphate of barytes or any similar substances, coloured with a small quantity of a derivative from coal tar (3 per cent. at the most).—Category 310. Duty, 5 per cent. *ad valorem*.

Bone-glue, English glue, bone-size (product of a gelatinous base used in the preparation of tissues and specially of Amiens cotton velvet).—Category 313. Duty, 6 francs per 100 kilos.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

THE SICILIAN SULPHUR INDUSTRY.

The French Consul at Messina has recently addressed a report to his Government upon the condition of the sulphur industry in Sicily. He states that the production of sulphur in 1891 showed a decided falling off as compared with 1890, the amounts being 4,499,479 cantars (13 cantars = 1 ton) in the former and 3,817,053 cantars in the latter year. This diminution is owing in great measure to the fact that the large mines which represent three-fourths of the production worked with exceptional activity at the time of the last crisis, in order to distribute the general expenses over a much larger product, with the result that at the present time they are unable to show an increased out-turn, and in some cases there is a very decided diminution in the amount produced. Again, no new workings were begun during the period the crisis lasted.

As regards the smaller mines, which are very numerous, these show no increase in production, while a large number have gone out of working altogether. In considering the question of the diminution in the supply of sulphur, account must also be taken of the variation in the number of hours devoted by the workmen to labour in the mines. When prices were low the Sicilian labourers were obliged to work like persons engaged in other industries, six days a week and as many hours as was found necessary, in order to extract the ore in sufficient quantity to enable them to draw an ordinary wage. With the enhanced value of the product came an increase in the price of labour, the workmen then

commenced to work by the half-day with one day a week off, and then a reduction of the hours of labour was effected, to the extent that about 24 hours' work a week is now about all that an ordinary labourer in the sulphur mines performs. Consequently, as the working mining population is limited and is composed of special workmen, the production becomes more and more restricted.

Among other causes of diminution in the output may be mentioned the placing under cultivation of land productive of ore of an inferior quality, and which the owners thought it more to their advantage to cultivate than to work for sulphur, and the imposition of a new tax of 60 centimes per kilogramme upon the manufacture of mining powder.

The very gravest apprehensions are felt for the future of the sulphur industry in Sicily. It is expected that for some years to come the production will be to a great extent limited. In the first place a restriction of labour appears to be threatened by the action of the Italian Legislature affecting the employment of children. Of the latter many of 11 to 12 years of age are engaged in the mines carrying ore, and owing to the absence of capital it will be difficult for the mine owners to replace their labour by machinery.

The depth of the mines is continually increasing, particularly in the case of those mines in which shafts are sunk vertically, and these latter are by far the most important and the richest. With an increase of depth, difficulties also increase, these consisting of more improved methods of extraction, greater ventilation, and the employment of larger pumps, all of which require considerable outlay. It will, therefore, in the opinion of M. de Lalande, be some years to come before the average production of the last 10 years is again reached.

According to the chief engineer of the Sicilian mines, the falling off in the production of sulphur in 1891, as compared with 1890, amounted to over 58,000 tons, and this was owing to the wild speculations in Sicily, especially those which were engaged in between December 1890 and May of the following year, and which ruined many of those engaged in the sulphur industry. At this period also throughout the world (for Sicily furnishes nearly nine-tenths of all the sulphur used) merchants, agriculturists, and manufacturers, in fact consumers of all kinds, rather than purchase at the then exorbitant prices, exhausted their stocks, and if it became necessary to buy they confined their orders to a supply only just sufficient to carry them on from day to day.

The exhaustion of the stocks of sulphur in foreign countries brings into relief the fact that the falling off in the demand is more accentuated in countries where sulphur is more particularly employed for agricultural purposes, and especially in the treatment of vines, as, for example, in France and Greece, than in countries like the United States, England, Austria, and Sweden, where sulphur is used chiefly in the various industries, and is therefore the object of frequent and direct purchases. From the United States, however, evidences are forthcoming of a tendency to substitute for certain industrial purposes pyrites for sulphur, but this substitution can only be effected slowly and in factories having had the time to renew their plant, and there is little probability of all of them acting in this respect simultaneously. This abandonment of sulphur in certain respects would find its compensation in the employment of the article by new industries or by the application of improved processes. In this connexion mention may be made of the methods now being attempted in Germany of extracting fatty substances and oils by the action of liquid sulphuric acid, and if, as is claimed, this system is superior, so far as results are concerned, to all those hitherto in vogue, it points in the future to a fresh outlet for sulphur and one not without some importance.

M. de Lalande, speaking of the present condition of the sulphur market in Sicily, says that it is by no means unsatisfactory; the production certainly shows a tendency to restriction, but this in his opinion is due less to an absence of confidence than to the want of new outlets. Capital is wanting, labour is dear, and miners difficult to find, but in his opinion the outlook is far from discouraging, as the sulphur beds in Sicily still enjoy the reputation of being the finest in the world.—*Board of Trade Journal*.

INDUSTRIAL DEVELOPMENT AND FIELDS FOR CAPITAL IN MEXICO.

A report has recently been presented to the French Government by the French diplomatic agent in Mexico, upon the undeveloped mineral and agricultural resources of that country. From this report the following information has been extracted:—

The richness of the soil of Mexico exceeds anything that can be imagined. In a relatively small area all climates and products are found. It is not necessary to travel great distances in order to pass the region of wheat, of the beet, oak, and pine, of the vine, olive, and orange, and of the sugar-cane, coffee, and vanilla. The transitions are rapid. The traveller who passes through the torrid region of Vera Cruz in the morning may at nightfall enter into the region of eternal snows.

The absence of means of communication has paralysed the efforts of numerous agriculturists, but this disadvantage is disappearing daily; the railways are extending and branching out rapidly throughout the country.

The wealth of the subsoil of Mexico is enormous; silver, gold, copper, iron, lead, tin, and all other minerals abound everywhere. The volcanoes contain immense quantities of sulphur; the petroleum wells and salt deposits present favourable openings for capital.

The abundance of raw materials and the cheapness of labour favour the establishment and development of industries. The raw materials cost little; there is no lack of coal mines, the working of some of them having already given satisfactory results. In Mexico, therefore, not only could the metallurgical industries be profitably established, but also weaving, sugar, dyeing and other industries. These industries certainly have at the present time some representatives, but they are by no means sufficient for such an extended market.

There is also a lack of saw and wood mills, and paper, oil and soap factories; there are no tanneries, glassworks, distilleries, factories of chemical products, for which some lakes and volcanoes offer inexhaustible quantities of valuable products.—*Ibid*.

ARGENTINE REPUBLIC.

Drug Imports.

Among the imports of pharmaceutical goods into the Argentine Republic in 1890, the following items are of interest. (The first number, except where otherwise stated, denotes the quantity in kilos.; the next, in parentheses, the value in dollars):—Sulphuric acid, 1,246,376 (62,219); linseed oil, 452,237 (80,908); spirits of turpentine, 437,261 (57,442); varnish, 98,253 (78,600); bicarbonate of soda, 360,374 (25,624); carbonate of potassium, 16,873 (2,531); carbonate of soda, 328,195 (12,715); paint, in powder, 1,958,916 (149,488); ditto, prepared, 2,011,057 (189,749); essential oils, — (43,860); specifics for curing sheep-scab, — (269,488); phosphorus, 16,079 (16,249); gums, 139,011 (33,279); iodide of potassium, 643 (3,215); scap, common, 36,930 (10,642); ditto, perfumed, 42,504 (22,784); malt, 2,902,798 (290,279); prepared medicines, — (273,560); perfumery, — (257,624); pharmaceutical products, — (65,595); chemical products, — (417,785); soda ash, 2,581,048 (77,430); caustic soda, 132,806 (6,640); sulphate of quinine, 19 (760); druggist's utensils, — (182,264); glass bottles, 238,624 dozen (71,584); scientific instruments, — (88,311); gutta-percha articles, — (92,254).

Drug Exports.

The exports from Argentina connected with the drug trade are mostly of the animal kingdom. They total as follows:—Extract of beef, 187,566 (375,132); glycerin, 161,306 (46,522); pepsin, 13,830 (20,745); honey, 52,799 (9,004); beeswax, 6,798 (3,059).—*Chemist and Druggist*.

MAURITIUS.

Drugs.

Last year Mauritius imported 1,385,100 rs. worth of chemical products, mostly sulphate of ammonia and nitrate of potash, from Australia and India, but also including 302,197 rs. worth of drugs and medicinal compounds from England and France.

Soap.

Ten years ago nearly all the soap used in Mauritius came from France and, as the consumption is over 1,000 tons a year, this was a trade worth cultivating. But since then France has been deprived of nearly half her trade by Australia and by the Seychelles islands, in which latter group a soap-works has recently been established.—*Ibid.*

MOROCCO.

British Trade.

The share of Great Britain in the imports of Mogadore is very satisfactory—viz., 55 per cent. in 1891 against 52 per cent. the year before. The remainder of goods imported was mostly from France.

Foreign Goods via London.

Although these figures are eminently gratifying, yet, on examining the subject more closely, we find that, in the import table at any rate, they are liable to some discount, since there is no doubt that for some years prior to 1890 a considerable quantity of goods of German and some of Belgian origin had been imported *via* London in English steamers, and therefore inclusively swelled the total from Great Britain. Even now some German merchandise sometimes comes in on English steamers.

Exports to Germany.

The export trade to Germany commenced in 1890 with the opening of the "Woermann" and "Atlas" lines of steamers. The first year the steamers took, among other goods, beeswax, 720*l.*; cumin seed, 507*l.*; gums, 900*l.*; olive oil, 29,248*l.*; orris-root, 36*l.*, and sesame, 33*l.* In 1891, beeswax, 2,304*l.*; cumin, 24*l.*; gums, 2,250*l.*; oil, 10,710*l.*; orris-root, 224*l.*; rose-leaves, and sesame, 48*l.*

Gums.

The gum exports from Mogadore were as follows:—

Gums.	1891.		1890.	
	Tons.	£	Tons.	£
Brown.....	85	6,375	48	3,600
Amral.....	33	1,056	In brown.	
Senegal.....	174	13,050	130	14,390
Sindarac.....	128	11,850	156	11,700

Olive Oil.

The shipments of olive oil were affected both by shorter supply and lowness of prices, especially in London, the total for the year amounting to 43,850*l.* against 138,720*l.* for the previous one. The value was thus divided: Great Britain, 8,960*l.*; France, 10,955*l.*; Germany, 10,710*l.*; Portugal, 2,905*l.*; Spain, 490*l.* In the middle of March there was a considerable quantity of Government oil in store, awaiting favourable advices from European markets.

—*Ibid.*

ITALY.

British Trade.

The following figures relate to the exports from and imports into Italy of pharmaceutical goods from Great Britain and her colonies:—

Imports into Italy.	1890.	1891.	Difference.
	Cwt.	Cwt.	Cwt.
Acids	8,640	6,388	— 2,252
Potash and caustic soda (impure).....	136,006	135,090	— 916
Alkaloids	33	72	+ 39
Oxides	17,344	20,440	+ 3,096
Carbonates	59,766	68,460	+ 8,694
Chlorides	76,482	38,406	— 38,076
Nitrates	40,554	14,700	— 25,854
Sulphates.....	258,412	308,596	+ 50,184
Other chemical products.....	25,698	32,662	+ 6,964
Quinine and bark.....	9,696	3,198	— 6,498
Gums and resins.....	21,144	37,368	+ 16,224
Soap.....	9,511	8,550	— 961

Exports from Italy.	1890.	1891.	Difference.
	Cwt.	Cwt.	Cwt.
Boric acid	34,050	28,272	— 5,778
	Lb.	Lb.	Lb.
Alkaloids	5,180	701	— 4,479
	Cwt.	Cwt.	Cwt.
Tartar and lees of wine.....	101,782	151,148	+ 49,366
Orange and lemon juices....	42,388	15,144	— 27,244
Liquorice, aloes, &c.....	12,882	12,182	— 700
Soap.....	19,018	21,156	+ 2,138

—*Ibid.*

MINERAL DISCOVERIES IN GREECE.

The mineral wealth of the island of Milo has just been increased by the discovery of mines of barytes containing, it appears, a large quantity of silver.

According to the French Consul at Syra, explorations have been made in the localities of Mirovilia, Pikrondon, Castagnia, and at Teriades on the promontory of Vani to the north-east of the island. Everywhere the results have exceeded the highest anticipations.

At Mirovilia there have been opened six galleries of a total length of 104 metres, and four wells of 11 metres each. Analysis has established the proportion of from 300 to 1,900 grms. of silver per ton of barytes.

At Pikrondon pits to a small depth have been sunk from which 720 metric centners of barytes have been extracted. The proportion of silver is from 200 to 250 grms. per ton.

At Castagnia the barytes extracted from three pits contains the same proportion of silver.

At Triades five horizontal galleries have been sunk, and the barytes extracted in this locality contains 300 grms. of silver per ton.

Further, in other places pieces of barytes have been gathered in the open trenches which have given up to 10,000 grms. per ton.

The mass of barytes at Milo is estimated at 12,000,000 tons. Supposing that 200 tons were extracted daily it would require 700 years to exhaust it. It is recommended that foundries of the "Angustin" type, similar to those in use in Hungary, should be established in the localities mentioned above, and more particularly at Kannari and at Pigadakia, where water is to be had in plenty. These two localities are also sufficiently near to the sea to permit ships of large tonnage to effect loading.—*Board of Trade Journal.*

EXPORTS OF HENEQUEN FROM MEXICO.

The French Consul at Vera Cruz, in a report upon the Mexican export of henequen in 1891, says:—

The weight of henequen exported from Mexico in 1891 was 113,263,519 lb., valued at 5,996,044 piastres. In 1890, the quantity and value were respectively 97,959,373 lb. and 5,007,562 piastres, and in 1889, 87,839,783 lb. and 8,783,978 piastres.

It therefore appears that production has increased to a large extent in 1891, compared with the two preceding years, but the article having kept at a low price, which was lower still in 1891, it results that the value exported in 1889 was superior to that which is represented by the exports for the two following years, although the quantity exported has been less.

In fact the average price in 1889 was 10 centimes of a piastre per pound, against 5.1 cents. in 1890 and 5.2 cents. in 1891. The average price for last year is therefore slightly higher than that for 1890, a fact which should be taken into account as well as the increase shown by the quantity exported.—*Ibid.*

GENERAL TRADE NOTES.

QUININE AND JAVA CINCHONA.

Chem. and Druggist, 40, 589–590.

Full statistics are given of the estimated crop of Java cinchona for 1892. The statistics show that of the 115 plantations known to exist in the island two have been abandoned since last year, while on three others all the trees have been uprooted. These three plantations only produced an aggregate of 120,000 lb. of bark, or less than 3 per cent. of the total production—a fact which disposes of the assertion that there has been a general uprooting of trees in consequence of the low prices which have ruled. Moreover, nearly all the uprooted cinchona averaged only 3 to 3½ per cent. of quinine sulphate, a yield admittedly too low to hold out any prospect of successful competition in the future. On the other hand, twenty-six plantations have either not yet come into bearing at all or only yield insignificant quantities, while six others, though still in existence and ready to ship bark under more favourable circumstances, did not harvest any last season. These figures indicate that there is plenty of reserve stock in the island to fall back upon when the market improves. Another important feature of the return is that the quinine value of the bark on almost all the large estates is increasing. The manufacturing bark from Java, which averaged about 3½ per cent. not long ago, will next season represent an average value of nearly 5 per cent. in sulphate of quinine, and that proportion is likely to be still further increased later on. The main interest of the statistical returns, however, lies in the fact that, for the first time in the history of the Java cinchona industry, they presage a falling off, positive as well as relative, in the shipments from the island. If the unit remains where it is now, the compilers expect the quinine output of the island to be fully 10 per cent. less than last season, and even if the unit should improve to 1½d. or 1¾d. per lb., it is likely to fall below that of 1891 by 1 per cent. or thereabouts. Private advices state that the actual shipments will almost certainly fall below the minimum mentioned in the returns, unless indeed, in the unlikely event of a considerable improvement in prices.

The position of the Java planters to-day resembles that of their Ceylon colleagues in 1886 in this respect—that the excessive feeding of the European bark-market is beginning to produce the inevitable reaction—but the situation is different from that in Ceylon six years ago, first, inasmuch as there is in Java a heavy supply of rich bark to fall back upon; secondly, because the Java growers have taken to heart the lesson that the indiscriminate production of low-grade, quickly-growing barks does not pay; and, finally, because they have not, as the Ceylon growers had at the time, looming before them the spectre of a new and rapidly-growing source of production the advent of which they are bound to forestall at all hazards. There is no important source of supply behind the Java planters.

The threatened falling off in the production of Java cinchona-bark would, no doubt, under ordinary circumstances, make itself felt in the quinine market. But that market has been unhinged to such a degree by speculative sales, that the effect of the laws which usually govern the fluctuations of manufactured products may be retarded for a considerable time. There is certainly no indication yet of any upward movement in quinine, though the signs which would warrant such a tendency are slowly accumulating at the horizon.

ON THE PRODUCTION OF SUGAR IN BRITISH INDIA.

Chem. Zeit 1891, 15, 1584.

According to statistics received by the Indian Government from a certain firm, the average yield of sugar is one ton per acre, and it is of very poor quality; whereas in the West Indies the sugar planter obtains two tons per acre. The explanation of this small yield is that, in India, with the exception of three large sugar factories in Madras, only small plantations exist, and the 2½–3 million acres devoted to the industry are almost exclusively cultivated by natives under conditions which render the management of large sugar refineries impossible. Some years ago the native planter was still using primitive methods which had been in vogue for centuries, but the above-mentioned firm has since introduced a cheap, easily transportable, crushing mill of simple construction, and this has been such a success that at present upwards of 200,000 are in use, and a planter who formerly cultivated 30 acres now cultivates 600 acres, and obtains a better product. Improved forms of evaporating apparatus have also been introduced.

—A. R. L.

THE SISAL GRASS OF YUCATAN.

One of the most remarkable vegetable products known, and one of the most valuable resources of Yucatan, says the *Mexican Financial Review*, is its sisal grass. It grows in long, narrow blades, often to the length of four or five feet, and these, when dry, curl up from side to side, forming a flexible string, stronger than any cotton cord of the same size ever manufactured. It is in great demand among florists and among manufacturers of various kinds of grass goods; but as soon as its valuable properties become known it will have a thousand uses now undreamed of. Ropes, coils, lines of any description and any size may be manufactured of it, and a ship's cable of sisal grass is one of the possibilities of the future. It is almost impervious to the action of salt water, and is not readily decayed or disintegrated by moisture and heat, and will, in time, prove one of the most valuable productions of Mexico. It takes its name from the port of Sisal in Yucatan, through which it was formerly exported.—*Ibid.*

CANADIAN PLATINUM.

It has long been known that platinum had been found in the province of Quebec. In the Report of the Geological Survey for 1851–52 it is stated that Dr. Hunt had detected native platinum in some of the gold washings of the Chaudière district. In the province of Ontario platinum has been discovered in the Sudbury district. It there occurs in combination with arsenic, forming the mineral sperrylite, which is of great interest, as it is “the first mineral yet found containing platinum as an important constituent other than the natural alloys with various metals of the platinum group.” So far as can be learned, no effort has yet been made to utilise sperrylite as a source of platinum, but at present it brings a high price as a mineralogical curiosity.

Canadian platinum ore, as a commercial article, is entirely the product of British Columbia. In association with alluvial gold it has been met with in a number of the streams of that province. At present the most important platinum-bearing district of British Columbia, as well, indeed, as of North America, is that of the Tulameen or North Fork of the Similkameen river. Placer mining in this district yields both gold and platinum, the latter being found, like the gold, in grains and small nuggets. A notable quantity of platinum has already been obtained from this district. One firm in the United States claims to have purchased within the last year or two fully 2,000 oz.

of British Columbia platinum, and it is well known that a portion of the yield of this district has found its way to the London market.

An increase of output may be expected, as the Tulameen Hydraulic and Improvement Company has made preparations to begin hydraulic mining on a large scale with the advent of spring. Mr. R. G. Tatlow, a member of this company, informs me that his company has erected a saw-mill having a capacity of 5,000 ft. per diem, and has constructed about two miles of flume, 5 ft. at base, 20 in. high, on sills placed on solid bed about 7 ft. wide, and having a grade of $\frac{1}{2}$ in. in 12 ft. The water is taken from Eagle Creek, about 14 miles above Granite Creek, the only creek capable of giving the necessary quantity of water and pressure. In addition to this flume, the company has on the ground and ready for work about 400 ft. of iron pipe and a monitor, which, where work is to be commenced, will work with a pressure of 900 miners' inches and a drop of about 160 ft. Mr. Tatlow also states that the largest yield of platinum appears to have been in the vicinity of and below Eagle Creek, where the yield has been about two parts of gold to one of platinum.

Two samples of this Tulameen ore contained 69.28 per cent. and 72 per cent. platinum. It is really a very complex alloy of platinum with a number of the comparatively rare metals of this group, such as palladium, iridium, and notably an alloy of osmium and iridium, known as osmiridium, which, in grains of proper size and form, is used for pen-points. This ore is worth to-day about 5.50 dols. per oz. troy. The price is very unsteady, being determined by the demand for the metal and by the state of affairs in Russia, the principal producer of the ore.

An interesting statement in connexion with the metallurgy of platinum was made by the President of the Chemical Section of the British Association at the meeting of last year. It is to the effect that one firm of refiners in London have such facilities that $2\frac{1}{2}$ ewt. of platinum may be melted in a single charge, and that the same firm, in a single operation, extracted a mass of palladium valued at 30,000*l.* from gold-platinum ore actually worth more than a million sterling!—*Engineering and Mining Journal*.

RUSSIAN SUNFLOWER OIL.

The sunflower has been known in Russia for many years but only in certain districts has it been cultivated on a large scale. The first cultivation of sunflower-seed for mercantile purposes in Russia began in 1842, in the village of Alexievka, district of Berutshinsk, government of Voronezh. That province is even now the chief district in European Russia for the growing of the sunflower. From there the cultivation of sunflowers spread to the adjacent governments of Tambov and Saratov, where there are extensive cultures owned by the town of Saratov itself. The people of the governments of the Don, Simbirsk, and Samara, are more or less engaged in this trade. Two kinds of sunflower are known, one with small seeds used for the production of oil, and the other with large seeds consumed by the common people in enormous quantities as a dainty. In a district where the seed is cultivated on a large scale, and the plant has been continually grown on the same soil for many years in succession, the sunflower has become subject to a disease called *Puccinia dioscorearum*. Owing to this disease the sunflower crops have been rather poor in the government of Voronezh for the last ten years, and the cultivation has, therefore, abated somewhat in this locality. The sunflower-seed is used principally for obtaining an oil which has superseded all other vegetable oils in many parts of Russia. In general, the cultivation of the sunflower in Russia is considered to be very profitable. At the average yield of 1,350 lb. per acre, and at the average price of $\frac{3}{4}$ d. per lb., the farmer receives an income of about 4*l.* per acre. This income can be increased in districts where the grower himself is engaged in producing the oil from the seed. However, oil-mills are very rare in the villages, the farmers selling their seed to the oil producers. In the seed-growing district of Saratov there are only 34 village oil-mills, producing oil worth 8,000*l.* annually, whereas in the town of Saratov 90,000*l.* worth of oil is manufactured annually. The substance remaining from the oil manufacture, or the

sunflower cakes, being used as cattle food, is also a valuable product. These cakes, however, have a comparatively small demand in Russia, and are largely exported to foreign countries, principally to Germany and England. The sunflower-shells, being used for heating purposes, form an article of trade in several districts. The seed-cups are used as food for sheep. Of the different kinds of sunflower seed in Russia—some white or grey, some brown with white or grey stripes, some quite black, dyeing the cells a dark violet colour—the grey and striped seeds are preferred, as they appear to be much cleaner and handsomer, and therefore command a higher price, especially for the purpose of raw consumption by the common people. The black seed, owing to its dark colouring matter, is generally avoided. All these seeds appear in the market divided into two sorts. The larger kind, containing less oil, is the cheaper; the smaller, producing more oil, is sold to the oil manufacturers, and is much more expensive. The latter seeds are flat and oval, like coffee beans, and are considered the best for this industry.—*Chemist and Druggist*.

THE CORNISH ASSAY.

Last year the Anaconda Mining Company took a step in advance by declining to sell copper matte in England upon English terms and deductions, so far as the settlement was concerned, bills being made out and settled for at so many pence for so many pounds of fine copper. The result was not reached without some grumbling on the part of English smelters, and now Mr. Haggin has made another further and radical advance in declining to sell any longer by the Cornish assay, insisting upon the wet analysis, with the allowance of 1.3 units, customary in this country. Upon these terms 1,800 tons of argentiferous matte were purchased by a large Liverpool house last month, followed by a second purchase of 600 tons by another smelter. Since then large contracts have been made on the same basis, amounting to many thousands of tons. It is but a step further now to compelling all foreign buyers to accept American assays and weights, since American methods of assay and settlement are conceded. In the present state of the market for furnace material it requires the concurrence of only two or three American producers to obtain this concession. As is well known, some of our largest copper miners never sell on any other basis.—*Engineering and Mining Journal*.

WIRE GLASS.

Under the name of wire glass a new invention has been brought on the market by a Dresden firm, the *Actien-Gesellschaft für Glasindustrie vorm. Friedr. Siemens*, says *Iron*, which marks an important development in the glass-making industry. The process of manufacture consists in furnishing glass in hot plastic condition with a flexible metallic layer, iron wire netting, for instance, which is completely inclosed by the vitreous substance and effectively protected against exterior influences, as rust, &c. The new glass possesses much greater resisting power than the ordinary material, and is, it is claimed, indifferent to the most abrupt changes of temperature. A proof of its toughness and durability is the fact that it may, in a highly heated state, be sprinkled with cold water without being materially damaged. The glass is specially adapted for skylights, the powerful resisting qualities of the material enabling the usual wire protectors to be dispensed with. As wire glass cannot be cut by the diamond, except under the application of great force, and cannot be broken without creating considerable noise, the substance is claimed to be, in a measure, burglar proof. Wire glass has also been successfully applied to the manufacture of hollow glass ware, it being particularly suitable for making glass vessels which have to withstand a high pressure or be subjected to rough usage. The new material is at present being manufactured in sheets of 8 mm. thickness and upwards.

ALKALI WORKS, &c. ACT AMENDMENT BILL.

On Friday, May 6th, a meeting, called by the Council of the Society of Chemical Industry, was held at the Society's offices, to consider the Alkali Works, &c. Act Amendment Bill recently introduced by the President of the Local

Government Board. The following gentlemen were present : Sir H. E. Roscoe, M.P., F.R.S., Mr. J. T. Brunner, M.P., Mr. J. C. Stevenson, M.P., Mr. A. E. Fletcher, Her Majesty's Chief Inspector under the Act it is proposed to amend, Col. D. Gamble representing a committee of Lancashire and Cheshire manufacturers, Messrs. Newlands, Crowder, Howard, Redwood, and Tyrer. The following resolution was passed :—"That this meeting of members of the Society of Chemical Industry, called by the Council of the Society, and comprising chemical manufacturers engaged in trades affected by the existing Act and the proposed Bill, adopts the resolution of the meeting of chemical manufacturers held yesterday in Liverpool, to the effect that the proposed Bill is not comprehensive enough in its scope, and that to be satisfactory provision should be made for the inspection of all works evolving certain specified noxious gases with the view of ultimately fixing a definite limit; also that the passing of the proposed Bill will render it difficult to pass another more comprehensive measure in the near future."

A meeting of the Chemical and Allied Trades Section of London Chamber of Commerce, states the *Chemical Trade Journal*, was held at the offices of the Chamber on Friday, 27th May, to consider the effect on chemical and allied industries of the same Bill. It was thought that this measure, if passed, would be productive of grave injury to many of the smaller industries, and might have the effect of driving them abroad altogether. Further, it was believed that the real offenders would not be touched by the present Bill, inasmuch as dyeworks and works of a similar character which give off noxious vapours, purposely carry on at times part of their process of manufacture during the night, with the result that any neighbouring

chemical or alkali works usually is credited with creating the nuisance complained of. It was reported that the chemical manufacturers of Liverpool, the Society of Chemical Industry, and the Coal Tar Distillers' Association had already taken steps to oppose the Bill, and it was resolved to second these efforts by a petition to the House of Commons. A petition has since been lodged opposing the Bill on the following grounds :—

(a.) That the extension of the provisions of the Alkali Act of 1881 to the works set forth in the schedule to the Amendment Bill would be a serious hindrance to trade, by reason of the restrictions proposed, and that in the case of many of the works it would seriously hamper them in their struggle with the increasing competition of foreign manufacturers, thus tending to drive these industries abroad.

(b.) That the Bill is entirely unnecessary inasmuch as where grievances are alleged the complainants have very ample facilities and powers to prosecute under the Local Government Acts.

(c.) That if further legislation is deemed necessary it is submitted that the present Bill is not sufficiently general, as the schedule thereto does not include many works which in their processes of manufacture are liable to emit gases at least as offensive and injurious as the works which form the subject of the proposed legislation.

(d.) That the inclusion of certain works and the exclusion of others similarly conducted and equally requiring inspection—if such is necessary—in the schedule to the Bill, can only result in anomalies, inconveniences, and difficulties, which would be a source of general dissatisfaction.

(e.) That any Bill affecting the industries scheduled should contain provisions for the inspection of *all* works evolving certain specified noxious gases.

MINERAL PRODUCTION OF PRUSSIA.

The production of the mines and metallurgical works of Prussia in 1890 and the two preceding years, according to the *Zeitschrift für das Berg-, Hütten-, und Salinenwesen im Preussischen Staate*, Band xxxix., was as follows :—

Production of Mines.

	Amounts.			Value.		
	1888.	1889.	1890.	1888.	1889.	1890.
	Tons.*	Tons	Tons.	Marks.†	Marks.	Marks.
Anthracite coal.....	59,175,551	61,433,991	61,375,816	291,918,365	332,581,039	479,523,844
Brown coal.....	13,297,888	14,295,047	15,468,134	32,159,347	35,928,133	39,871,250
Asphalt.....	10,747	12,310	14,523	101,391	167,220	200,315
Petroleum.....	2,770	3,059	2,249	393,762	417,980	338,178
Rock salt.....	188,692	254,849	250,351	943,655	1,145,231	1,212,264
Salt from brine.....	268,463	268,363	271,615	5,639,810	6,354,758	6,884,394
Kainit.....	257,557	279,984	308,660	3,734,147	4,044,220	4,383,505
Other potassium salts.....	723,181	689,341	708,467	7,380,141	7,329,100	7,750,316
Magnesium salts.....	11,452	8,959	6,688	87,598	68,189	57,243
Boracite.....	148	111	176	48,594	33,490	53,040
Iron ore.....	4,145,254	4,375,283	4,243,399	25,540,012	31,424,330	31,599,880
Zinc ore.....	666,700	707,537	757,862	13,727,832	17,656,457	23,375,415
Lead ore.....	143,383	148,773	148,615	16,036,003	16,971,808	17,398,456
Copper ore.....	521,873	563,863	587,722	17,240,071	17,868,749	19,944,173
Gold and silver ore.....	63	77	152	41,223	31,403	51,374
Cobalt ore.....	33	503	651	3,367	10,954	42,955
Nickel ore.....	9	17	33	1,345	3,489	1,634
Arsenic ores.....	1,198	1,882	2,183	72,330	104,320	110,910
Manganese ores.....	27,308	44,006	40,131	613,542	901,589	726,785
Pyrites.....	99,395	107,955	111,292	746,131	781,620	867,843
Other vitriol and alum ore.....	211	343	911	1,217	1,977	2,594

* Metric tons of 2,204 pounds.

† The mark is equivalent to 23½ cents.

Production of Prussian Smelting Works.

	Amounts.			Value.		
	1887.	1889.	1890.	1888.	1889.	1890.
	Tons.	Tons.	Tons.	Marks.	Marks.	Marks.
Pig iron.....	3,098,757	3,218,719	3,288,369	142,832,232	162,746,028	196,510,082
Zinc.....	133,280	135,972	159,056	43,578,005	49,331,086	62,296,438
Lead.....	89,847	90,809	91,133	22,971,754	23,036,212	22,850,823
Litharge.....	3,208	2,973	2,907	801,918	635,976	761,811
Copper.....	18,900	21,668	21,779	27,614,902	21,655,217	25,720,003
Black copper.....	15	..	1	6,186	..	250
Copper matte.....	977	263	792	341,021	101,068	268,853
Nickel.....	288	282	454	1,168,900	1,196,415	1,807,130
Cobalt.....	36	38	40	529,500	751,310	789,760
Chloride of tin.....	220	340	..	137,500	207,409	..
Antimony alloys.....	49	161	115	32,733	74,580	67,596
Manganese and alloys.....	14	16	24	40,330	43,200	59,331
Arsenic salts.....	842	813	817	175,558	172,660	161,433
Sulphur.....	2,270	2,133	1,904	237,350	235,006	160,390
Sulphuric acid.....	207,062	319,574	349,512	9,397,182	10,097,329	10,586,258
Sulphate of iron.....	8,517	7,245	6,384	252,129	204,697	159,618
Sulphate of copper.....	1,618	1,700	2,182	597,609	693,897	868,202
Mixed vitriol.....	175	243	281	21,624	29,071	33,207
Sulphate of zinc.....	772	1,117	1,914	41,668	81,173	113,831
Sulphate of nickel.....	28	27	26	5,999	5,960	33,900
Mineral paints.....	687	1,158	1,659	71,077	122,466	135,540
	Kilos.	Kilos.	Kilos.			
Silver.....	259,504,331	256,323,881	260,824,414	32,855,892	32,281,411	36,187,865
Gold.....	195,935	179,337	127,667	548,633	501,990	357,179
Cadmium.....	4,794	7,067	4,157	12,855	17,745	15,154
Bismuth.....	..	..	..	..	..	..

THE PRODUCTION OF STASSFURT SALTS.

The productions of these well known mines, which are controlled by German syndicate, are extensively used for manufacturing and agricultural purposes. The following table gives total annual production for the last three years:—

	1889.	1890.	1891.
	Tons.	Tons.	Tons.
Potassium chloride.....	60,667	62,009	65,739
Potassium sulphate.....	3,917	6,343	8,810
Double sulphate of potassium and magnesium calcined.	1,514	5,306	5,585
Double sulphate of potassium and magnesium crystallised.	328	444	515
Mannite salts—calcined.....	1,390	897	1,507
Kieserite.....	11,592	15,682	13,993
Kainit and sylvinit.....	129,090	149,156	202,619
Carnalite.....	18,682	17,093	19,317

—*Chemical Trade Journal.*

THE SALE OF FOOD AND DRUGS ACT.

The following is the text of the Bill introduced into the House of Commons last February, by Dr. Cameron, M.P., and only just printed:—

Be it enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

1. The provisions of the Sale of Food and Drugs Act, 1875, and of any Act amending the same, shall apply to and include every wholesale trader or manufacturer of any article of food or drug who shall sell to the prejudice of the purchaser any article of food or drug which is not of the nature, substance, and quality of the article demanded by such purchaser; and the 17th section of the said Act shall be read as if the words "whether by wholesale or" were inserted between the words "on sale" and the words "by retail" in the said section.

2. The 25th section of the said Act shall be and is hereby amended by the deletion of the word "written" before the words "warranty to that effect," and every wholesale trader or manufacturer of any article of food or drug, or other person who in the course of trade shall sell to any person any article of food or drug, with intent that the same may be resold by retail in the state in which it is purchased from him, shall, unless he has in writing informed the purchaser to the contrary, be deemed, for the purposes of the said Act, to have given a warranty to the

person purchasing from him that such article of food or drug is of the nature, substance, and quality demanded by such purchaser.

3. In any proceedings under the principal Act having reference to the sale of "margarine" as defined by the Margarine Act, 1887, it shall be a good defence to prove that the sale was made in conformity with the regulations of the said Margarine Act, 1887, and in the case of proceedings in Scotland under the said Margarine Act, the 33rd section of the Food and Drugs Act, 1875, shall be held to be added to the sections 12 to 28 inclusive incorporated in section 12 of that Act.

4. In determining whether an offence has been committed under section 6 of the principal Act, by selling to the prejudice of the purchaser coffee not adulterated otherwise than by the admixture of chicory, it shall be a good defence to prove—

(a.) Where the admixture of chicory does not exceed 50 per cent., that the seller delivered with or on such mixture a notice by a label distinctly and legibly written or printed bearing the words "This is sold as a mixture of coffee and chicory."

(b.) Where the admixture of chicory does not exceed 75 per cent., that the seller delivered with or on such mixture a notice by a label distinctly and legibly written or printed bearing the words "This is sold as a mixture of chicory and coffee."

(c.) Where the admixture of chicory exceeds 75 per cent., that the seller delivered with or on such mixture a notice by a label distinctly and legibly written or printed stating the proportion of chicory contained in such mixture.

5. This Act shall be read and construed with the Sale of Food and Drugs Act, 1875, and any Act amending the same.

6. This Act may be cited for any purposes as the Sale of Food and Drugs Act (1875) Amendment Act, 1892.

BOARD OF TRADE RETURNS

SUMMARY OF IMPORTS.

	Month ending 30th April	
	1891.	1892.
Metals.....	£ 2,072,814	£ 1,837,214
Chemicals and dyestuffs.....	843,379	783,674
Oils.....	181,971	608,108
Raw materials for non-textile industries.....	3,129,869	2,912,160
Total value of all imports....	38,002,337	34,920,272

SUMMARY OF EXPORTS.

	Month ending 30th April	
	1891.	1892.
Metals (other than machinery)	£ 3,663,725	£ 3,179,216
Chemicals and medicines	800,492	677,211
Miscellaneous articles.....	3,091,150	2,367,571
Total value of all exports.....	20,919,066	17,865,876

IMPORTS OF METALS FOR MONTH ENDING 30TH APRIL.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Copper:—			£	£
Ore..... Tons	5,579	11,394	44,780	82,478
Regulus..... "	16,625	11,562	405,983	294,529
Unwrought "	3,323	2,329	183,268	199,842
Iron:—				
Ore..... "	265,659	311,713	215,138	230,810
Bolt, bar, &c. ... "	3,119	3,446	28,846	28,058
teel, unwrought.. "	514	352	6,519	3,596
Lead, pig and sheet ..	12,995	18,454	161,621	293,376
Pyrites..... "	55,648	62,691	105,781	199,986
Quicksilver..... Lb.	538,425	137,435	58,759	12,260
Tin..... Cwt.	62,806	46,948	281,912	213,097
Zinc..... Tons	4,830	3,424	110,709	79,081
Other articles... Value £	..	..	469,498	470,101
Total value of metals	..	..	2,072,814	1,837,214

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 30TH APRIL.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Bark, Peruvian .. Cwt.	9,820	9,075	£ 23,195	£ 21,613
Bristles..... Lb.	260,837	144,703	43,758	21,753
Caoutchouc..... Cwt.	29,563	20,915	406,470	203,159
Gum:—				
Arabic..... "	4,738	4,036	13,156	12,830
Lac, &c..... "	15,867	19,370	61,114	75,204
Gutta-percha "	6,138	5,844	64,236	79,847
Hides, raw:—				
Dry..... "	48,188	42,904	117,052	110,049
Wet..... "	34,355	38,910	78,341	82,064
Ivory..... "	1,048	1,246	59,027	62,126
Manure:—				
Guano..... Tons	3,660	1,278	17,557	9,111
Bones..... "	10,366	11,042	50,137	50,040
Paraffin..... Cwt.	60,944	43,651	88,185	59,110
Linen rags..... Tons	3,216	3,349	30,919	29,529
Esparto..... "	19,251	16,340	91,544	74,796
Pulp of wood "	12,390	13,344	59,631	69,699
Rosin..... Cwt.	193,553	166,286	26,470	34,314
Tallow and stearin ..	181,172	122,519	224,052	157,406
Tar..... Barrels	2,820	1,275	1,274	799
Wood:—				
Hewn..... Loads	199,443	219,072	340,213	372,004
Sawn..... "	142,007	211,333	326,394	492,112
Staves..... "	8,046	11,734	47,828	66,962
Mahogany..... Tons	4,142	6,883	39,881	62,521
Other articles.... Value £	..	..	907,732	804,472
Total value .....	..	..	3,120,869	2,942,160

Besides the above, drugs to the value of 81,277*l.* were imported as against 88,863*l.* in April 1891.

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH
ENDING 30TH APRIL.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Alkali..... Cwt.	7,668	5,503	£ 4,119	£ 2,997
Bark (tanners, &c.) „	41,073	36,071	16,164	17,129
Brimstone..... „	28,189	59,036	9,663	16,089
Chemicals..... Value £	..	..	113,787	115,393
Cochineal..... Cwt.	625	363	3,889	2,273
Cutch and gambier Tons	2,417	2,484	56,328	57,032
Dyes:—				
Aniline..... Value £	..	..	26,759	11,263
Alizarine..... „	..	..	27,254	20,126
Other..... „	..	..	739	1,439
Indigo..... Cwt.	4,399	2,287	69,157	39,044
Nitrate of soda.... „	603,719	457,266	267,113	196,826
Nitrate of potash. „	37,659	39,832	32,314	25,894
Valonia..... Tons	1,823	4,356	39,344	61,187
Other articles... Value £	..	..	182,809	212,992
Total value of chemicals	..	..	843,379	783,674

IMPORTS OF OILS FOR MONTH ENDING 30TH APRIL.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Cocoa-nut..... Cwt.	26,092	14,015	£ 39,770	£ 16,397
Olive..... Tons	1,314	1,976	55,298	74,265
Palm..... Cwt.	74,585	111,069	8,5648	120,430
Petroleum..... Gall.	8,224,252	10,493,718	179,668	222,377
Seed..... Tons	1,684	1,972	41,199	48,373
Train, &c..... Tons	576	587	12,798	12,519
Turpentine..... Cwt.	4,445	19,259	5,857	22,922
Other articles... Value £	..	..	63,496	80,185
Total value of oils...	..	..	181,974	608,168

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING
30TH APRIL.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Alkali..... Cwt.	524,749	662,650	£ 107,862	£ 169,344
Bleaching materials „	119,533	114,588	49,576	45,189
Chemical manures. Tons	24,817	25,006	181,840	159,809
Medicines..... Value £	..	..	97,253	85,214
Other articles... „	..	..	28,296	217,395
Total value.....	..	..	500,492	677,211

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR
MONTH ENDING 30TH APRIL.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Brass..... Cwt.	9,091	8,296	£ 43,834	£ 38,254
Copper:—				
Unwrought..... „	73,703	79,662	204,506	194,669
Wrought..... „	30,995	27,007	102,562	80,395
Mixed metal..... „	21,885	26,869	69,786	67,883
Hardware..... Value £	..	..	218,055	181,401
Implements..... „	..	..	116,536	112,499
Iron and steel..... Tons	287,422	223,518	2,612,179	1,835,715
Lead..... „	4,214	4,973	62,182	61,518
Plated wares... Value £	..	..	39,026	21,060
Telegraph wires, &c. „	..	..	59,226	447,883
Tin..... Cwt.	9,920	8,594	47,134	40,719
Zinc..... „	17,614	21,742	19,478	29,245
Other articles... Value £	..	..	78,211	76,975
Total value.....	..	..	3,663,725	3,179,216

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH
ENDING 30TH APRIL.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Gunpowder..... Lb.	1,058,800	622,800	£ 23,974	£ 15,144
Military stores.. Value £	..	..	116,926	88,352
Candles..... Lb.	1,357,700	1,422,500	26,433	27,387
Caoutchouc..... Value £	..	..	114,575	97,582
Cement..... Tons	62,162	34,978	125,960	66,638
Products of coal Value £	..	..	179,689	123,256
Earthenware... „	..	..	176,350	151,867
Stoneware..... „	..	..	15,844	13,696
Glass:—				
Plate..... Sq. Ft.	240,823	191,468	14,264	11,390
Flint..... Cwt.	9,669	7,446	20,058	16,659
Bottles..... „	81,249	62,559	38,303	29,811
Other kinds.... „	17,331	21,514	13,150	16,575
Leather:—				
Unwrought..... „	11,814	11,818	107,762	112,211
Wrought..... Value £	..	..	30,449	21,582
Seed oil..... Tons	8,271	5,906	185,670	117,476
Floorecloth..... Sq. Yds.	1,505,700	1,155,100	65,636	48,380
Painters' materials Val. £	..	..	152,245	118,335
Paper..... Cwt.	95,196	79,457	162,731	131,991
Rags..... Tons	3,613	4,606	29,527	31,858
Soap..... Cwt.	15,657	48,359	52,841	52,142
Total value.....	..	..	3,091,150	2,367,571

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

7533. J. Duckett, A. Duckett, and H. Stephenson. *See* Class IX.

7753. J. Morrison. Improvements in ejectors for ejecting water, thick or thin, or tar and ammonia water. April 25.

7923. W. Foulis. Improvements in apparatus for regulating the flow and pressure of gas. April 27.

8155. J. Bonnoure. Improvements in distilling apparatus. April 29.

8773. G. F. Redfern.—From W. P. Abell, British Guiana. *See* Class XVI.

9140. A. Koehl. Improved apparatus for evaporating solutions. May 13.

COMPLETE SPECIFICATIONS ACCEPTED.*

1891.

8823. A. McDougall. Covering lead surfaces to protect water and other liquids from contamination with the dissolved metal. May 18.

9187. E. J. Mills and C. J. Ellis. Means and method of closure for the regulation of gaseous pressures. May 18.

9318. A. J. Boulton.—From A. Klönne and P. Bredel. Apparatus for charging retorts. May 11.

10,456. H. L. Callendar. Pressure gauges, suitable especially as piezometers, barometers, thermometers, and the like. April 27.

10,771. W. J. Tranter and S. Hale. Compound for preventing incrustation and corrosion in steam and other hot-water boilers. May 4.

10,833. A. W. Ellis. Stand for chemical or other purposes. May 4.

10,902. J. F. Braidwood. *See* Class II.

11,034. R. Harvey. Evaporating apparatus. May 4.

11,210. L. H. Armour. *See* Class II.

14,221. J. Tobin. New method of applying soda to internal parts of boilers for preventing the formation of scale. May 4.

16,965. R. Morris. Preventing incrustation in steam boilers. April 27.

1892.

5325. H. H. Lake. — From T. Craney. Evaporating apparatus. May 4.

5377. S. H. Johnson and C. C. Hutchinson. Apparatus for mixing liquids with liquids and solids. May 18.

5619. J. A. Fisher. Construction of non-conducting coverings to prevent the radiation of heat. April 27.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

7379. A. J. Boulton.—From H. C. Rew, United States. Improvements in or connected with gas generators. Complete Specification. April 19.

7468. A. Philburn. An improvement in apparatus for burning smoke. April 20.

7614. G. Heslop. *See* Class VII.

7708. J. C. Chaudler. Improvements in apparatus for washing, purifying, and scrubbing gas. April 23.

7709. H. Pazolt. The manufacture of an improved artificial fuel. April 23.

7888. J. H. W. Stringfellow. Improvements relating to the distillation of coal and other substances for gas-making and other purposes, and in apparatus therefor. April 26.

7983. P. Dvorkovitz. Improvements in apparatus for the manufacture of gas for illuminating or heating purposes, applicable also for the distillation of liquid hydrocarbons. Complete Specification. April 27.

7995. J. P. Bayly. An improved apparatus for charging inclined gas-retorts. April 28.

8159. R. Marshall. Improvements in the combustion of fuel and apparatus therefor. Complete Specification. April 30.

8207. W. Hawkins, T. Hawkins, H. Fuller, and W. H. Fuller. An improved metallic block to be used in the production of gas. April 30.

8426. A. Longsdon.—From F. Krupp and Co., Germany. New or improved processes for the manufacture of gas from water vapour, and for purification and separation of mixed gases. Complete Specification. May 4.

8481. J. E. Richardson. Improved means or apparatus for generating ozonised oxygen. May 5.

8592. T. D. C. Leveritt. An improvement in the purification of coal-gas used for the purposes of heating and cooking. May 6.

8664. R. Welford. Improvements relating to fuel. May 7.

8892. H. J. Rogers. An improved apparatus for the manufacture of gas for lighting and heating and for use in gas-engines. May 11.

8906. J. Duggan and W. J. Harley. An improved fire-lighter, also applicable for use as a temporary fire. May 11.

8919. T. J. Barnard. Improvements in the manufacture of fuel, together with the means and combinations in connexion therewith. May 11.

9080. W. D. A. Bost and T. F. Haldane. Improvements in the manufacture of fire-lighters. Complete Specification. May 13.

9114. R. N. Oakman, jun. Improvements in gas-producing plant. Complete Specification. May 13.

9171. T. Charlton. Improvements relating to the more perfect combustion of fuel in furnaces. May 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

10,902. J. F. Braidwood. Apparatus for charging retorts for the manufacture of gas and for other like purposes. May 11.

11,210. L. H. Armour. Ovens, furnaces, retorts, or other structures used in the making of coke or charcoal, or for distilling or roasting carbonaceous matter, or otherwise subjecting carbonaceous matter to the action of heat. May 11.

11,761. A. O. Jones. Manufacture of artificial fuel, utilising sewage therein. May 4.

12,572. G. E. Stevenson. Apparatus for charging inclined gas retorts. May 4.

1892.

5994. J. Rudd. Apparatus and means for increasing the illuminating power of gas. May 4.

6362. C. Bongourd de Lamarre. Process and apparatus for the manufacture of illuminating gas. May 11.

7079. C. R. Collins. Gas-making apparatus. May 18.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATION.

8462. P. H. Bayle and A. Cambray. An improved process of distillation, heating, and condensation of bituminous schists and any mineral substances which by distillation in closed vessels will yield mineral oils, paraffins, ammoniacal waters, and analogous products, and improved apparatus in connexion therewith. May 4.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

8269. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of dialkylised meta-methoxy, meta-ethoxy, and metabenzyloxy-para-amido benzophenones. May 2.

8270. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of azo-colouring matters derived from paraphenylenediamine. May 2.

8455. J. Y. Johnson.—From F. von Heyden, Germany. Improvements in the manufacture of alpha-oxynvitic acid. May 4.

8456. J. Y. Johnson.—From F. von Heyden, Germany. Improvements in the manufacture of colouring matter from alpha-oxynvitic acid. May 4.

8631. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture of triphenylmethane dyestuffs. May 6.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

10,861. H. H. Lake.—From K. Oehler. Manufacture of colouring matters. April 27.

11,016. J. Y. Johnson.—From the Badische Anilin und Soda Fabrik. Manufacture and production of alpha-naphthoquinone dichlorimide, and of basic dyestuffs therefrom. May 11.

11,049. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of meta amidobenzaldehyde, and of salts thereof. May 4.

11,275. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik.—Manufacture and production of new dyes of the rosaniline series and of new materials therefor. May 4.

11,328. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of yellow azo-colouring matters striking on mordants, and absolutely fast against the action of fulling, soap, and light. May 4.

11,472. W. B. Espeut. Manufacture of extracts from logwood and other dyewoods, also in preparing dyewoods for use in dyeing. May 11.

11,629. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture of basic naphthalene colouring matters and of sulpho acids therefor. May 4.

11,663. B. Willecox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Manufacture of colouring matters for dyeing and printing, derived from benzidine and its analogues. May 4.

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATION.

8363. G. Young. Improvements in the process or mode of producing polished, dyed, and bleached yarns or threads, and in machinery or arrangements for the purpose. May 3.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

8776. F. V. M. Raabe. Treatment of vegetable textile fibres for the manufacture of yarns and fabrics. April 27.

10,543. W. R. Comings. Impregnating paper and other fibrous materials. April 27.

1892.

5297. P. Temming. A new fabric suitable as a substitute for cotton waste for cleaning parts of machinery, and process for making the same. April 27.

6550. B. J. B. Mills.—From G. Bergier. Spinning and treatment of silk in the manufacture of various classes of silk thread. May 11.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

7440. T. Dawson and H. F. Clayton. Improvements in the method of and apparatus for dyeing cotton and other like textile fabrics. April 20.

7555. C. Schmürch. Improvements in apparatus for effecting the oxidation of aniline black in the process of dyeing cotton thread or wool on bobbins and cops. Complete Specification. April 21.

7628. G. Young and W. Crippin. Improvements in or applicable to mechanism or apparatus for dyeing, bleaching, and otherwise treating cotton and other fibrous materials in the raw or manufactured or partly manufactured state. April 22.

8170. J. Aldred. Improvements in bleaching cotton piece-goods. April 30.

8244. E. Sykes and D. Sykes. Improvements in machinery for scouring and dyeing hanks of yarn. May 2.

8364. M. Löb. Improvements connected with the dyeing of stockinette. May 3.

8921. T. T. Whittington. "Whittington's" direct mordant for dyeing cotton and linen fabrics. May 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

9470. R. Landam and D. Gulland. Method and apparatus for embossing, colouring, and printing upon paper or other suitable material. May 18.

10,138. E. B. Truman. Solution for use in the dyeing of silk fabrics, yarns, and threads. May 11.

10,678. E. Sutcliffe and G. E. Sutcliffe. Dyeing and treatment of cotton and other textile materials. May 18.

11,327. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Process of dyeing silk a solid black by means of alizarine, flavopurpurine, anthrapurpurine, and mixtures of these bodies. May 4.

20,737. C. H. Nevill. Process for producing designs upon calico and other woven fabrics. May 28.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

7393. F. Hurter. Improvements in the manufacture of bleaching powder and apparatus to be employed therein. April 19.

7528. J. W. Smith and H. B. Jagger. Improvements in the manufacture of vinegar. April 21.

7614. G. Heslop. The application of a by-product of the manufacture of acetates for warming and heating purposes. April 22.

7958. H. Precht. A process for the production of phosphates of potassium or aluminium soluble in water. April 27.

7997. H. C. Bull. Improvements in or connected with the manufacture of ferric chloride. April 28.

8276. La Société A. R. Pechiney and Cie. Improvements in means or apparatus for the manufacture of a mixture of hydrochloric acid gas and air. Filed May 2. Date applied for November 28, 1891, being date of application in France.

8890. B. E. R. Newlands. Improvements in the purification of carbonic acid. May 11.

8964. W. P. Thompson.—From W. B. Brittingham, United States. New or improved bleaching compound. Complete Specification. May 11.

9181. J. Hargreaves and J. Hargreaves. Improvements in apparatus employed in the manufacture of sulphate of soda. May 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

9732. D. Rylands. Manufacture of carbonic acid gas, and in tubes for containing the same. May 18.

9947. A. T. Hall. Treatment of waste liquors from metallurgical processes to obtain sulphurous or sulphuric acid and zinc. May 4.

9948. A. T. Hall. Treatment of waste liquors from metallurgical processes to obtain sulphurous or sulphuric acid and oxide of iron. May 4.

10,630. A. Dupré.—From F. Dupré. Manufacture of potassium carbonate. April 27.

11,469. T. H. Bell.—From T. Schloesing. Manufacture of anhydrous chloride of magnesium, and the apparatus used therein. May 11.

11,470. T. H. Bell.—From T. Schloesing. Manufacture of chlorine, and apparatus used therein. May 11.

1892.

5425. J. C. Ody. Method for making caustic soda (sodium hydrate). April 27.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

7792. C. F. E. Grosse. An improved method of producing marbled glass. Complete Specification. April 25.

7906. H. C. Bull. Improvements in or connected with casting tables for glass and glass making. Complete Specification. April 27.

8361. J. Rigby. To make pressed plate glass of any thickness or any colour or design. May 3.

8517. H. W. Cox. Improvements in vitrifying photographic prints on glass, metal, porcelain, china, and like substances. May 5.

8865. V. B. Lewes. Improvements in the manufacture of glass. May 10.

8896. T. H. Hunt. Improvements in appliances employed in the glazing of earthenware pipes and analogous articles. May 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

10,454. J. Armstrong. Manufacture of tanks or boxes and other articles of glass, and mechanism or appliances to be used in the said manufacture. April 27.

10,817. I. Pennell and J. T. Harris. Apparatus or appliance for use in supporting ceramic ware in enamel kilns whilst being fired. May 4.

11,039. P. Sievert. Process for producing glass articles with metal enclosures. May 4.

11,205. H. J. Chappell. Machines for pressing and moulding plastic materials. May 11.

16,005. G. Pitt. Mode of constructing flues for brick, terra-cotta, and other kilns. May 4.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

7490. G. Martenstein. Improvements in the manufacture of materials for street and other pavements. April 20.

7502. W. P. Thompson.—From L. O. Roeser-Müller and B. Deike, Germany. Improvements in and in the manufacture of plaster for building purposes. Complete Specification. April 20.

7533. J. Duckett, A. Duckett, and H. Stephenson. Improvements in and relating to the construction of kilns or ovens for drying and burning bricks, tiles, lime, and the like. April 21.

7719. S. Théraizal and F. Grand'Montagne. Improvements in the manufacture of artificial marble. April 23.

7744. J. C. Bloomfield. Improvements in the manufacture of plaster. April 25.

7850. E. T. Warner and J. F. Curry. An improvement in the art of making mortar. Complete Specification. April 26.

7857. A. Angell and F. Candy. Improvements in the manufacture of hydraulic cement from sewage sludge. April 26.

8232. G. M. Graham. Improvements in artificial stone blocks. Complete Specification. May 3.

8460. W. W. Hewitt and A. Stuart. Improved compounds for paving or covering roads, paths, or floors, and for manufacture of paving bricks or blocks. May 4.

8777. T. W. Brittain. Improvements in apparatus for grinding cement or other substances. May 9.

8889. F. H. Willis and R. Astley. An improved form and method of constructing fireproof floors and stairs. May 11.

9209. R. Astley. An improved form and method of construction of fireproof floors. May 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

7845. H. Faija. Continuous or running kilns for the calcination of cement. May 11.

11,209. H. Aitken. Treatment of stone, brickwork, plaster, or stucco, and the like, for preventing deterioration thereof. May 18.

12,730. F. Wachsmuth. Process for use in the manufacture of gypsum objects. May 11.

16,005. G. Pitt. See Class VIII.

21,199. R. Norwood. The manufacture of an improved compound for coating walls and other surfaces, and for the production of casts or mouldings, and for analogous purposes. May 4.

21,374. R. Norwood. The manufacture of an improved compound for coating walls and other surfaces, and for analogous purposes. May 18.

1892.

5746. A. T. Morse. Distemper for walls, ceilings, and the like. April 27.

6745. V. F. L. Smidth. Manufacture of hydraulic cement for building purposes. May 18.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

7378. P. C. Choate. Improvements in the art of producing metallic zinc. Complete Specification. April 19.

7418. W. Mayer. The manufacturing of cast iron expansive moulds used for molten materials of different kinds. April 20.

7473. C. H. Aston. Improved methods of utilising slag made in connexion with iron and steel furnaces. April 20.

7748. R. Evans and E. Davies. Improvements in means or apparatus to facilitate the manufacture of moulds for use in casting moulds for ingots of steel or other metal. April 25.

7758. H. Höfer. Improvements in refining iron. April 25.

7795. J. Colley and A. Colley. Improvements in the manufacture of steel and iron. April 26.

7832. H. A. Penrose. Improvements in or relating to the treatment of silver ores containing zinc and gold ores containing zinc. April 26.

7909. G. Wegner. A process for galvanising aluminium. Complete Specification. April 27.

8121. A. Brin. Improvements in converting and refining metals, and in cupolas or apparatus employed therein. April 29.

8257. C. M. Pielsticker. Improvements in the method of extracting gold and silver from ores. May 2.

8280. E. Bonehill. Improvements in the manufacture of iron, and in apparatus therefor. May 2.

8393. W. Holland. Improvements in apparatus or means for hardening and tempering metals. May 4.

8400. H. J. Smith. Improvements in the manufacture of pig-iron or steel ingots. May 4.

8467. H. R. Lewis and C. Gelstharp. Improvements relating to the treatment of ores containing blende or zinc in association with gold, silver, lead, copper, antimony, sulphur, and other metals or metalloids, and to apparatus therefor. May 4.

8523. J. Simpson. Improvements in the separation of gold or silver from auriferous or argentiferous sulphide of antimony ores, sometimes called stibnite. May 5.

8551. A. J. Boulton.—From C. Sauer, Germany. Improvements in or relating to aluminium solder. May 5.

8571. J. J. Lish. Improvements in the treatment of blast-furnace slag. May 5.

8612. E. H. Sumter. Improvements in or relating to the purification of iron or steel therefrom. Filed May 6. Date applied for January 21, 1892, being date of application in Belgium.

8779. J. B. Chamberlain and A. Gutensohn. An improved process for the preparation of iron or steel plates to receive electro-plating of other metals, such as silver, gold, or nickel. May 9.

8834. E. W. Cooke. An alloy. Complete Specification. May 10.

8861. C. F. Hengst. An improved metallic alloy. May 10.

8887. T. Twynam. Improvements in the utilisation of tin plate, scrap, and tin slags and residues. May 11.

8932. W. H. Luther. Improvements in and relating to baths for coating metallic plates. May 11.

9098. A. Needham. Improvements in the manufacture of steel, iron, or other material to be used in the making of treads for stairs, steps, and floors. May 13.

9127. J. Y. Johnson.—From N. Lébédoff, Russia. Improvements in the extraction of metals from ores or metalliferous materials. May 13.

9128. J. Y. Johnson.—From N. Lébédoff, Russia. Improvements in the manufacture of alloys of aluminium. May 13.

9146. W. A. Briggs. An improved alloy of aluminium. May 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

2361. J. B. Alzugary. Improvements in metal alloys. May 18.

8819. W. Bevan. An annealing apparatus to be applied to heating furnaces for iron, steel, or metal sheets and plates. April 27.

8837. The Rovello Syndicate, Lim., and J. C. Howell. Apparatus for use in obtaining copper. May 4.

9117. J. O. Day. Alloys and compositions for use in covering and coating surfaces of iron and steel, and the surfaces of other materials, in order to prevent corrosion and fouling thereof when submerged. April 27.

9708. C. J. Fauvel. Furnace for the treatment of refractory ores. May 4.

10,761. C. W. Bildt, G. Ashworth, and E. Ashworth. Linings for Bessemer converters. May 4.

10,984. F. H. Mason. Process for the extraction of tin from tin slags or tin refuse by founders' ashes, copper salts, carbonaceous matter, fluorspar, and other suitable fluxes. May 18.

11,095. J. S. Taylor and S. W. Challen. Process or method of manufacturing metal tubes. May 4.

11,190. F. W. Harbord and W. Hutchinson, jun. The utilisation of tin-plate scrap. May 11.

11,208. J. Turton. Process for the extraction of metals from ores and metal minerals containing them. May 4.

11,247. L. Reuleaux. Construction and working of smelting and melting furnaces. May 11.

1892.

4173. P. Rossigneux. Method and means of desulphurising castings or alloys of certain metals. May 4.

6038. G. Wegner. Solder for joining together aluminium pieces or pieces of aluminium with other metals. May 4.

6704. S. H. Brown. Compound for carburising metals. May 18.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

7412. Sir C. S. Forbes, Bart. An improved battery element. April 19.

8083. J. O. Dale. A means of electrically heating iron, steel, and other metals in the processes of rolling, drawing, pressing, and stamping. April 29.

8108. J. W. Davis and J. O. Evans. Improvements in the manufacture of metallic articles by electro-deposition. April 29.

8529. W. Moseley. Improvements in galvanic batteries. May 5.

8572. H. Beckmann, E. Beckmann, and J. Schmitt. An improved galvanic element. Complete Specification. May 5.

8987. P. Germain. Improvements in secondary batteries and accumulators. Filed May 12. Date applied for February 23, 1892, being date of application in France.

9014. H. J. Allison.—From P. Kennedy and C. J. Diss, United States. Improvements in storage batteries. May 12.

9132. H. Howard. Improvements in heating and welding by electricity. May 13.

9192. A. J. Boulton.—From F. C. Bromley. Improvements in the electrolysis of chloride and other solutions. Complete Specification. May 14.

9197. A. J. Boulton.—From E. Liebert, Belgium. A process of extracting zinc, iron, lead and copper from the solutions of their salts by electrolysis. May 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

9652. A. Watt. Production of copper tubes by electrolysis. March 18.

11,060. P. Giraud. Thermo-electro batteries. May 4.

11,560. G. G. M. Hardingham.—From J. H. Hard and H. Coumett. Galvanic batteries. May 11.

18,997. C. N. Souther. Galvanic batteries. May 11.

19,617. M. Muthel. Exciting fluid for galvanic zinc carbon batteries, and method of recovering useful products from the spent fluids of such batteries. April 27.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

7354. R. Bell. Improvements in the manufacture of soap. April 19.

7581. R. Stewart. Improvements in soap or washing-powder. Complete Specification. April 21.

8217. C. Kloeble. An improved soap tablet. April 30.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

10,516. R. J. Jordan. Compound for cleansing purposes. May 11.

11,799. N. M. Henderson. Treating or purifying paraffin wax, and apparatus therefor. May 18.

11,889. O. C. Hagemann.—From E. K. Mitting. Treatment and purification of soap-makers' spent lye for extracting glycerin therefrom. May 18.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

7353. R. Bell. A new or improved compound or mixture for preventing the fouling of ships' bottoms and other submerged surfaces or structures. April 19.

7631. E. Waller and C. A. Sniffen. Improvements in the manufacture of white lead for use as a pigment. April 22.

7688. W. Cutler. Improvements in the manufacture of gold, silver, and bronze paints. April 23.

8199. B. Goldmann. Improved dryer for paints and the like. April 30.

8765. J. Burbridge. Improved mode of preparing variegated rubber for manufacturing purposes. May 9.

9135. F. D. Mott. An elastic or resilient covering for ships' bottoms. Complete Specification. May 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

8480. F. Ragon. Manufacture of material applicable as a blacking and for other purposes. April 27.

1892.

5287. J. W. H. James. Manufacture of white lead, and apparatus therefor. May 4.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

7698. A. J. Boulton.—From A. E. Ebert, Germany. Improved manufacture of substitute for leather. Complete Specification. April 23.

8469. H. H. Lake.—From Durio Bros., Italy. Improvements in and relating to tanning hides and skins. Complete Specification. May 1.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

6416. W. P. Thompson.—From F. A. Wolff. Apparatus for the treatment of liquid gelatin or glue for the ultimate production of plates or sheets of such. May 11.

XV.—AGRICULTURE AND MANURES.

APPLICATIONS.

8859. T. M. Smith. Improvements in and in the method of manufacture of fertilisers. Complete Specification. May 10.

8901. J. S. Yule. An improved manurial compound obtained in filtering sewage. May 11.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

8274. A. Walker. Improvements in the treatment and saccharification of grain and other materials containing starch, dextrin, or similar substances. May 2.

8336. W. P. Thompson.—From J. A. Morrell and W. R. Stringfellow, United States. New or improved process and apparatus for concreting sugar, or crystallising saline or other solutions. Complete Specification. May 3.

8773. G. F. Redfern.—From W. P. Abell, British Guiana. Improvements relating to filtering apparatus for saccharine and other liquors. May 9.

9167. S. C. B. Hunter. A new or improved treacle or syrup compound. May 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

11,874. R. Harvey. Manufacture of sugar, and apparatus therefor or connected therewith. May 18.

1892.

6160. R. Brockhoff. Apparatus for manufacturing sugar. May 4.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

7534. J. Y. Johnson.—From J. A. Saladin, France. Improvements in the manufacture of malt and in the apparatus employed therein. April 21.

7547. O. Ritter, J. H. A. Meyer, and L. Hofman. An improved wort and yeast aerator. April 21.

7643. A. H. Hobson. Improvements in the production of non-alcoholic ales or beers. April 22.

8060. J. Chesmore. A new or improved non-alcoholic ale. April 28.

8290. H. Gehrke. Improvements in apparatus for filtering beer and other alcoholic and gaseous liquids. Complete Specification. May 2.

8623. T. Haynes, jun. An improvement in the drying and curing of malt. May 6.

8952. P. M. Justice.—From A. W. Billings, United States. Improvements in apparatus for the manufacture of malt liquors. Complete Specification. May 11.

9165. R. G. Ross, J. B. Hilliard, and W. Paterson. A new or improved method of purifying and hardening water for use in the manufacture of malt extract, and for brewing and analogous purposes. May 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

11,123. M. A. Adams and C. S. Meacham. New or improved means for the preservation of hops. May 4.

1892.

4682. A. J. Boulton.—From The Pfandler Vacuum Fermentation Co. Manufacture of beer. April 27.

4688. A. J. Boulton.—From the Pfandler Vacuum Fermentation Co. Manufacture of beer. April 27.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

7789. E. Edwards.—From F. Grognet, France. An improved process and apparatus for preserving meat, fish, and other perishable substances. April 25.

7848. E. Barker. Improvements in or relating to the preparation or treatment of certain waste products to make them suitable for use as food and in apparatus therefor. April 26.

8264. G. Müller. Process of producing sterilised butter. Complete Specification. May 2.

8727. A. P. Wire. Improvements in the preservation of animal and vegetable substances. May 9.

B.—Sanitary Chemistry.

7721. H. H. Hazard. A system for the treatment of smoke, gases, fumes, or chemical products arising from any furnace, chimney, vent, fire-place, or outlet, so as to prevent the contamination of the atmosphere and the evils arising therefrom, and for making use of the products. April 23.

C.—Disinfectants.

8725. C. F. Hiron. The Hiron's disinfectant and air purifier. May 9.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1892.

5589. S. L. West. Apparatus for purifying, sterilising, and filtering water, and rendering the same fit for potable purposes. April 27.

5725. J. Faleimagne. Preservation of meat and fatty matters. April 27.

6841. W. Crawford. Manufacture of malt bread, biscuits, confectionery, and other articles of diet. May 18.

B.—Sanitary Chemistry.

1891.

10,929. W. E. Adeacy. Treatment of sewage sludge. May 4.

11,761. A. O. Jones. *See Class H.*

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

8239. W. Saunders. Highly everlasting solid white non-fading opaline key covering for pianofortes, organs, &c. May 2.

8473. J. Robertson. Improvements in the manufacture of vegetable parchment. May 4.

8700. C. F. Cross, E. J. Bevan, and C. Beadle. Improvements in dissolving cellulose and allied compounds. May 7.

8713. S. G. Rawson. Improvements in and in the manufacture of waterproof paper, cardboard, and the like. May 7.

8810. K. L. Grubert. An improved method of manufacturing variegated plates of wood-pulp or cellulose, and other plastic materials. May 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

8487. A. Sheldon. Apparatus for the manufacture of paper pulp. May 18.

10,513. W. R. Comings. *See Class V.*

1892.

433. H. Richardson and H. Glenny. Manufacture of paper, and apparatus used for that purpose. May 11.

2629. V. B. Drewsen. Method of purifying the liquid which has been used in the manufacture of cellulose, and the production of useful products therefrom. April 27.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

7782. B. Willecox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of periodides of phenols and phenolcarboxylic acids. April 25.

7979. E. Kauder and L. Merck. Improvements relating to the production of narceinesodium-sodium-salicylicum. April 27.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

11,833. B. Willecox.—From The Farbenfabriken vormals F. Bayer and Co.—Manufacture and production pharmaceutical compounds. May 11.

11,844. J. F. von Mering. Improved anæsthetic and hypnotic. May 11.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

7414. E. Hooker. Improved means and ingredients for colouring and tinting photographic silver prints. April 19.

7501. A. J. Boulton.—From G. Eastman, United States. Improvements in or relating to photographic films or the like. April 20.

7567. T. Christy. Improvements in the manufacture of transparent materials and the application of the same to photographic and other purposes. April 21.

8145. C. E. Elliott. Improvements in connexion with artificial-light photography. Complete Specification. April 29.

8328. E. H. Fitch. Improvements in and connected with photographic sensitised celluloid films. May 3.

8967. A. J. Boulton.—From G. Eastman, United States. Improvements in or relating to photographic plates or films. May 11.

COMPLETE SPECIFICATION ACCEPTED.

1891.

10,101. J. Joly. Methods of obtaining solar altitudes by the aid of instantaneous photography. May 11.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

7392. A. R. Molison and A. McLucas. A steam cartridge for blasting purposes. April 19.

7978. C. H. Curtis and G. G. André. Improvements in explosives. April 27.

7981. J. Lawrence. Improvements relating to the extraction of nitro-glycerin from the waste acid formed in the manufacture of nitro-glycerin. Complete Specification. April 27.

8256. G. W. Thomas. Improvements in matches, fusees, and the like. May 2.

8740. M. Mullineux. Improvements in smokeless cartridges. May 9.

8926. C. O. Lundholm and J. Sayers. Improvements in the manufacture of explosives. May 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

9485. T. Holmes. Safety-fuse igniting to be used in conducting blasting operations in mines, quarries, and the like. May 18.

14,429. G. C. Dymond.—From E. Lagneau. Manufacture of matches, and apparatus or machinery therefor. May 11.

19,346. P. W. Masson. Time or distance fuse for explosive shells. May 11.



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J. H. Collins X.	H. S. Pattinson, Ph.D. VII., X.
V. Cornish...VIII., IX., XIII.	H. T. Penter- } XVI., XVII. mann..... }
P. Dvorkowitsch. II., III., IV., XII., XIII., XXIII.	G. H. Robertson XI.
Dr. P. Norman Evans XIX.	F. W. Renaut... Patent Lists.
W. M. Gardner..... V., VI.	H. Schlichter. Ph.D. V., XV.
Oswald Hamilton..... I.	Edward Simpson I.
P. J. Hartog, B.Sc. Gen. Chem.	A. L. Stern, B.Sc. XVII.
Prof. D. E. Jones, B.Sc. XI.	D. A. Sutherland ... II., III.
W. E. Kay VI.	Eustace Thomas XI.
A. J. King, B.Sc. ... VI., XVI.	H. K. Tompkins, B.Sc. X.
F. S. Kipping, } II. and D.Sc. } Gen. Chem.	V. H. Veley, M.A. Gen. Chem.
Chas. A. Kohn, } Gen. Chem. Ph.D. }	C. Otto Weber, Ph.D. IV., XIII.
L. de Koningh XVIII., XXIII.	A. Wingham X.

NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list will retire from their respective offices at the forthcoming Annual General Meeting.

Sir John Evans, K.C.B., F.R.S., has been nominated to the office of President; and Professor J. Emerson Reynolds, F.R.S., has been nominated Vice-President under Rule 11.

Dr. F. Hurter, Dr. W. H. Perkin, F.R.S., Mr. John Spiller, and Professor T. E. Thorpe, F.R.S., have been nominated Vice-Presidents under Rule 8; and Mr. Thos. Tyrer has been nominated an Ordinary Member of Council under Rule 17, in the place of Mr. John Spiller, nominated a Vice-President.

Mr. Ludwig Mond, F.R.S., has been nominated Foreign Secretary; and the Treasurer has been nominated for re-election.

Mr. R. Forbes Carpenter, Mr. C. C. Hutchinson, Mr. John Pattinson, Mr. A. Gordon Salamon, and Mr. E. C. Cortis Stanford have been nominated, under Rule 18, to fill five vacancies among the Ordinary Members of Council.

A ballot list is enclosed herewith.

ANNUAL GENERAL MEETING.

The Annual General Meeting will be held in London on the 20th, 21st, and 22nd July next. The following is a synopsis of the arrangements:—

Wednesday, July 20th.

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|--|-----------|
| 1. Annual Meeting (Drapers' Hall) | 3 p.m. |
| 2. Reception by the President at Galleries of
Royal Institute of Painters in Water
Colours | 8.30 p.m. |
| 3. Smoking Concert at do. do. | 9 p.m. |

Thursday, July 21st.

- | | |
|--|-----------|
| 1. Excursion to Works on the Thames below
Bridge; steamer leaves Charing Cross Pier | 9.30 a.m. |
| 3. The Dinner at "The Ship," Greenwich | 6.30 p.m. |

Friday, July 22nd.

- | | |
|---|-----------|
| Excursion to Windsor and Clevedon; train
leaves Paddington | 9.30 a.m. |
|---|-----------|

Post Office Orders should be made payable at the General Post Office, London, to the Honorary Treasurer, E. Rider Cook, and should be forwarded to him at Bow, unless it be desired to notify a change of address.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is prepared to offer 5s. apiece for copies of the Society's Journals for January 1883 in saleable condition.

LIST OF MEMBERS ELECTED, 23rd JUNE 1892.

Barden, Alf., Far Bank, Shelley, near Huddersfield, glue and size manufacturer.

Bell, Percy Carter, Fyde Terrace, Fleetwood, Lancashire, analytical chemist.

Buchanan, D. G., Mount Vernon House, Glasgow, analytical chemist.

Duxbury, Thos., Gas Works, Darwen, Lancashire, gas engineer.

Feld, Walther, Chemische Fabrik, Hönningen a/Rhein, Germany, manufacturing chemist.

Ferguson, W. B., 3, Plowden Buildings, Temple, E.C., and Bankfield, Prestwich, barrister-at-law.

Hampson, Jas., 42, Woodland Street, Cheetham Hill, Manchester, chemist.

Harrison, M. C. C., Haverbrack, Bishop Stortford, Essex, brewer.

Holton, E. C., Sherwin-Williams Co., 130, Canal Street, Cleveland, Ohio, U.S.A., chemist.

Howard, Alf., 4, Prince's Road, Lewisham, S.E., architect and surveyor.

Hunter, Sidney H., 202, Bow Road, E., mechanical engineer.

Innes, Robt., 85, Brook Road, Bootle, Liverpool, soap works chemist.

Lambert, Alan, 1, Prince's Mansions, Victoria Street, S.W., oil mills director.

McVie, Jas. P., Tennant's Works, Hebburn-on-Tyne, analytical chemist.

Meacham, C. S., Brewery House, Earl Street, Maidstone, Kent, brewer.

Mereer, C. A., Dagmar Lodge, Cheam Road, Sutton, Surrey, chemical apparatus manufacturer.

Russell, W., Summerlee Ironworks, Coatbridge, N.B., analytical chemist.

Slater, Sydney H., 126, Highbury New Park, N., chemical student.

Stein, Sigmund, 323, Vauxhall Road, Liverpool, sugar refinery manager.

Stephens, H. O'Reilly, 20, Brunswick Gardens, Kensington, W., ink manufacturer.

Stewart, Ebenezer, Oilseed Mills, Rochester, Kent, seed crusher.

Turnbull, Saml. G., 10, Rue de Bas Trevois, Troyes (Aube), France, dyer and finisher.

Valentine, A. H., 11, Tenerife Street, Broughton, Manchester, chemist.

Whitney, Willis R., Mass. Inst. of Technology, Boston Mass., U.S.A., assistant in general chemistry.

Wirtz, Dr. Quirin, 28, Great Ormond Street, W.C., consulting chemist.

CHANGES OF ADDRESS.

Allibon, G. H., 1/o Liverpool; c/o Richardson Bros. and Co., 30, Donegall Place, Belfast.

Bailey, C. M., 1/o Uphall; 6, Pampherton, Midealder, N.B.

Barrow, J., 35 (not 65), Bromboro' Road, Bebington, near Birkenhead.

Bayley, Thos., 1/o Merrion; 2, Sandymount Avenue, Ballsbridge, Dublin.

Blythe, Herbert F., 1/o Leyland Road; Southport, Lancashire.

Burdekin, G., Journals to Sutton Lodge Works, St. Helens.

Chorley, J. C., 1/o Warrington; University College, Gower Street, W.C.

Christie, John, Journals to Levenfield, Alexandria, N.B.

Coomber, Thos., 1/o Clifton; 40, Clarendon Road, Redland, Bristol.

Cunningham, H. D., 1/o Hebburn; 14, Griffin Street, York Road, S.E.

Curphey, W. S., 1/o Strathbungo; 15, Bute Mansions, Hillhead, Glasgow.

"Engineer, The," 1/o Strand; 33, Norfolk Street, Strand, W.C.

Everett, H. B., 1/o Borneo; Highclere, Marlborough Road, Tooting, S.W.

Fleck, H., 1/o Tübingen; 108, Rittenhouse Street, Germantown, Philadelphia, Pa., U.S.A.

Francis, E. G., 1/o Halstead Villas; c/o Manbré Saccharine Company, Hammersmith, W.

Gilmour, J. D., 1/o 138; 142, Aitkenhead Road, South Side, Glasgow.

Graham, J. A., 1/o Dunmow; The Rookery, Dovercourt.

Harvey, E. Feild, 1/o Brompton; c/o C. W. and W. Gray, 31, Great St. Helens, E.C.

Holland, Philip, 1/o Albert Road; c/o Jas. Greenway, 33, London Street, Southport.

Houston, R. S., 1/o Hope Villa; Brisbane House, Bellahouston, Glasgow.

Kemp, W. J., 1/o Croydon; Mountfield, Hawkhurst, Kent.

King, Walter R., 1/o St. John's Road; 1, Florence Villas, Haulleigh Road, Southend.

Knaggs, A. Batty, 1/o Leeds; Springfield Mill, Morley, near Leeds.

Krause, O. H., 1/o box 577; Box L., Jersey City, N.J., U.S.A.

Latham, B., Journals to 13, Victoria Street, Westminster, S.W.

Lenox, L. R., 1/o Washington; Stanford University, Palo Alto, Cal., U.S.A.

Limpach, Dr. L., 1/o Manchester; Schweinfurt, Germany.

Miller, Robt., 1/o Manchester; 79, West Nile Street, Glasgow.

Moore, Thos., 1/o Thio; "Le Nickel," Noumea, New Caledonia.

O'Neill, Charles, 1/o Carter Street; 14, Cecil Street, Greenheys, Manchester.

Pitt, Theo, 16 (not 12), Coleman Street, E.C.

Roberts, C. F., 1/o Bradford; Linfitts, Delph, via Oldham.

Sharp, Henry, 1/o Bournemouth; Sutherland House, Southampton.

Small, J. I., Journals to Harcourt, Bickley, Kent.

Smith, Fred., 1/o Box 1812; c/o W. J. Kent, Box 291, Johannesburg, S.A.R.

Takamine, J., 1/o Japan; 907, Chamber of Commerce Building, Chicago, Ill., U.S.A.

Walton, F., 1/o Portugal Street; 114, Holborn, E.C.

Williams, Percy B., 1/o The Bank; 22, Bisham Gardens, Highgate, N.

CHANGES OF ADDRESS REQUIRED.

Gibson, Dr. J., 1/o 15, Dick Place, Edinburgh.

Venables, T., 1/o 3, Gardner Street, Glasgow.

Deaths.

Ellis, G. E. R., at Nelson, British Columbia.

Fullarton, R., 30, Donegall Place, Belfast.

Pringle, Wm., Castle Street, Bangalore, India.

Sieher, C. H., Whitworth, near Rochdale.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: T. Tyrer.

Vice-Chairman: W. Crowder.

Committee:

C. F. Cross.

J. Dewar.

A. G. Green.

S. Hall.

C. W. Heaton.

D. Howard.

W. Kellner.

W. Ramsay.

B. Redwood.

W. S. Squire.

G. N. Stoker.

F. Navier Sutton.

Wm. Thorp.

T. E. Thorpe.

Hon. Local Secretary: John Heron.

Ellerdaie, Cottenham Park, Wimbledon.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies, and will take office in July next:—*Chairman:* Wm. Thorp. *Secretary:* John Heron. *Committee:* C. C. Hutchinson, B. E. R. Newlands, F. G. Adair Roberts, A. Gordon Salaman, T. Tyrer, and Frank Wilson.

SESSION 1891-92.

1892:—

July 20th, 21st, and 22nd—Annual General Meeting

Meeting held Monday, 30th May 1892.

MR. THOS. TYRER IN THE CHAIR.

THE LATE PROF. A. W. VON HOFMANN, F.R.S.

THE CHAIRMAN, referring to the recent death of Dr. Hofmann said, that as a considerable number of industrial chemists in the London Section of the Society were students of his in the days when he occupied the position of Professor of Chemistry in the Royal School of Mines, it was only fitting that at the commencement of the proceedings that evening some reference should be made to the great master. He had, therefore, taken upon himself to communicate with some of those who were most intimate with Dr. Hofmann; among them were Sir Frederick Abel and Dr. Perkin. Sir Frederick Abel was prevented, in consequence of his engagements, which pressed upon him very severely, from attending the meeting, but he had written a letter which would be read; after which he would ask Dr. Perkin to speak of Dr. Hofmann as he knew him, and to move a resolution which Mr. David Howard, Mr. Mond, and Mr. William Thorp would support. Mr. John Spiller, who was away from home, had telegraphed his inability to come, and his sympathy with the action taken. Sir Frederick Abel had written as follows:—"I very much regret that it is impossible for me to attend the meeting on Monday evening, as I could much have wished to have the privilege of moving a resolution expressing the Society's sense of the great loss which chemists have sustained in the death of Hofmann, and the reverential affection with which his memory is cherished by his old pupils, of whom I was the first entered at the college, and from whom I was the first whom he selected as assistant." He would now call upon Dr. W. H. Perkin to pay his tribute of honour to the great master.

Dr. W. H. PERKIN regretted that Sir Frederick Abel could not be present, but he was glad to take the opportunity of saying a few words about the great chemist who

had just passed away, being one of his old pupils, who felt how much he owed from having studied under such a teacher, whose enthusiasm and zeal could not but stimulate any student who had in him a spark of love for his science. His knowledge of Dr. A. W. von Hofmann dated from the year 1853, when he was Professor at the Royal College of Chemistry in Oxford Street, an institution rendered famous by the thorough chemists he made of those who studied there, as well as by the brilliant and continuous flow of scientific work which was produced, not only in his own laboratory, but also by his students, whom he inspired with the love of research. No other laboratory in the kingdom was so fruitful as that of the Royal College of Chemistry, and it was a great loss to this country when Dr. Hofmann left London. Of the value of the work which he achieved during his lifetime it was difficult to form an adequate idea, its amount being so great, and he continued it with unremitting zeal throughout his life; in fact his last paper had only just been published. His researches were of special interest to the Society on account of the technical bearing which many of them possessed, showing the practical value of scientific investigation for the advancement of chemical industry, a fact which was now being so well recognised on the Continent, and was becoming more and more appreciated in this country. To Dr. Hofmann's kind and genial nature all who knew him could testify, and any one who had read the three volumes which he wrote in remembrance of his deceased chemical friends could get some idea of his kindness of heart. Of this he might mention an instance in his own experience. When the Fellows of the Chemical Society gave a dinner in his (Dr. Perkin's) honour on the occasion of his being their President, Dr. Hofmann travelled all the way from Berlin in order that he might preside, a practical mark of friendship for his old student, which he would never forget. He little thought that that would be the last time that he would have the pleasure of seeing his old master, as it proved to be. They had indeed lost a great man, one who left behind him an almost unparalleled record of devotion to chemical science. He would conclude by moving the following resolution:—

"We, the members of the London Section of the Society of Chemical Industry, desire to express our deep sympathy with the family of the late revered Professor A. W. von Hofmann. So many of the members owe all their chemical success to Professor von Hofmann's invaluable instruction, that his memory will ever endure amongst us, and as long as chemical industry exists, his historic discoveries will remain the foundations of no small portion of our work."

MR. DAVID HOWARD felt no small honour in being allowed to speak a few words in expression of the deep regard and the profound respect which he felt for the great man who had been taken away. Those who were under him in the old days knew the marvellous power he had, not only of teaching—which was a great gift—but of communicating that wonderful enthusiasm for science, the love of knowledge for its own sake, which he possessed to an extent which none perhaps had ever exceeded. It might be questioned whether it was quite appropriate to speak of his love of pure science to a body of men who were devoting themselves to applied science. He thought, however, that all the great discoveries in that science were grounded upon a love of truth for its own sake. Truth for itself was the first, the use made of it the second, consideration, and therefore, by one of those paradoxes which have a great meaning underlying them, because he studied truth for itself, he was the great founder of applied science.

MR. LUDWIG MOND said that, although he had not been a pupil of Dr. Hofmann, he considered it a privilege to be allowed to say a few words in his memory. The name of August Wilhelm von Hofmann was revered by everyone who called himself a chemist. He had lived long enough to remember the startling effect which his researches had made on the chemical world during the last 30 or 35 years. He had the pleasure of meeting Dr. Hofmann not much more than a year ago. At that time, although grey, he was as full of life as any one in the room, and as cheerful as only a man who had so splendid a career behind him could be, a man whom he should have hoped to meet again, and

whose researches he expected to enrich our science for many a year to come. He had been taken away in the full strength of his mind, and up to the last day had devoted himself, with that enthusiasm for which he was unparalleled, to the science which they all cherished. Whilst addressing an assembly of technical chemists, he felt bound to call attention to Dr. Hofmann's great appreciation of applied chemistry, which was clearly shown in the classical volumes which he had published on the progress of applied chemistry in 1862 and 1873, works containing more information, and having that information better arranged, than any books on the subject which had ever been written.

MR. WM. THOMAS thought that the speakers had proceeded in very appropriate order. He regretted the absence of Sir Frederick Abel, as Dr. Hofmann's first English student, but was glad that Dr. Perkin, at all events one of his earlier students, was present. He felt it a great honour to be asked to speak, seeing that he was not one of Dr. Hofmann's first English pupils, for it was during the time that he was a student at the College of Chemistry that Dr. Hofmann left England to go to Germany. One of the most striking characteristics of Dr. Hofmann was the amount of attention which he gave to his pupils, and perhaps that was the secret of his success. He made it a practice to see all the first year's students every other day; half of them one day, and the other half the next; and all the second, third, and fourth year students he saw every day at least. It was said that a stamped document was not valid unless it had actually touched the substance of the die; and it seemed to him that this personal contact with the teacher was the great secret of Dr. Hofmann's success with his students. It might have been that some of his pupils were very unrecceptive, and did not do him credit; but still he believed that his close attention to them (which, together with the immense amount of work he had on hand in the way of private research and consulting practice, must have meant a large amount of personal self-sacrifice), was the means of giving to his pupils something of that enthusiasm to which Dr. Perkin had referred. Some three or four years ago, happening to be in Berlin, as a matter of course, as an old pupil, he called upon his former teacher. He was received very cordially and they had a long talk about old times. Perhaps one of the things that struck him most was that Hofmann said that although he had then been for twenty years in Germany he thought that he knew London better than he did Berlin, which seemed to imply that his heart was still very much in London. He did not think that a greater loss could be suffered by industrial chemistry than that inflicted by the death of Dr. Hofmann.

THE CHAIRMAN thought that he ought to content himself with putting the resolution as worded; but as one who had been a pupil of Dr. Hofmann at the same time as his friend Mr. David Howard, at a time when Dr. Perkin's researches had become objects of ambition and stimulus for every one of the pupils; when in the same laboratory were Professor Macleod, who was Dr. Hofmann's efficient assistant (where efficiency meant perfection); when Martins, Volhardt, E. J. Mills, Groves, Griess, Valentine, and others well known in applied chemistry were in the laboratory studying in one part of it or another, one felt it an honour to have been in the same place and at work with such men. References had been made to the personal character of Dr. Hofmann, and the enthusiasm which he created in the minds of those who came within the sphere of his influence. There was an atmosphere about the place which was one of industry; a lazy man was told severely and promptly that his room was more valued than his company. The place was small, but it was crowded, and enthusiasm was in the atmosphere. He could say at this distance of time—30 years—that Dr. Hofmann had little reason to be proud of him as a pupil; but he had every reason to thank Dr. Hofmann for having permitted him to study under his influence. The personal influence of Dr. Hofmann had done a great deal more to stimulate enthusiasm than anything else, and it would be a good thing if they could have a Hofmann in every school of science. The science of chemistry had never before had a better professor,

and it seemed hardly possible that they should see his like again. As far as he, personally, was concerned, everything that he was owed to the fact that he had been a pupil of Dr. Hofmann. It had given him his introduction to business; and ever since he had found it a testimony and a passport to favour and to consideration. He confidently asked the meeting to support the resolution.

The resolution was accepted in silence.

VINEGAR MANUFACTURE.

BY J. A. KETTLETON, F.R.S.

IN the works on vinegar-making edited by Braunt, vinegar is defined as consisting of "a dilute solution of acetic acid, contaminated with colouring, flavouring, and extractive matters from various cereals." Whether this definition was the result of his own sad experience, or whether in creating it "the wish was father to the thought" I do not know. Other authors have adopted the same definition. But vinegar, as I prefer to understand it, and as it is manufactured in the United Kingdom, is a fermented and acidified wort derived from malted and unmalted cereals and from sugar. The distillate from such wort may also be included in the definition, as may also the acidified product from the fermented juice of apples, pears, and other fruits. Wine vinegar is another description of the genuine article, and German potato vinegar has some claim to be included also.

I must not attempt this evening to cover the whole course of vinegar making, nor can I even allude to the legal nor to the historical aspects of the manufacture, nor to the older methods of vinegar-making, as they are still conducted in some parts of the country.

On the manufacturing scale the earlier parts of the vinegar-makers routine coincide almost exactly with those of the distiller. He employs any material from which he can economically obtain a saccharine extract, whilst soured ales or wines may occasionally be worked in. As competition with the acetic acid makers is so keen, I will endeavour to show where economies may be effected, and I will therefore refer to three of the most important processes of the manufacture.

Broadly, the object of the vinegar brewer is to obtain from a given weight of grain and sugar materials as much acetic acid as he can, and to obtain it quickly in a palatable and presentable form. To do this it is first necessary to obtain from the same materials the largest possible amount of alcohol, and so, travelling backwards, it will be seen that during the mashing process the extract from the materials should be as high, and the conversion of it to a fermentable form as complete as practical considerations permit of.

With this purpose, and to employ as large a proportion of unmalted material as is possible, it is necessary to ensure the complete gelatinisation of the starchy material and to bring it intimately into contact with—at the best conversion temperatures—the diastatic albuminoids of the malted materials, not neglecting the saccharifying principles possessed by the albuminoids of the unmalted materials. When the mash consists of barley, oats, and wheat, with a proportion of malt, these functions are assisted by first rendering the raw material more friable by kilning it for several hours at a temperature of 110°–120° F. This process assists the mash conversion and doubtless improves the flavour of the final product, not only by driving off the rawness and reducing the bitterness of such materials, but also by its effect during the fermentation process. The kilning may be regarded as practically sterilising the grain, by weakening the mould and bacterial organisms that abound upon it, and so curtailing their effect and reducing their products in the fermenting vat; especially is this the case

if moderate quantities of sulphurous fumes are allowed to play upon the drying grain. Besides this the gain in friability implies a direct gain in extract, gelatinisation is more easily effected, and a more saccharine wort is produced. The system of dry-grist heating prior to mashing, if limited in this manufacture to a temperature of 130° F., will effect most of the same services. When rice and maize grists, whether previously gelatinised or not, are ventured upon, their complete gelatinisation must be secured, either by the acid or the malt conversion treatment, before they are admitted to the malt mash, and this admission must be gradual, so that full play is allowed at or near the optimum diastatic temperature. Even with the ordinary mashes of barley and oats it is better to reserve a portion of the malt grist for mixing with the mash after gelatinisation and cooling to a slightly lower temperature. The same completion of saccharification may be brought about if sufficient of the first and cooler malt extract is held over for admixture in the underback with the final dextrinous runnings from the mash-tun. There are several other ways of manipulating the mash so as to secure the highest extract and one richest in fermentable carbohydrates, besides the obvious one of retaining the final spargings for the next mashing, the principles in each case being, to gelatinise and dissolve the starch, then to cool the wort and bring it into contact with unimpaired diastase. Thus in American distilleries the method is adopted of cold-water mashing, followed by partial draining, then steaming up the grain slowly, and afterwards cooling and finally returning the cold wort first drained off. In any mashing, it is not so much a question of the proportion of malted to unmalted materials, but rather one of how the mixture is made and maintained. The choice of fully-grown but moderately kilned-malt and the utilisation of the powerful diastatic properties of green malt are matters of great importance.

Before leaving the mashing process it may be pointed out that, as the wort is not boiled, a pure water supply is an important consideration. Either by filtration or by heating with moderate quantities of disinfectants, impure supplies should be improved. With the view of slightly encouraging diastatic action during mashing, moderate quantities of those salts which generally appear to effect this result may be added to the mash liquor.

Later on, reference will be made to the use of sugar. Here it is recommended that all sugar worts should be boiled. An obvious advantage of employing sugar is that the mash goods can be thoroughly drained of extract without fear of reducing the gravity too low.

Passing now to the cooling and fermenting operations. If no opportunity exists for aerating the wort during cooling the aeration may be performed in the fermenting back. Not that exhaustive fermentation cannot be guaranteed without any aeration save that resulting from the transitory exposure on the refrigerator, for, as a matter of fact, the attenuation is completed without any additional exposure. But in such cases the fermentation has to be rushed by employing high pitching heats, and allowing the temperature to run up to 94–95° F. during the operation. Excessive quantities of yeast are also added for the same purpose. In several ways these causes are deleterious to the ultimate quality of the wash, besides occasioning a sheer waste of yeast, an item of no little importance when it has to be purchased. Even when yeast production is effected the loss is almost as heavy, for as Adrian Brown has recently shown (*J. Chem. Soc.* 1892, 369) doubling or trebling the quantity of pitching yeast involves neither an increased crop nor in the end an increased alcoholic yield. With much less yeast, a lower temperature, and plenty of aeration, an exhaustive fermentation may be ensured, and as the aeration by modern means, even in the deepest backs, is a simple process, it is to be strongly advocated. Pitching at high temperatures with an excessive quantity of yeast makes it next to impossible to secure a bright wash for admission to the acidifier even if time be allowed for settling and cooling. Again, the system of aeration by means of compressed air forced through a pipe readily permits of the entrance of a much purer quality of air to the wort than the exposure of the wort on a cooler permits of. It may be urged that it is useless to purify such air when it is remembered that the

wort itself has not been boiled, and must, therefore, swarm with disease ferments, and that the acidification process later on necessitates the absorption of a large quantity of aerial impurities. But it must be pointed out that, with a considerably reduced fermentation heat the disease organisms would be less powerful, and their products consequently reduced; and further, that by the judicious use of antiseptics, it is possible still further to limit their action without endangering the main fermentation. As for the impure air entering the draught holes of the acidifier it would doubtless be an improvement if such air were filtered or washed in some way, but even without this it is to be remembered that, during acidification, with increasing quantities of acetic acid and decreasing quantities of nutrient for foreign organisms, these latter receive less and less encouragement. But their entry into rich wort in the fermenting back allows them a fuller play. As fermentation is carried on at present, many distinct fermentations proceed simultaneously, the high temperature favours them, and it is difficult to believe that the alcoholic yield is not sensibly diminished. Some experiments made on a large scale with fermenting wash at Bordeaux by Gayon and Dupetit, and described in the Society's Journal in 1886, confirm my contention, whilst some smaller ones made by Lindet on the effects of high fermentation heats show corresponding increases in fusel oil. We often find that at the high temperatures attenuation of the wash is completed in 24 to 30 hours from an original gravity of 1,050 down to or below water, but, in consequence of this haste, a yeasty wash is produced, containing as much as 0.5 per cent. of acid and literally swarming with disease organisms. Their products are, of course, strongly in evidence, most of these being included in the comprehensive term "fusel oil," the effect of which in the acidifier will be referred to. The high fermentation heats entail a loss of alcohol and ethers through evaporation, and much is carried away by the large volumes of CO_2 that are eliminated. This is found to be so when attempts are made to purify the escaping gases in the manner carried out at Guinness's brewery.

It may be remarked here that if the collection and purification of the CO_2 from fermenting vats could be made remunerative anywhere, it could surely be so at a large vinegar brewery, where the fermentations are conducted quickly and exhaustively, and at temperatures which must drive off the greater portion of the gas. I calculate that from a vat holding 10,000 gallons of wash fermented from 1,050 down to water the maximum quantity of CO_2 evolved is approximately $2\frac{1}{2}$ tons. With a close-covered back and two or three outlets for the gas, the removal being facilitated by suction, a high percentage of the maximum production could be collected.

As to the yeast crop, it is high time that vinegar brewers should endeavour to secure all or much of their pitching yeast. The economy ought to be effected in the same way that it is done at many distilleries, not only with regard to the pitching yeast but also with the view of supplying pressed yeast for the baker's use. Even if the high temperatures are adhered to these economies can be effected. An occasional all-malt brew might sometimes be advisable, the wash being mixed eventually with the grain wash, but even without this and with nothing but grain worts it is possible to secure most of the pitching yeast and to supply a large quantity of pressed yeast.

Of late some attention has been given to the subject of fractional fermentation both for analytical purposes, and as applied to beer manufacture. The products from pure cultivated yeasts or from moulds in different fermenting media have also been studied. Amongst many others who have worked in these directions there is Borgmann, who has found that with wort from a lager brewery, if a selected type of Carlsberg yeast be used, the ordinary alcohol ratio to that of glycerin in the products is increased, whilst the flavour produced is distinctive for any one variety of yeast. Ordonneau has published similar results both as to the quality and quantity of the alcohols produced. Gayon and Dupetit, by the aid of a species of mould, have been able not only to saccharify dextrin and starch but to cause the sugar so formed to ferment, whilst they have shown that the same organism in the presence of all the ordinary

products of alcoholic fermentation and of the residues which accompany them is still able to complete the main fermentation by saccharifying and fermenting the residual carbohydrates. Now these bodies are always present in the wash, and it is a matter worthy the attention both of distillers and vinegar brewers whether the sowing of appropriate quantities of these yeasts or of these moulds would in the time at their disposal be able to produce sufficient yield in alcohol to repay the trouble.

I have made a calculation with a view of showing the amount of vinegar at 6 per cent. acid that can be expected from the mashing materials usually employed, but as the loss of acid during acidification varies so considerably I will first state the results in wort which possesses an alcoholic strength of 5.75 per cent.

Taking malt 3 cwt. the quarter, and the wort produced at 1,050 original gravity (18 lb. per barrel), with good work 5 barrels, or 180 gallons, should be collected. Allowing 5 per cent. for waste during fermentation and removal to the acidifier, 171 gallons remain as the net estimated wort yield at 5.75 per cent. alcohol, it being assumed that attenuation is carried down to water.

In the same way, with malt and grain mixed (one-third malt and two-thirds barley, oats, and wheat) there would be a wort production of 200 gallons, which, less 5 per cent., leaves 190 gallons for acidification. With sugar of good quality, yielding per 1 cwt. a barrel at 42 lb., a net yield of 81 gallons of wort for acidification would result, or 243 gallons for 3 cwt.

With rice or maize in the raw state, and separately gelatinised, 1 cwt. would yield about 68 net gallons, or 204 gallons per 3 cwt. The gelatinised grists of rice and maize would yield still more.

Summarised, the estimated yields in wort of 1,050 original gravity would permit of the acidification of the following quantities of wash, viz.:—

Malt.....	3 cwt. 171 gallons,
Malt and grain	" 190 "
Rice and maize	" 204 "
Sugar (raw, good quality) ..	" 243 "

From the above figures some 5 to 20 per cent. must be deducted before ascertaining the final vinegar yield, the deduction varying according to mode of acidification. The cost per gallon of vinegar is found by dividing the actual yield in gallons into the cost per 3 cwt. of materials.

The distinctive operation at a vinegar brewery is the acidification. It aims at a rapid and complete oxidation of the alcohol to acetic acid, with the retention in the wash of any volatile products formed during the alcoholic or the acetic fermentation. An additional object is to form a vinegar which will keep bright under the ordinary conditions of exposure. It is therefore necessary by allowing time for settling, and by effective filtration, to introduce as bright a wort as is possible into the acidifier. This precaution delays the periodical sliming of the filling material, and accelerates the acidification. During the whole process the heat should be steadily regulated by means of the tin coil in the charging or in the receiving vessel. As the acidification slackens towards the end of the process in consequence of the smaller amount of available alcohol and the diminution in the amount of nitrogenous, carbohydrate and mineral food, means should be taken to supply these deficiencies and of maintaining the optimum temperature and increasing the air supply. A constant flow of warm air through the draught hole should be admitted, and means should be taken for condensing the large quantities of escaping fumes which are so rich in acid, alcohols, ethers, and aldehyde. The fumes should, when condensed, be made to trickle back again or be otherwise collected and returned.

The loss of acid usually taking place where no precautions of this nature are adopted, ranges from 6 to 20 per cent., the average is at least 12 per cent. estimating it upon the alcoholic percentage of the raw wash as compared with the acid percentage of the raw vinegar. The loss is generally attributed to evaporation, and it is increased if the up-draught is too powerful, for this carries away the nascent aldehyde. To further promote the acidification it is very

essential that the ferment and the fermentable liquid should be brought closely and constantly together—not merely intermittently. In the majority of cases this detail is imperfectly carried out, though of late, by the introduction of new filling materials and new methods of arranging them, the delay and loss have been minimised. Delay is sometimes due to the flooding of the acidifier with a cold, thick wort, or one rich in alcohol but very poor in nutriment for the acetic ferment; at other times an excessive and cold air-supply is admitted. The former case prevails when worts derived mainly from sugar are used and to which only just sufficient nitrogenous food has been added in the form of malt-extract to permit of alcoholic fermentation. So again, when worts derived largely from maize and rice grists are utilised. It has been recognised in alcoholic fermentation that with these descriptions of wort the nitrogenous food may be so diminished as to need the addition of yeast foods to complete the fermentation, but the idea has scarcely extended itself to the acetic fermentation. The addition of nitrogenous and mineral food for stimulating either the alcoholic or the acetic fermentation requires, however, the most careful management. Adrian Brown, in his paper on the "Numerical Increase of Yeast Cells," read before the Institute of Brewing in January 1890, showed that although a moderate quantity of nitrogenous food stimulated the fermentation, an excessive quantity interfered with it. Previously to this, viz., in June 1885, Salamon, in a paper read before this Society, had shown that in malt worts at any rate after the main alcoholic fermentation was complete, there always remained a large proportion of the nitrogenous matter which had existed in the original wort. He showed that similar results occurred with the salts of phosphorus. Notwithstanding these facts it is evident that in the fermentation, either alcoholic or acetic, of strong sugar worts, nitrogenous food certainly, and mineral food probably would be necessary to finish the processes.

There are other causes for loss and delay. The filling material may be too tightly packed, or may become so gradually, so that air cannot rise through it. The wash in such a case selects a natural course for itself in a series of channels, in which the slime accumulates. A thick, yeasty wash accelerates the sliming. Through the absence of an attenuator, the wash may undergo extreme variations in temperature, so that fermentative action is alternately weakened and strengthened. The exposure of a part of the acidifier to cold draughts chills the action. The filling material is but a poor medium for encouraging the continuous contact of wort, ferment and air. What is required is not merely the largest surface of exposure to aeration or to liquid, but a surface, which, like flannel, is absorptive or retentive of a large portion of liquid. The constant, rapid flow over materials such as smooth round twigs affords little time for the desired contact.

There are more intricate causes of dissatisfaction than any of these. The quantity and quality of the constituents of the wash exercise a powerful effect upon the fermentative action. Not only does the wash contain, according to its origin, more or less of the more prominent constituents such as the nitrogenous, mineral, and carbohydrate residue, but it contains, besides the main fermentation products, all the minor fermentation products, as well as the numerous species of ferments which originally created them. The alcohols higher than propyl in the ethyl series are not oxidised to their corresponding acids by the action of the ferment; not only is this the case, but there is reason to believe—guided by the researches of Adrian Brown—that the growth of the acetic ferment is directly retarded by these bodies. I believe I am well under the mark in stating that the higher alcohols in a vinegar wash at the close of the vinous fermentation, and when the wash is admitted to the acidifier, amount to $\frac{1}{2}$ per cent. of such wash, or range from 2 to 5 per cent. of the total alcoholic produce. Such a quantity must appreciably affect the action of the ferment. Then again there is the presence of many other ferments or micro-organisms to consider, and their continued action during the acidification period not only upon the alcohol present, but upon the other organic matter in solution. Take, for instance, the effect of some

varieties of the acetic ferment itself upon the large quantities of yeast in the wash and, in a minor degree, upon any dextrose or levulose residue. The slimy cellulosic matter formed by the continuous contact of these impedes the main process. So, too, with other specific ferments which abound in the wash, and which, for a time at least, must continue their work commenced in the fermenting vat, and so deprive the wash of appreciable quantities of acetic acid. Thus the lactic fermentation which sets in so powerfully at the high fermentation temperatures, not only tends to retard the attenuation, but competes with the acetic ferment for the appropriation of the nitrogenous and carbohydrate supplies.

An obvious remedy for many of the inconveniences occurring during acidification would be found in a method of sterilising the fermented wash in a close vessel, followed by filtering over materials steeped in vinegar or clear vinegar wash.

Perhaps a short explanation as to the general construction of acidifiers will make my previous remarks more clear. The usual acidifier resembles a large wooden vat some 15 to 20 ft. high, slightly tapering towards the top, the lower diameter being, say, 11 ft., and the upper 8 ft. The lower portion of the vessel, to the height of some 4 or 5 ft., is fitted with a block-tin coil, so that the wash that trickles into it from the higher portions may be kept at a uniform temperature of about 90° F. This part of the acidifier serves as a collecting tank, whence, by a pipe dipping almost to the bottom of it, the wash is pumped up to the top of the acidifier, where it is distributed over the top surface by means of a revolving sparger. The sparger, with the pump and pipe, are invariably made of ebouite or of wood. Immediately above the collecting tank is a stage which supports the filling material. This stage may be simply formed of crossed laths supported at the centre and side of the vessel, or the laths are themselves supported by stronger bars similarly held. In other cases the stage may be of strong wicker work, two or more pieces of it in one plane so as to form a complete stage or diaphragm. Upon the stage rests the filling material. Shavings of beech wood were formerly used, they required to be thoroughly steamed and then saturated with vinegar. The shavings were long and broad, and much trouble was taken in arranging them neatly to the height of some 4 or 5 ft. on one or more stages in the acidifier. Though shavings or even small chips are still employed in some places, they have been more frequently displaced by bundles of twigs. The tender twigs of birch or beech are tied up in small bundles, and, like the shavings, are thoroughly steamed and then saturated with vinegar and packed in layers on one or more stages, the total height being 4 to 6 ft. Resting upon the top surface of the filling material is a frame of wicker work, and just above this the sparger revolves. A clear space of two or more feet intervenes between this and the inside of the top cover, unless the sparger is fixed too high and revolves immediately below the cover. The cover fits close, but it is pierced with a few draught holes, which are usually kept plugged, or there may be a few such holes in the acidifier's circumference just below the cover. The escaping air, gases, and vapours have, as a rule, no other escape than through the small spaces between the planks of the cover, or through the interval between the cover and the circumference it rests upon. Just below the lowest stage of the acidifier are bored the draught holes, an inch or more in diameter and about 12 ins. apart round the whole circumference of the vessel. These are plugged when necessary so as to diminish the air supply. Air is also admitted in some vessels through the bottom of the vessel by a tube passing well up into the centre of the vat, and protected by a cowl.

Formerly there were some ingenious automatic arrangements for constantly feeding the vessel and dispersing the wash, but the pump and sparge arrangement has supplanted them. The air-supply is slightly warmed, for the acidifying chamber is kept warm by a stove or other heating arrangement, and the admission of cold air is regulated by a shutter.

A few years ago Shears and Manbré exhibited at the Brewers' Exhibition an acidifying tower consisting of a series of superimposed chambers. Each chamber consisted of a perforated floor supporting a portion of the filling material—shavings, I believe. Draught holes were pierced below each floor, so that aération was well provided for. The wash entered the top chamber and gradually trickled down through the whole series, meeting in its course fresh supplies of air. The bottom chamber was as usual fitted with a coil. The patentees claimed that the acidification was accelerated, the loss of acid vapours reduced, and the acidifying period was to be reduced from some eight or twelve days to at least half the time. I am not aware that any vinegar maker has adopted the invention, though it has been tried at one large brewery with the object of clarifying the condition of and increasing the acidity of soured beers so as to render them suitable for cutting isinglass.

I am inclined to believe that rapid acidification depends more upon the description of filling material than upon an increased air supply. A constant through draught of warm air and a constant shower of finely-divided wash are doubtless advantages, but a filling material of an absorptive or retentive character will facilitate acidification better than will one with a smooth, polished surface over which the wash easily glides. This idea evidently suggested itself some ten years ago to Edward Luck, and to some American inventors. They proposed, though in different ways, the substitution of the ordinary filling material by flannel or felt, or by other fabric. The Americans placed this material over a number of parallel hollow frames fixed in rows one above another. The air could surround the flannel on both sides, whilst the wash, after having traversed one frame, was guided on to the top of the one below it. The flannel when saturated with wash acted as a nucleus for the acetic ferment, and the wash slowly traversing it was in continual contact with the organism. Luck preferred strings, bands, or cords of the material. A large number of these were twisted tightly round wooden bars, and the wash was made to traverse these appendages by entering a groove or channel to which the strings were attached. I believe the new arrangement has proved most satisfactory. The same principle has subsequently been suggested by other persons though the internal arrangement of the acidifier was differently provided for.

Other recent improvements in acidifiers refer to means of creating a through draught by means of an exhaust fan, and to methods of condensing the escaping fumes and inducing a steady up-draught, but this is too large a field to be entered upon now.

Before closing this paper, I will venture a few remarks upon the discrimination of genuine from spurious vinegars, as the subject is one of some interest. For the manufacturer himself it is a comparatively easy matter to decide whether a given sample is his own or not. He has at his disposal all the ordinary analytical data with their limits of variation in his own particular produce to guide him. There is the final specific gravity, the percentage of fixed and volatile acid, the percentage of solid matter with its ratio of organic and mineral residue, and the amount of the different salts in the latter. Furnished with these and supported by the further observations which the outside analyst must rely upon, he cannot fail to recognise his own again. The analyst is often obliged to work without these data, and he has to distinguish between various kinds of vinegar. There is the genuine vinegar, but of all strengths; there are diluted vinegars which have been fortified with acetic acid and flavoured with acetic ether; there is distilled vinegar, a variety seldom met with; and there are the acetic acid preparations. Attempts have been made to decide upon adulteration by the ratio of two or more constituents or properties, such as specific gravity taken with the percentage of volatile and fixed acid, the various salts (especially the phosphates), and the nitrogenous matter. Now for all these determinations very wide limits must be allowed, for natural vinegars vary in strength from 6½ to 3½ per cent. of total acid. As to the nitrogenous matter, this also varies considerably, according to the materials used, a highly sugared wort or one largely derived from rice and maize being much poorer in this constituent than

a wort from malt and barley. Besides the nitrogenous matter is in many cases carried away to a great extent by the mineral findings in the final stages of clarification, whilst in other cases no fining operation is performed.

As to the varying proportions of phosphates and of nitrogenous matter in unfermented wort, and in the same wort when fermentation is complete, I may refer to a paper read before this Society in June 1885, by Salamon. Salamon found in worts produced from malt and sugar of varying qualities, that the amount of P_2O_5 ranged from a maximum of 0.197 grm. per 100 cc. of wort to a minimum of 0.086 grm., that is less than half the higher quantity. After the fermentation, with equal quantities of the same yeast, and without any disturbing influences, the residual phosphates ranged in amount per 100 cc. of the original volume from 0.153 grm. to 0.051, nor would any ratio between the original quantity and the residual quantity be established. As to the nitrogenous matter in the wort before and after fermentation, Salamon's experiments show that a mere comparison of the quantities originally and finally present would not help us here. In some cases the residual quantity was nine-tenths of the original in the wort, in others it was only four-tenths. The vinegar brewer's worts vary in strength from 1,030 to 1,060 gravity, and Salamon's experiments show that within these limits, with carefully regulated fermentations the residual nitrogenous matter yielded quantities of nitrogen per 100 cc. of original wort ranging from 0.03 grm. to 0.118 grm. These variations would probably be extended during the acetic fermentation, so that as quantitative tests, for the genuineness of vinegars the estimation of phosphates and nitrogen appears to me to be valueless. As qualitative tests the estimation is of some service, for phosphate and nitrogenous residues are always present in genuine vinegars however small those residues may be.

Variations from a given standard for vinegar residues are also due to the quality of the water employed in mashing, and to its treatment for brewing purposes, so that wide limits in the mineral residue must be made upon these accounts. The analyst must also allow for the use of preservatives and of colouring matter (both in moderate quantities) during the final stages of the vinegar process, nor should these substances be regarded as evidences of adulteration, but rather as legitimate and even necessary adjuncts.

Vinegar substitutes are frequently very cleverly prepared, and it is impossible in some cases to detect adulteration, unless the vinegar brewer will assist the analyst. Genuine vinegars will contain residues of carbohydrate, nitrogenous, and saline matter, and appreciable quantities of ethereal salts. Examined microscopically, they will be found to abound in the acetic ferment, though mostly the ferment is inactive; yeast cells too can nearly always be found. The acid substitutes will not contain these organisms, and usually they are stronger in acid percentage than a genuine vinegar. The coloured preparations will leave a caramel residue, but scarcely any nitrogenous residue.

DISCUSSION.

MR. A. GORDON SALAMON wished to ask Mr. Nettleton a question with reference to the "body" which vinegar-makers seemed desirous to obtain in their products. As far as the mashing temperatures were concerned, he would like to ask the author of the paper if he could give the approximate ratio between the maltose and the dextrine that should be formed, because that would influence very largely the flavour of the ultimate product, and also the attenuations which could be carried out. With reference to the preparation of his wort, Mr. Nettleton had dwelt upon the fact that it was not subjected to the hopping and boiling process obtaining in brewing; and yet at the same time he had emphasised the necessity of removing some of the nitrogenous matter. He would like to ask him, in that connexion, whether he had ever tried the use of gypsum in waters for the manufacture of vinegar. He had understood him to say that he had tried various salts. The consideration of the effect which would be produced by the action of gypsum on the water used for preparing

the worts was a matter of great interest, both from the theoretical and the practical point of view. He would also like to ask Mr. Nettleton what percentage of alcohol he would regard as the maximum one could venture upon in preparing the wort. If a malt vinegar were examined it would be found that there was a considerable residue left after the acid was removed, and his own experience led him to believe that there were limits in the preparation of the alcohol beyond which one must not go. He would like to hear Mr. Nettleton's views about those limits, and he thought it would be an advantage if he could define them. With regard to the question of analysis of malt vinegars, he would say that Mr. Helmer's method was an admirable one for estimating their purity; but he (Mr. Salamon) always took the phosphates in conjunction with the amount of acids, and he also took it with reference to the gravity; and he thought that if that were done a very accurate opinion could be formed as to whether the acetic acid was artificially added or naturally formed.

Mr. T. S. DAVIS would like to hear a little further discussion with reference to the question of fermentation. He understood Mr. Nettleton to say that in the alcohol fermentation for vinegar he considered it highly undesirable that air should be artificially introduced to a variable extent according to the rapidity of its progress. He (Mr. Davis) had had much experience in that direction, and had not found any benefit whatever from the artificial introduction of air through the body of the wort in the fermenting vessel. Mr. Nettleton had also referred to the fact that under certain circumstances he thought it desirable and economical to preserve the yeast obtained from one fermentation and add it to the next, just as a brewer would do. In his opinion, it was far better that the whole of the yeast should be allowed to deposit. He would also state, for the information of those not practically acquainted with the subject, that the cost of fresh yeast per 1,000 gallons of vinegar would be under 3s., and that as fresh yeast could always be obtained from a beer brewery, it was far more convenient to add such than to preserve that produced in a vinegar manufactory where brewings took place at irregular intervals, dependent on the rapidity of the subsequent acetifications. He advocated legislation as to the selling of vinegar below a certain standard. The strongest standard vinegars sold in London and the country usually contained about 6.3 per cent. of monohydrated acetic acid; but owing to competition the price had been much reduced, and in some instances cheap descriptions were sold containing as little as $2\frac{3}{4}$ per cent., and he did not consider that vinegar sold at that strength was worthy of the name. He would also like to be allowed to make an observation with regard to distilled vinegar, of which a large quantity was manufactured, and was principally consumed in the North of England. This was produced in two grades; one was a vinegar distilled from a pure malt vinegar, and another was diluted acetic acid distilled from sodium acetate. There was a certain amount of ether present in pure distilled malt-vinegar, which rendered it both different in flavour, in character, and in aroma from that which could be produced from any other source. A short time ago a case came before a court of law as to whether the distillate from a pure malt vinegar could be correctly described as "malt vinegar." A certain analyst announced in court that a sample had no right to be so called, inasmuch as the phosphates had been separated therefrom, thus making it simply pure acetic acid, and this assertion was supported by the judge. This view was erroneous, because the acetic acid was flavoured with an aroma which could not be separated therefrom by distillation, but to prevent any future erroneous nomination, the vinegar is now described as "white vinegar distilled from pure malt vinegar." This description is accepted as satisfactory, both on the part of the analysts and consumers.

Mr. NETTLETON, in reply, said that he entirely sympathised with the remarks made by Mr. Davis in reference to the fixing of a standard. He was of opinion that 2 per cent. was far too low a standard at which vinegar should be allowed to be sold. It was well known that at least 90 per cent. of "white vinegar" was the product of the distillation of acetate of soda. In reference to the question of yeast, he quite concurred

in the view that there might be practical reasons why vinegar brewers did not hold over yeast from one brewing to another; but he thought there might be other ways of disposing of it. In alcoholic fermentations there was a vast amount of yeast wasted, and it was only during recent years that distillers began what had now become an enormous trade in pressed yeast, and yet even they could also use some of their yeast after a time for their own fermentations. For his own part he could not see why vinegar makers should not do the same. He could see many points in favour of occasionally purchasing barrels of yeast from the beer brewer; and he also recognised that if brewings only took place periodically, or a long interval lapsed between two different brewings, this would have to be done. The only other course he could see was to have some system of washing and preserving the yeast. As to the question of air. Of course an acidifier would not always work well, but as a rule he thought acidifiers had quite a sufficient air supply; but it should be remembered that the air was sometimes supplied at a temperature of 60°, at other times at one of 70° or 80° F. He thought there were more improvements to be made in the direction of regulating and distributing the air at a suitable temperature, such as 80° or 85°, than by admitting a larger quantity. He presumed Mr. Salamon's question with reference to the standard of alcohol in wort was dictated by a wish to know what would be the most economical arrangement to carry out. Thus, assuming that worts could be obtained at a very high specific gravity, and that consequently a large yield of alcohol were obtained, and that such alcohol could be completely acidified, what would be the highest percentage of alcohol that should be found in the wort?

Mr. SALAMON explained that he meant the proportion of alcohol in the practical limits of work.

Mr. NETTLETON replied that in Brant's work on vinegar a certain limit was quoted, beyond which it would not pay to have the alcoholic strength in the wort; but whether that limit was 10 or 12 per cent. he could not remember. Such a high standard as that of 10 or 12 per cent. absolute alcohol was never reached in practical work.

Mr. SALAMON further explained that his object in asking the question was, that he understood Mr. Nettleton to say that the vinegar maker fermented his wort below 1,000, and therefore he was anxious to know the percentage of alcohol.

Mr. NETTLETON explained that supposing a wort of very high specific gravity, say 1,080, were taken, it would be quite possible to ferment below 1,000, but he questioned whether it would be wise to have such a very high alcohol percentage. He did not think that such strong wort would undergo acetic fermentation, because so much acid would be formed that he believed the acetic ferment would not be able to cope with the residual alcohol, and unconverted alcohol would remain. He was aware that there was a system of acidifying by which a very strong wort could be used, the wort being passed first through one vessel so constructed that it would induce acidification up to a certain point, and then through two others which finished off the acidifying. But this was a very complex process, and he did not think it was used in this country. He was of opinion that in ordinary worts it was desirable to ferment down as low as possible.

Mr. SALAMON asked whether he was right in understanding that any dextrin formed during the process of washing underwent fermentation.

Mr. NETTLETON admitted that there must be a residue of dextrin, but whether it was solely responsible for the "body" which existed in vinegar he doubted, for there was also a nitrogenous residue. He thought that the use of gypsum in moderate quantities was very desirable. Gypsum was supposed to exercise a clarifying influence upon the wort. In the case of vinegar brewing, such action in the mash-tun had alone to be relied on, for extra clarification could not be produced as there was no boiling operation. So far as its action in the mashing and fermenting processes were concerned he would say that gypsum in very moderate quantities was a most beneficial salt to use.

ON CERTAIN ALUMINIUM ALLOYS.

BY C. R. ALDER WRIGHT, D.S.C., F.R.S.

It is well known that whilst, as a general rule, molten metals are miscible with one another in all proportions, there are a small number of well-marked exceptional cases where the two metals behave to one another as ether and water when shaken together, *i.e.*, two such metals, A and B, when intermixed molten give a mixture of two alloys which separate from one another by gravitation on standing molten for a sufficient time; one, consisting chiefly of the heavier metal, A, and as much of the lighter one, B, as it can dissolve at the temperature prevailing, the solubility being greater the higher the temperature; the other mainly consisting of B, with as much of A as is permanently soluble therein at that temperature. For instance, when A is lead or bismuth, and B zinc, the immiscible binary alloys formed have the following compositions* deduced from the average of a large number of determinations:—

Temperature.	Heavier Alloy.		Lighter Alloy.	
	Lead.	Zinc.	Lead.	Zinc.
Near 650°	98.76	1.24	1.14	98.86
„ 800°	98.70	1.30	1.57	98.43
	Bismuth.	Zinc.	Bismuth.	Zinc.
Near 650°	85.72	14.28	2.32	97.68
„ 750°	84.82	15.18	2.47	97.53
„ 800°	84.17	15.83	2.52	97.48

On the other hand, when lead (or bismuth) is mixed with melted tin a homogeneous fluid results, exhibiting no tendency whatever to separate into two different alloys, no matter how long the mass is allowed to stand molten.

It does not, however, follow that because a mixture of two (or more) metals remains perfectly homogeneous whilst standing at rest molten at an equable temperature, therefore the mass will solidify as a uniform whole; or that if solidified, the ingot will not “liquefy” on heating again, a more fusible alloy running away from a less fusible one of different composition. In fact, the reverse is very frequently, if not almost invariably, the case, the forces coming into play when change of state occurs being wholly different from those at work when the whole mass is kept always liquid.

The author has recently made a number of observations on various aluminium alloys, some of the results of which are wholly at variance with the usually received notions on the subject, as described in the text-books. Thus he finds that from the point of view of complete or imperfect miscibility with other metals whilst molten, aluminium presents a close resemblance to zinc, in that it will not mix in all proportions with lead or bismuth, mixtures of this kind separating on standing molten into two alloys, one consisting of lead (or bismuth) with a minute quantity of aluminium dissolved therein; the other chiefly consisting of aluminium with a small quantity of the other metal. It differs, however, from zinc in not mixing in all proportions with cadmium. On the other hand, mixtures of aluminium with most other metals (notably tin, silver, zinc, antimony, &c.) give homogeneous fluids exhibiting no tendency to separate into different alloys whilst standing molten, provided the temperature is sufficiently high to keep the whole mass fluid; if, however, the temperature be low enough to permit of a solid less fusible alloy separating, this sometimes occurs, especially with antimony.

These results as regards bismuth, cadmium, and antimony are very far from being in accordance with the usual book

statements. As regards lead, it was originally observed by Deville, and subsequently by Tissier and others, that the two metals will not mix when melted and stirred together. Tissier found that antimony behaved in the same way, and the statement that the two metals are not perfectly miscible is accordingly copied into the text-books, although this is very far from being the case. On the other hand, Tissier found that bismuth and aluminium combine readily, forming fusible alloys which oxidise very rapidly when melted, and are also very alterable in the air at ordinary temperatures when the bismuth is in large proportion. This description applies accurately to certain of the antimony aluminium alloys (not to all, some being comparatively infusible); but is quite incorrect as regards bismuth and aluminium, inasmuch as these two metals are as immiscible as are zinc and lead. The alloy containing 10 per cent. of bismuth described by Tissier as hard and malleable does not exist.

According to Deville, cadmium unites easily with aluminium forming malleable and fusible alloys capable of being used to solder aluminium, but only imperfectly. The author, on the other hand, finds that cadmium and aluminium are as immiscible as bismuth and aluminium, or lead and aluminium.

The source of these inaccuracies, in all probability, lies in the circumstance that when mixtures of metals not completely miscible together are well incorporated by agitation, what is formed is a sort of metallic froth or emulsion, which in many cases requires a very considerable time before it completely separates into two different fluids; so that if the fused mass is solidified before this separation has taken place, a product is obtained consisting of a more or less intimate mechanical intermixture of two entirely different substances. If, on the other hand, the fused mass be poured into a hot long narrow crucible (like a long clay test tube), and maintained molten at an equable temperature for eight hours and upwards (preferably by immersion in a bath of melted lead), the two constituent binary alloys gradually separate from one another, in some cases completely, so as to give a well-marked line of demarcation between the two, as with a froth of ether and water, or water and chloroform, allowed to stand until complete separation takes place; in other cases less thoroughly, but in such fashion that the lowest portion of the fluid mass consists of the heavier alloy with little or no admixture of suspended particles of the other, and *vice versa*, with the uppermost portion: the middle part consisting of the two still mechanically intermixed, much as a frothy mixture of ether and water containing soapy or mucilaginous matters often behaves under similar conditions. In all such cases when the clay test tube is removed from the lead bath and quickly cooled down, the contents solidify to a thin compound bar, easily obtained by breaking away the clay; with a tube of $\frac{1}{2}$ to $\frac{3}{4}$ -inch internal diameter and 5 to 7 inches long, filled half or two-thirds full of metal, the bar is generally solidified sufficiently rapidly to prevent any material alteration in the normal composition of the two alloys constituting its ends, through liquation or segregation during solidification, although such an action is obviously not impossible, and indeed with very slow cooling is sometimes noticeable.

When aluminium and tin (or silver) are fused together, well stirred, and maintained molten for eight hours in a lead bath, the bar finally obtained gives on analysis sensibly the same results, whether the portion employed be cut from the extreme bottom, the middle, or the uppermost part of the bar, indicating perfect miscibility of the two metals whilst fluid. If, however, lead or bismuth be used as the second metal very different results are obtained; provided that the molten mass has stood long enough to bring about proper separation, the heavier end of the bar consists almost entirely of lead (or bismuth) with only a minute quantity of aluminium; whilst the lighter end consists of aluminium with 1 to 2 per cent. of the heavier metal. If, however, the separation has been less complete, more or less considerable increment is observed in the aluminium found by analysis of the heavier end and of the lead (or bismuth) found at the heavier end. The following figures were obtained on analysis of a number of such binary alloys, the aluminium only being determined at the heavier

* Alder Wright and Thompson, Roy. Soc. Proc. 45, 461; 48, 25; and 49, 156.

end, and the lead (or bismuth) at the other end; the temperature of the lead bath throughout was between 750° to 850°, averaging near 800°, as determined by the platinum specific heat pyrometer. The period during which the mass stood at rest molten was usually eight hours.

LEAD—ALUMINIUM.

Aluminium in Heavier Alloy.	Lead in Lighter Alloy.
0·02	1·31
0·03	1·59
0·06	1·72
0·11	1·80
0·11	2·00
..	2·06
..	2·10
..	2·25
..	2·49
Mean	1·92

BISMUTH—ALUMINIUM.

Aluminium in Heavier Alloy.	Bismuth in Lighter Alloy.
0·10	1·70
0·10	2·01
0·24	2·35
0·24	..
0·49	..
0·51	..
Mean	2·02

On comparing these results with those above quoted obtained with zinc instead of aluminium, it is obvious that notwithstanding the slightly higher temperature, the solubility of aluminium in lead or bismuth is markedly less than that of zinc in these metals respectively, especially in bismuth. The solubility of lead in aluminium, on the other hand, is slightly greater than that of lead in zinc; whilst the solubility of bismuth in aluminium is slightly less than that of bismuth in zinc, the difference not being very great in either case.

It results from the incomplete miscibility of molten aluminium with fluid lead or bismuth, that when a third metal is added to a mixture of aluminium and either of these metals, such that this third metal is miscible in all proportions with either aluminium or lead (or bismuth), the ternary alloy formed will either be "real,"* exhibiting no tendency to separate into two different ternary alloys, or "ideal," i.e. incapable of permanent existence, separating on standing into two different ternary alloys, according as the mixture represents a point lying outside or inside the "critical curve" for the three metals employed at the temperature of the experiment. The data for the delineation of the critical curves for various mixtures of aluminium and lead (or bismuth) with appropriate third ("solvent") metals are being accumulated.

When aluminium and cadmium are melted together and well stirred, they behave in a fashion much resembling that observed with lead (or bismuth) and aluminium, on standing at rest molten for some hours, cadmium containing only a few tenths per cent. of aluminium, sinks to the bottom, whilst aluminium containing between 2 and 3 per cent. of cadmium floats up to the top.

On examining the behaviour of aluminium when melted along with antimony some remarkable results were obtained, leading to the conclusion that with certain proportions alloys are formed exhibiting melting points much above those of either antimony or aluminium; so that unless the temperature of the mixed metals is considerably elevated, the whole mass sets solid, or at any rate so pasty as to be incapable of being poured out from the crucible. With mixtures containing from 15 to 25 per cent. of aluminium and 75 to 85 of antimony, the temperature of complete fusion of the mixture appears to be quite as high as that of silver. Thus, on melting aluminium in a small Fletcher's blast gas furnace, and then adding the antimony in lumps, the latter rapidly melted down and sank to the bottom of the crucible, the fused aluminium floating on the top; on continuing the heat for a few minutes so that the whole mass was well above the melting point of silver, and stirring up with a clay rod previously heated nearly white hot, the two metals quickly intermixed, and then set to a nearly solid mass. When the proportion lay between 10 and 15 of aluminium to 85 and 90 of antimony, or between 25 and 35 of the former to 65 and 75 of the latter, the mixtures remained fluid at temperatures above the melting point of silver; but on continuing the stirring at a slightly lower temperature they became pasty, a precipitation of a solid alloy obviously occurring. By carefully pouring off the yet fluid portion when this occurred, putting down the solidified or pasty mass in the crucible with a red hot clay pestle, so as to squeeze out as much fluid metal as possible, the contents of the crucible could be divided into two portions, viz., the more fusible alloy poured off, and the almost solid residue. This latter, on cooling, formed a brittle, highly crystalline mass; when the mixed metals were in the proportions of 18—19 aluminium to 81—82 antimony, very little fluid alloy could be thus expressed, and this differed but little from the unfused portion in composition; with mixtures richer in aluminium the more fusible alloy always contained considerably more aluminium than the less fusible residue; whilst with mixtures poorer in aluminium the reverse was the case; strongly suggesting that the precipitated solid alloy essentially consisted of a definite compound indicated by the formula $AlSb_3$, which requires—

	Per Cent.
Al.....	18·4
Sb.....	81·6
	100·0

together with more or less considerable intermixture of mechanically adherent more fusible alloy containing excess of aluminium or of antimony, as the case might be.

When the proportion of aluminium present in the mixture was less than about 10 per cent., it was found difficult to regulate the temperature so nicely as to bring about the precipitation of this comparatively infusible alloy; but on allowing the mass to cool and solidify, and then raising the temperature again, so as to cause a portion to melt and liquefy away from the rest, it was found that the portion thus melted contained more antimony relatively to the aluminium than the unmelted portion; indicating as before that the latter was $AlSb_3$ together with an admixture of more fusible alloy, containing in this case excess of antimony.

Precisely similar results were obtained when the proportion of aluminium present exceeded about 35 per cent., excepting that in this case the portion liquating away from the rest contained more aluminium relatively to the antimony than the less fusible portion.

Whether the proportions of aluminium present were below or above 18·4 per cent., in all cases if the temperature were high enough the whole mass melted to a uniform fluid easily poured off from the scorifier which formed somewhat rapidly on stirring; to diminish this tendency the air-blast was so regulated as to keep the flame reducing rather than oxidising. When the melted metal was poured off into a brightly red-hot clay test tube and kept fused for several hours at a temperature of 900° C. and upwards, no marked difference in composition between the top and bottom ends of the resulting ingot was noticeable,

* Vide this Journal, 1892, p. 245. Abstracts of papers by the authors and collaborateurs read before the Royal Society.

showing complete miscibility of the metals when thoroughly melted. With the smaller percentages of aluminium the resulting alloys were brittle and crystalline, and differed little from antimony in appearance; on keeping in the air, especially when coarsely powdered, they absorbed oxygen and slowly disintegrated to a black powder, not unlike manganese dioxide. The alloys richest in aluminium were generally somewhat spongy; they also absorbed oxygen from the air slowly, the ingots swelling up and falling to powder on keeping.

The difficultly fusible substances that precipitated solid from the molten mixtures containing intermediate proportions of antimony (more or less impure AlSb) showed the greatest tendency of all to absorb oxygen and disintegrate to black powder, a considerable gain in weight being usually noticed if fragments were weighed and left on the pan of the balance for some hours. When placed in water a slow evolution of hydrogen was generally noticeable, becoming strongly marked on heating the water to near its boiling point. The gas thus evolved appeared to contain small quantities of silicuretted hydrogen (derived from traces of silicon contained in the aluminium used) as it slowly browned white paper moistened with silver nitrate; but on burning, no antimonial spots were produced on cold porcelain, and only very faint indications of antimonial mirrors were formed on passing through a red-hot narrow combustion tube for half an hour at a time; so that antimonuretted hydrogen was practically not evolved at all.

The following numbers were obtained on analysis of a series of products formed with mixtures of aluminium and antimony where the former varied between 8 and 36 per cent. of the whole mass. The aluminium used was commercially pure metal (so-called 99 per cent., containing small quantities of silicon and iron, but otherwise pure); the antimony was pure metal prepared from tartar emetic. The analysis was made by dissolving in dilute hydrochloric acid containing a little nitric acid, precipitating the antimony by means of sulphuretted hydrogen, collecting on a weighed filter, and finally heating a portion of the mixed precipitate of sulphur and antimony sulphide in an atmosphere of carbon dioxide. The aluminium was precipitated from the filtrate by ammonia, and the weighed alumina corrected for traces of silica and ferric oxide. In each case the figures are calculated on the sum of the aluminium and antimony found as 100:—

	Percentage of Al originally employed for Fusion.	Comparatively Infusible Residue.		More fusible Alloy poured off.	
		Aluminium.	Antimony.	Aluminium.	Antimony.
1.	36	27.25	72.75	55.00	45.00
2.	32	26.75	73.25	38.55	61.45
3.	29	24.50	75.50	31.75	68.25
4.	23.5	21.00	79.00	27.75	72.25
5.	21	18.78	81.22	21.28	78.72
6.	20	19.42	80.58	18.35	81.65
7.	15	15.23	84.77	12.98	87.02
8.	8	7.55	92.45	5.60	94.40

The mixtures marked 1 and 8 were *liquated*, i.e., after fusion the mass was allowed to solidify, and then by raising the temperature a portion was melted which was poured off, leaving the unmelted part behind. The other mixtures, Nos. 2 to 7, were prepared by melting the aluminium, adding the antimony which melted and sank to the bottom, and then stirring well together with a red-hot clay rod, the temperature being so regulated that during the stirring a portion of the alloy precipitated in the solid form. With Nos. 5 and 6 the temperature was judged to be above the melting point of silver, and very little fluid alloy could be poured off; with the other mixtures the temperatures were somewhat lower, but not much.

With the mixtures numbered 1 to 4, the proportion of aluminium originally used was above that corresponding

with the formula AlSb; and in these cases the more fusible alloys contained much larger proportions of aluminium than the comparatively infusible residues. With Nos. 5 and 6, the original compositions differed little from AlSb; in these cases the more fusible alloy obtained was very small in quantity, and differed comparatively little from the less fusible portions. With Nos. 7 and 8 the proportions of aluminium originally employed were below that corresponding with AlSb; and in these cases the more fusible portions contained excess of antimony as compared with the others. In all cases, therefore, the relative values are just such as would be obtained by the separation out from the molten mass of a solid compound AlSb, this compound necessarily remaining wetted, as it were, by the more fusible alloy when this latter is poured off as far as possible.

On contrasting the temperatures of complete fusion of a series of alloys starting with pure antimony and going up to AlSb, it is evident that the melting point continuously rises up to a value considerably above the melting point of pure aluminium; when the aluminium present exceeds that contained in AlSb the melting point falls again, the maximum being with the composition AlSb. A precisely similar state of things has been recently shown by Professor Roberts Austen to occur with aluminium-gold alloys,* excepting that the maximum is found for the definite purple-coloured compound Al_2Au , and not for a compound containing only one atom of each metal.

DISCUSSION.

The CHAIRMAN said that he was going to ask Dr. Wright what was the practical application of the alloy, but when the samples were seen the hopes of practical application were at an end. The question of oxidation was exceedingly interesting, and the absence of antimonuretted hydrogen was a very singular fact. With regard to the compounds from which the samples were reduced, he had had a good deal of experience in purifying commercial bismuth, and he had found that in ordinary methods of fusion the bismuth adhered to, or, in the author's words, dissolved considerable fractions of impurities, so as to render the production of pure bismuth, as distinguished from ordinary commercial bismuth, a matter of considerable difficulty. But it had been done. Although the immediate practical results of Dr. Wright's investigations in this connexion were not apparent, yet the value of such researches would be seen when they appeared in the Journal.

* R. Soc. Proc. 50, 368.

Manchester Section.

Chairman: Ivan Levinstein.

Vice-Chairman: Edw. Sluncheon.

Committee:

J. Augell.	J. Grossmann.
G. H. Bailey.	P. Hart.
R. F. Carpenter.	A. Liebmann.
G. E. Davis.	Sir H. E. Roscoe, M.P.
Harold B. Dixon.	C. Truby.
H. Grimshaw.	D. Watson.

Hon. Local Secretary:

J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next:—Committee: F. H. Bowman, J. M. Irving, and E. Knecht.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Tuesday, 31st May 1892.

MR. R. FORBES CARPENTER IN THE CHAIR.

ON OIL AND IRON STAINS IN COTTON CLOTH.

BY CARL OTTO WEBER, PH.D., F.R.S.

OIL stains in cotton cloths are an occurrence well known to every bleacher and dyer, and it is the general experience that their complete removal is effected in the kiering process. This is absolutely certain where the oil stains have been caused by animal or vegetable oils and greases, as in this case under the circumstances obtaining in kiers, the saponification of these oils completely removes the stains. Not quite so simple is the case if the stains are caused by mineral oils. These are incapable of saponification, but as soap solutions (especially alkaline ones) dissolve considerable quantities of mineral oils, it is generally assumed that the rosin soap employed in the process of kiering emulsifies, and eventually dissolves also these stains. This may be true as long as the stains are fresh, but it applies not to old stains, which through long exposure to the air have undergone oxidation. Cloth containing such mineral oil stains cannot be effectively dealt with in an open kier, although in a pressure kier and conditional to a liberal supply of rosin soap, the stains practically disappear, *i.e.*, they can no longer be seen, and in the process of printing or dyeing such cloth, nothing occurs that would indicate that these oil stains are still in existence. Iron stains perhaps occur not so often in cloth as oil stains and may prove a great nuisance occasionally, but under ordinary circumstances their removal is easy enough. If the stains are few and far between, they are treated one by one with a moderately strong solution of oxalic acid, the piece being subsequently washed. If there are too many of these stains in a piece to apply this treatment, padding in a bath of oxalic acid at 5° Tw. or in bisulphite of soda at 7° Tw. will answer. If, however, oil and iron stains appear in the same piece, forming as it were one single stain, the question of getting rid of these combined stains is in most cases a matter of very considerable difficulty, the oxidised oil retaining the iron stain even against concentrated solutions of oxalic acid or strong sulphurous acid; even the most powerful agent for removing iron stains, a solution of tin oxalates in hydrochloric acid has not the slightest effect on these compound stains. I may at once say that I do not know of a case of these stains ever being found in grey cloth, or being produced in the course of the bleaching process, although the single oil or iron stains are common enough at this stage. But the compound stain inevitably forms when oil-stained cloth is dyed with an iron mordant. The faintest trace of an oil stain left in the cloth can be found out by treating a suspected sample in a bath of ferrous or ferric sulphate, and producing the well-known iron buff by afterwards passing through weak soda carbonate. As a rule the stain does not show in the buff, but after stripping the colour in any suitable acid bath, a bright iron stain remains wherever the cloth retained the least trace of an oil stain. From this it is clear that in the majority of cases these compound stains will never be noticed, unless the cloth is stripped of its dye. Unfortunately the latter process is frequently necessary in the case of drab twills, which have at times from some unaccountable reason an awkward tendency to bleach in the folds, or to come up a wrong shade in dyeing. For the purpose of re-dyeing such pieces the colour is stripped and then the oil stains become visible as bright iron stains. On re-dyeing these pieces in the manner generally used for this class of goods, by first giving two ends in a mixed bath of fustic, sumac, and annatto, and afterwards fixing in a bath of ferrous sulphate, these iron stains do not disappear but show as ugly olive patches. That these stains show only in the second dyeing is easily accounted for, as they now contain twice as much iron as the rest of the piece. It is therefore evident that, before re-dyeing pieces stained in this manner, it is absolutely necessary to first remove these stains. I have already mentioned the obstinacy with which these stains resist all ordinary agents, and the cause of this, no doubt, is that we have the iron here in the form of an iron soap. Taking

this into consideration, there is no doubt that the iron stain will only yield if treated with an agent, which at the same time loosens the oil stain. After a great many experiments, I found that by padding such pieces in a hot solution of one part of soft soap, one part of glycerin, and three parts of water, taking through squeezing rollers, letting lie for 24 hours, then washing, the iron stains, together with the oil stains, are completely removed. The rationale of the process will be readily understood if we remember the great ease with which oils of every description dissolve in solutions of glycerin and soap, and also the capability of alkaline glycerin solutions to dissolve ferric oxide in large quantities. The price of the process amounts to about 3s. per 100 lbs. of the cloth, and from this the price per piece may easily be calculated, the weight of a piece varying from 26 to about 80 lb.

The whole difficulty about these compound stains would of course best be dealt with by taking care to remove every trace of oil in the cloth in the kiering process, but as I have already remarked, this is a matter of considerable difficulty in the case of mineral oil stains, although pressure kiers are as a rule fairly efficient in this respect. From experiments carried out on a large scale, it appears, however, that this difficulty can be overcome by deliberately increasing the mineral oil stain in the grey cloth, by adding a vegetable oil to it. Treatment even in an open kier is then quite sufficient to remove every trace of an oil stain.

TURKEY-RED OIL.—PART II.

BY J. ARTHUR WILSON.

THE results contained in this paper are a brief *résumé* of an extended investigation into the best method of detecting and approximately determining the adulterants of Turkey-red oil. The most common, and at the same time the cheapest adulterant is, of course, water, but as most buyers and users of this material stipulate for a certain percentage of fatty matter, it is necessary to use some cheap oil in place of water. Cotton-seed oil is possibly the most used, and I may say that I have reason for believing that a large amount of adulterated Turkey-red oil is made and used. It is as well to remember that a manufacturer of oil may unwittingly prepare an adulterated article. I mean, of course, by the use of adulterated castor oil. The writer has submitted the fatty matter prepared in a definite manner from Turkey-red oils made from genuine castor oil, also from castor oil containing other oils, to the usual methods of analysis of oils and fats, and more especially to Benedikt's acetyl process, but it is to be regretted that none of these methods alone give evidence sufficient to condemn or pass a sample. It is the careful consideration of the results of the *whole* of the tests on which one must rely. These tests are, 1st. Specific gravity, combining weight, point of congelation of fatty acids, iodine value, and acetyl value.

Before describing the results of my investigations, it is necessary to mention the method of preparation of the fatty matter for analysis. 100 grms. of the sample are taken in a 24 oz. flask, to which is added 250 cc. of methylated spirit and 20 grms. pure caustic potash. A long tube is attached and the flask and its contents kept for one hour on the water-bath with frequent agitation. The alcohol is then evaporated and about half a litre of water added, containing sufficient pure hydrogen sulphate to decompose the soap and leave a moderate excess. A piece of pumice coiled with platinum wire is added and the contents of the flask kept in gentle ebullition for one hour. The flask is allowed to stand and the aqueous layer syphoned off, and the fatty acids washed three times with hot water, dried on the hot filter, and then by heating in a porcelain dish for a short time. The fatty matter thus prepared is used for the above determinations.

The results of my investigation are as follows: The specific gravity of the fatty matter prepared as above from genuine castor oil varies with the proportion of vitriol used

in the manufacture of the Turkey-red oil, but only to a small extent, whilst on the other hand, olive and cotton-seed oil are much more affected. The average density of the various acids taken by the Westphal balance at 98° C. are:—

Nature of Oil.	Specific Gravity at 98° C.
Castor oil acids	892.0
Olive oil acids	851.0
Cotton oil acids	872.0

The point of congelation of the fatty acids is often very useful. The fatty acids of Turkey-red oil from castor oil do not deposit any, or the merest traces, of solids at 15.5° C. Olive oil and, still more, cotton-seed oil acids deposit much solid matter at the above temperature. The melting point of the acids from olive oil and cotton-seed oil as determined by the capillary tube pressure method are:—

Melting point of cotton-seed oil acids	41° C.
Melting point of olive oil acids	40°

The combining weights of the fatty acids are too near one another to be of any service whatever. Thus we have:—

Nature of Oil.	Mgms. of KHO per 1 grm. of Fatty Acid.
Castor oil	180—184
Olive oil	173—176
Cotton oil	171—175

The iodine value is also very variable, and besides being dependent on the age, &c. of the oil used, is liable to considerable fluctuations, by the method of preparing the Turkey-red oil, especially on the amount of vitriol used. On this account it is not to be strongly recommended.

The method on which the most reliance is to be placed is undoubtedly the acetyl value. I may remind members who may not be acquainted with this process that it consists of the introduction of acetyl groups into the substance and subsequent elimination by saponification, and estimation of the alkali required for this removal. It is, notwithstanding the remarks of Lewkowitsch, a most valuable process, and is certainly a very valuable addition to our methods of examining oils and fats. The process is worked as follows: The dry fatty matter is heated to boiling for one and a half hours under a reflux (dry) condenser with four-fifths of its weight of dry acetic anhydride, and the acetylised acid washed with hot water till the wash-water is neutral to delicate litmus paper, when the fatty matter can be dried as quickly as possible. A weighed quantity of about 2.5 grms. is then titrated in alcoholic solution quite cold with semi-normal alcoholic potash, and the amount noted. A further quantity of alcoholic potash about 1½ times more than the first quantity is added, and the flask kept 30 minutes on the water-bath with a long tube attached. After this time the residual alkali is estimated by semi-normal hydric chloride. Phenolphthalein is used as indicator in both cases. The alkali used in the first instance is calculated to milligrammes per 1 grm. of fat, and is termed the acid value. The total alkali is calculated in the same way and is termed the saponification value, the difference between the two is the acetyl value.

The three chief oils for Turkey-red oil manufacture show when thus tested:—

Nature of Oil.	Acid Value.	Saponification Value.	Acetyl Value.
Castor oil	136.7	291.7	155
Olive oil	170.0	206.0	36
Cotton-seed oil	189.5	210.5	21

Owing to the interactions between the glycerides and the vitriol in the manufacture of the Turkey-red oils the differences are not so apparent. The following table shows the results to be expected:—

Nature of Turkey-red Oil.	Acid Value.	Saponification Value.	Acetyl Value.
Castor oil, maximum	141.0	287.4	146.4
Castor oil, minimum	140.2	287.9	138.7
Olive oil	158.7	205.0	106.3
Cotton-seed oil	179.0	232.0	53.0

The determination of the iodine value before and after acetylisation, affords a check on the latter determination. Useful information is also afforded by a determination of the solidifying and melting point before and after acetylisation. If mineral or rosin oil were present they would of course be separated and estimated in the usual manner.

SOME FURTHER NOTES ON NITROGEN IN COAL-GAS.

BY GEORGE E. DAVIS.

FOLLOWING the reading of a paper at the last meeting of this Section, by Mr. C. H. New, on the determination of nitrogen in coal-gas, a discussion occurred in which some doubts were expressed as to whether such a large amount of nitrogen as 14 per cent. could possibly exist in a gas supply, seeing that Professor Vivian Lewes had examined a sample of London coal-gas which contained less than 1 per cent. of nitrogen. It was also pointed out by Mr. Stenhouse that if 15 per cent. of nitrogen were present due to the pumping in of air, there should be at least 2 per cent. of free oxygen, the presence of which the reader of the paper had not recorded. I saw that the argument used by Mr. Stenhouse would at once prove the accuracy or otherwise of Mr. New's results, and on Saturday, May 7th, the day after the reading of the paper, I decided to make an examination of the gas for oxygen, nitrogen, and illuminating power, concurrently. At 10 a.m., and when it might be supposed that the night gas lay dormant in the pipes, I found the gas contained 1.1 per cent. of oxygen, and its illuminating power 15.6 candles. At 12.30, after the gas had been burning the whole interval in the laboratory, tests were again made, with the following results:—

	Per Cent.
Oxygen	2.1
Nitrogen	13.9
Illuminating power	13.6 candles.

I think this shows clearly enough that there is a difference between the night gas and the day gas, and that the difference in illuminating power is chiefly due to oxygen and nitrogen. Why this is so I do not pretend to explain. I have made some further tests with reference to the percentage of nitrogen. The day tests on the 18th instant were 8.28 per cent. of nitrogen with 1.08 per cent. of oxygen. On the 23rd the day gas contained 8.67 per cent. of nitrogen. The night tests contained less nitrogen. On the 16th, taken at 8 p.m., the percentage of nitrogen was 7.3; on the 17th it was 7.4, with 1.5 per cent. of oxygen; on the 19th, at 7.30 p.m., it contained 5.6 per cent. of nitrogen; on the 20th, at 10.30 p.m., it contained 7.4 per cent. of nitrogen; and on the 22nd, at 8 p.m., it contained 7.75 per cent. Between the 16th and 23rd the illuminating power varied from 13.2 candles in the daytime to 15.6 candles at night.

Compared with Professor Vivian Lewes' figures of the London gas, we appear to have a very different mixture in Salford, and the low illuminating power as recorded upon our photometer is clearly explained. How this nitrogen and oxygen gets into the gas is a matter I

have not considered, and these facts seems to be borne out by some further figures from Professor Lewes. He finds that 100 volumes of gas require about 230 volumes of either air or nitrogen to reduce its luminosity to nil, a quantity which certainly does not agree with the earlier notions of gas engineers. In the Salford gas there exists at the utmost 14 volumes, and, as a general thing, 7 to 8 volumes, which is about the proportion necessary to reduce the illuminating power from 18 to 14 candles, if reckoned as a diluent, combined with a certain amount of light-destroying power. Hunter, in his lecture at Salford (published by J. and E. Cornish, Manchester) in 1878 states (p. 32) that 10 per cent. of air added to 25-candle gas reduced its illuminating power to 8·25 candles. Under extraordinary conditions this might be so, but I think I have shown that it is possible to have 11 per cent. of nitrogen and 2 per cent. of oxygen in 14-candle gas.

DISCUSSION.

MR. STENHOUSE (Rochdale) said that after hearing Mr. Davis's and Mr. New's papers read at the last meeting, he had obtained two samples of gas from Blackfriars Street, and very carefully determined the amount of oxygen, finding 0·6 per cent. in each sample. If there were oxygen in the gas there must be air present, and there could not be a large quantity of nitrogen in the gas without there being a corresponding quantity of oxygen. Such a large percentage of nitrogen was very remarkable, especially from Salford gas, where it was very carefully made and where there would be no means of air rushing in without its being known. If they did pass air in they would only use just sufficient to revivify the purifiers, whether oxide of iron or lime were used; and with that end in view it would be folly to add more than four or five per cent. altogether, because half a per cent. of air could not possibly be taken up by partly fouled oxide. It might be said that they made a very good gas at Salford, and then reduced its illuminating power by passing air into it, but that would be a very expensive process, and if Mr. Davis's figures were correct, of which there could be scarcely any doubt, it would appear that a large quantity of air was being passed into the gas. Mr. Davis appeared to have found a large quantity of nitrogen in the morning. It was difficult to understand why there should be more in the morning than at night, for if they had to pass air in it would be in regular quantities, and it would be impossible to say into which holder it had passed.

MR. DUNCAN asked if the nitrogen might have got there by diffusion?

MR. CARPENTER said that he remembered it once being suggested that every gas manufacturer who proposed to put air in his gas should carefully measure it, but it was quite possible that air might get into the gas through cracked retorts.

MR. STENHOUSE: That would be an isolated case; whereas Mr. Davis had quoted many instances.

MR. CRIPPIN: I said that undoubtedly there were certain periods when gas contained large quantities of air, but how the air got there he could not say, unless it was through cracked retorts. He had just heard evidence given before a Parliamentary Committee with regard to the Eccles and Swinton districts which verified the fact.

MR. DAVIS, in reply, said that he could not see why it would be foolish to put air into gas, so long as the consumers were prepared to accept a mixture of gas and air. It was an undoubted fact that gas had a low illuminating power at certain times of the day; and it was also undoubted that the tests proved the presence of air, but whether it got there by diffusion through the pipes or joints as suggested, by Mr. Duncan, he was not prepared to say.

Nottingham Section.

UNIVERSITY COLLEGE, NOTTINGHAM.

Chairman: L. Archbutt.

Committee:

<i>F. Clowes.</i>	<i>E. W. Small.</i>
J. B. Coleman.	H. J. Staples.
G. It. Field.	C. Taylor.
H. Forth.	Sir John Turney.
<i>E. Francis.</i>	J. T. Wood.
S. J. Pentecost.	

Treasurer: J. M. C. Paton.

Hon. Local Secretary:

R. L. Whiteley, University College, Nottingham.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies, and will take office in July next:—*Vice-Chairman:* F. Clowes. *Committee:* F. J. R. Canulla, F. D. Mordle, and G. J. Ward.

SESSION 1892.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Wednesday, 25th May 1892.

MR. L. ARCHBUTT IN THE CHAIR.

ON THE MANUFACTURE OF PORTLAND CEMENT FROM ALKALI WASTE AFTER TREATMENT BY THE CHANCE SULPHUR RECOVERY PROCESS.

BY CHARLES SPACKMAN.

THE accumulations of waste from the manufacture of soda by the Leblanc process have long been a source of unceasing trouble and expense to the manufacturers, and the proposal to make use of this waste as the lime constituent of Portland cement is not new. In a book on Portland cement by H. Reid, published in 1877, reference is made to experiments carried out at St. Helens some years previously with a view to its utilisation for this purpose, which were not successful, as the sulphate of lime interfered with the production of a perfectly hydraulic cement.

A paper describing his process for the manufacture of cement from alkali waste was read before the Liverpool Section of this Society by J. S. Rigby (this Journal, 7, 301), in which the author states that his attempts to produce cement with the unpurified waste were unsuccessful.

"It produced a cement of a very uncertain quality; when made into briquettes and placed in water they frequently crumbled away, or if they held together at all a very slight strain caused them to break. The cement had also an unpleasant slippery feel with it when taken from the water; it also evolved sulphuretted hydrogen when treated with an acid." Cement of good quality was, however, obtained by purifying the waste. This was said to be accomplished by passing carbon dioxide obtained from the calcination of a previous kiln of cement through the semi-liquid waste, either before or after it had been mixed with the required quantity of clay.

A second paper, by the same author (this Journal, 9, 254), considers the action of calcium sulphate on cement, and describes a continuous process of calcination.

In Mr. Chance's paper describing his sulphur recovery process, three analyses of the waste after treatment by this process are given (this Journal, 7, 162), and reference is made to the possibility of utilising it for the manufacture of cement. In this paper I propose to briefly consider this subject, and to give the result of an actual experiment.

The analysis of the waste with which my experiments were made was as follows:—

Coke	27.492
Sand	1.694
Silica	1.156
Alumina	0.926
Ferrous sulphate	1.488
Ferrous sulphide	0.421
Calcium carbonate	68.861
Calcium sulphate	4.735
Magnesium carbonate	2.428
Soda	0.962
Water	15.714
	<u>100.277</u>

Sulphur compounds exist here in much larger quantity than in the samples of which analyses are given by Mr. Chance. The presence of sulphur to any great extent in the raw materials is liable to seriously interfere with the production of Portland cement of even moderate quality, and as the material in question will always certainly contain a small quantity, and may contain a considerable one, we must, as part of our subject, consider what its effects are, and to what extent its presence is detrimental.

The action of sulphates on lime was first investigated by the late General Scott, R.E., F.R.S., now more than 25 years ago. Experimenting with the Plymouth hydraulic limestones and burning a piece of the stone in a dull fire, he found on grinding to a fine powder and mixing with water that instead of slaking and heating as previous samples had done, it set and hardened in exactly the same manner as a cement. He consulted Dr. Faraday respecting this, and they came to the conclusion that the change was due to the formation of some form of sub-carbonate of lime. It was, however, subsequently ascertained that it was caused by the presence of a small quantity of calcium sulphate formed by the action of the iron pyrites of the

coal. This led to the invention of Scott's cement, which was made as follows:—grey chalk lime, such as that of Barham on the Medway, containing from 10 to 15 per cent. of clay, was reheated to redness in shallow kilns with perforated hearths. When the lime was sufficiently hot, pots of sulphur were placed beneath the hearths, the sulphur being immediately ignited by the heat of the kilns. The sulphur dioxide evolved combined with the lime to form calcium sulphite which afterwards passed to sulphate. When finely ground the cement was ready for use.

This system of manufacture was about 1871 abandoned for a much simpler one, the lime being finely ground with a certain proportion of gypsum. When so treated it is known as selenitic lime, and it is now manufactured in large quantities from the hydraulic limestones. Mortar made with selenitic lime hardens rapidly and possesses a much greater strength with a larger proportion of sand than if made in the ordinary manner with the same lime not made selenitic.

General Scott also found that by the addition while grinding of a quantity not exceeding 2 per cent. of gypsum to hot overlied Portland cement with a tendency to expand and blow, it could be rendered fit for immediate use without undergoing the usual process of air slaking, and that sound but quick setting cement could be rendered slow setting by the same treatment. This fact is now so well recognised that the German standard rules, which most stringently regulate the addition of any foreign substance to Portland cement by the manufacturer, allow gypsum to be added in quantity not exceeding 2 per cent. to confer slow setting properties. Its effects are well illustrated by the results given in the following table by Messrs. Dyckerhoff taken from the Minutes of Proceedings Inst. C.E., Vol. LXII, p. 92, which shows the gradual increase in the time of setting of a sample of quick-setting cement by the addition of $\frac{1}{2}$, 1, and 2 per cent. of gypsum, and the corresponding increase of strength, both neat and with three parts of standard sand at from one to fifty-two weeks:—

TABLE BY MESSRS. DYCKERHOFF.
Showing the increase in strength which results from an increase in the time occupied in setting.
Kilogrammes per sq. centimetre.

No. One Sort of Cement.	Time of Setting.	Neat Cement. 275 Grains of Water to 1,000 Grains of Cement.					One of Cement to Three of Sand. Standard Test.				
		Neat.	One Week.	Four Weeks.	Twelve Weeks.	Twenty-five Weeks.	One Week.	Four Weeks.	Twelve Weeks.	Twenty-six Weeks.	Fifty-two Weeks.
	Minutes.										
1	20	22.7	28.5	36.4	43.7	49.3	8.1	11.8	16.7	21.2	25.3
2 The same cement with $\frac{1}{2}$ per cent. of gypsum	240	22.2	32.1	40.3	43.9	45.8	10.0	14.9	23.8	24.8	27.4
3 The same cement with 1 per cent. of gypsum	600	26.4	35.7	39.9	49.0	51.9	11.2	16.7	21.9	25.9	27.0
4 The same cement with 2 per cent. of gypsum	840	29.9	38.2	48.4	50.5	50.7	12.7	18.5	21.4	26.3	28.8

We must now consider calcium sulphate occurring as one of the constituents of Portland cement, instead of being added after burning. The materials in general use for the manufacture, as a rule, contain sulphur compounds in such small quantity that practically their presence may be disregarded. At the same time, calcium sulphate occurs in more or less quantity in all Portland cement, its presence being due to the coke used as fuel. The sulphur dioxide evolved during its combustion, in passing upwards through the layers of unburned material in the kiln, to some extent attacks the calcium carbonate, forming ultimately calcium sulphate, as in the manufacture of Scott's cement, except that in the latter case entire absorption of the sulphur dioxide was secured by heating the lime to redness. The formation of calcium

sulphate is less in open than in closed kilns, and less in some forms of closed kilns than in others. The quantity, however, due to this cause is too small to, of itself, at all influence the character of the cement, but many French engineers attach great importance to the freedom of Portland cement from sulphuric acid—it is difficult to understand why—and specify a maximum percentage. The cement specification for the Boulogne harbour works contains a clause providing that sulphate of lime shall not exceed 1 per cent., a condition that few, if any, English cements, which are generally burned with gas-coke, could comply with.

If the raw materials, as in the case of the desulphurised alkali waste, contain sulphur in any form—for even under the most careful treatment we know that it must do so, as any ferrous sulphide present cannot be decomposed, and

as we shall presently see, the quantity of calcium sulphate that may be present in the cement is a limited one, the quantity of this due to the ash and iron pyrites of the coke becomes an important consideration, and it is necessary to know what the amount really is. In the following table I have arranged the results of some experiments which show this:—

TABLE A.

	Unburned Material.		Cement.
	CaSO ₄ Per Cent.	FeS ₂ Per Cent.	CaSO ₄ Per Cent.
1.			1.169
2.			1.562
3.			1.501
4.	0.231		1.579
5.			1.691
6.			1.334
7.	0.004		1.990

The mixture as dried ready for the kiln in Nos. 1 to 6 contains only 0.231 per cent. of CaSO₄, which would give about 0.32 per cent. in the cement. FeS₂, a common constituent of many clays, was entirely absent. The kilns were open ones of about 20 tons of cement capacity. About one-half the coke was gas-coke; the remainder was made in ovens underneath the drying flats. The cement from each of six kilns was ground separately and carefully sampled, the CaSO₄ being determined in each with the results given in the table. The average of these is 1.528, and if we deduct 0.32 per cent., the approximate quantity due to that originally present in the raw materials, we have 1.2 per cent. derived from the coke. Practically, the cement differed in no way from specially prepared samples in which the CaSO₄ fell considerably below 1 per cent.

In No. 7, the CaSO₄ in the material before burning exists as a mere trace, FeS₂ being absent. The cement was burned in closed kilns, with the result that we get 1.99 per cent. of CaSO₄ derived entirely from the coke.

In the next table the results show the CaSO₄ present in the cement produced by burning by different methods, a mixture containing sulphur present principally in FeS₂.

TABLE B.

	Unburned Material.		Cement.	How Burned.
	CaSO ₄ Per Cent.	FeS ₂ Per Cent.	CaSO ₄ Per Cent.	
1.			6.130	In 30-ton close kiln, with a head draught. Whole product of kiln.
2.			5.972	As No. 1.
3.			5.902	As No. 1.
4.			5.950	As No. 1, but a very sharp draught. A high wind during whole time kiln was burning.
5.	0.442	1.677	4.778	As No. 1, but draught of kiln permanently improved.
6.			4.148	As No. 1. Sample from bottom of a kiln.
7.			5.100	In open 30-ton kiln. Whole product.
8.			3.803	In open 20-ton kiln. Whole product.
9.			3.872	In open 15-ton kiln. Whole product.
10.			4.320	From top of 15-ton open kiln.
11.			3.349	From bottom of 15-ton open kiln.

A consideration of this table will show that it is not an unimportant matter in what state sulphur if present exists in the raw materials. Taking the example given, we find that the mixture before burning contained 1.677 per cent. of FeS₂. This quantity is equivalent to 3.801 CaSO₄, and would make with the 0.442 actually present as CaSO₄ a total of 4.243 before burning, giving in the cement about 6.33 per cent. of CaSO₄. If we take into account that derived from the coke, which, in a closed kiln of the kind used for burning cements Nos. 1 to 4, would certainly be not less than 2 per cent., we should get 8.3 per cent. of CaSO₄ in the cement, supposing the S present combined with Fe as FeS₂ had existed in combination with lime as CaSO₄, or if the SO₂ evolved by the decomposition of the FeS₂ had entirely combined with lime.

The presence of 8.3 per cent. of CaSO₄ would be fatal to the cement, and it will be noticed that it is much higher than any of the tabulated results. Evidently then a considerable amount of sulphur escaped from the kilns as SO₂, the best results being obtained in the small open kilns, there being practically no difference between those of 15 and 20 tons capacity.

The cements in Table B, with many others in which the CaSO₄ varied from 3 to 6 per cent., were tested against a sample containing only 2.5 per cent., and their behaviour carefully watched. The 2.5 per cent. sample was prepared in the same manner and from practically the same materials as the other cements, by omitting a shale which contained the principal part of the FeS₂ and substituting another containing a smaller quantity.

Generally, the results were as follows:—From 2.5 to about 4 per cent. of CaSO₄, both the time of setting and the comparative strength of all the samples tested increased with the percentage of CaSO₄, and all were moderately slow setting.

With from 4 to 6 per cent. of CaSO₄ all the cements did not give good results. Those that were successful set much more slowly than the previous series, the time occupied in setting increasing with the percentage of CaSO₄, until with 6 per cent. the cement set so slowly as to render it unsuitable for many purposes. The strength of these when tested without sand was very great at short periods of time, much greater than was the case with those containing below 4 per cent. of CaSO₄; with sand the results were not quite so good. All the test briquettes were moulded as soon as possible after the cement was ground, and in no case was any sample improved by exposure to air before being tested. It has been already explained that the effect of gypsum added in small quantity to quick-setting cement or to freshly-made cement with a tendency to expand or blow, is to render it slow setting and fit for immediate use without being air-slaked. We now see that the same effect is produced by CaSO₄ occurring as one of the constituents of the cement.

The tests, some thousands in number, extended over a long period of time, and the result generally showed a high initial strength steadily increasing with age, except, of course, in the case of the samples just mentioned as not having given good results, the cause of the failure of which we must now consider.

We have hitherto assumed that the whole of the sulphur present in the cement exists in CaSO₄, but this is not strictly true, as a small quantity of CaS is also always present, which is formed by the reduction of CaSO₄ during the calcination of the cement, which takes place in contact with the fuel. Even if only 1 per cent. of CaSO₄ is present, CaS will also be found, and the larger the quantity of CaSO₄ the larger is the quantity reduced to CaS. If ordinary care is exercised in the manufacture, the quantity of CaS in cements containing up to 4.5 per cent. of CaSO₄ is not a matter of great importance, but from 4.5 to 6 per cent. it may exist to so great an extent as to entirely ruin the cement.

I found that when the CaSO₄ would exceed 5 per cent. in the finished cement, great care was necessary during the process of manufacture to prevent the formation of a dangerous excess of CaS, to which cause the failures were due. Briefly, its effects are as follows:—The fine blue grey colour of the freshly-ground cement gradually changes to a

dirty brown. This is caused by the CaS in presence of the moisture of the air reacting with the FeO or Fe₂O₃ existing in the cement. FeS first forms, this slowly oxidises to FeSO₄, which is further oxidised and becomes brown. This reaction takes place much more rapidly when the cement is gauged. Samples left in air dry out a dirty brown colour, if broken when dry the fractured parts are of a pale greenish blue, which rapidly becomes brown on exposure. If immersed in water the samples do not harden well especially when mixed with sand, and become throughout of a dark green colour, which changes to brown on removal from the water and exposure to air. The cement sets extremely slowly, even with a moderate proportion of water, with excess of water it will scarcely set at all, especially at a low temperature. Briquettes made of neat cement will, if allowed to thoroughly harden before being put in water, frequently possess a fair tensile strength, but with sand the strength when compared with that of ordinary cement of average quality is very low indeed.

The results of the experiments of which I have given a brief summary led me to fix the absolute limit to which CaSO₄ may be present in Portland cement at 5 per cent. This is considered, not as added to a normal cement, but as derived from the fuel and the materials from which it is made, the relative proportions of basic and acid constituents in the mixture before burning being arranged with reference to the percentage of CaSO₄ ultimately present in the cement.

Although my experiments were made with other materials and with a different object, they are equally applicable to the present case, in which we are considering the application of a material to the same purpose, the only drawback to its successful use being the presence of sulphur compounds.

The analysis of the alkali waste previously given shows that even when mixed with sufficient clay to bring the calcium carbonate down to about 72 per cent. in the dry mixture, it would still contain calcium sulphate in such quantity as to largely exceed in the cement the limit I have laid down.

An experiment was, however, made in the following manner: The waste was dried and ground in the dry state with clay fairly free from calcium carbonate. The mixture was pugged with a small quantity of water, and was moulded into bricks, which were dried on a heated floor and afterwards burned with coke in a trial kiln. Mixtures were made with various proportions of the alkali waste and clay, the cement in each case being ground and tested separately, with the result that every one of the samples failed, although some remained sound until put in water. Clearly then, it was necessary to devise some means of reducing the quantity of calcium sulphate if success was to be achieved, and the following method was adopted.

A marly clay was used containing from 30 to 40 per cent. of carbonate of lime. This rendered necessary the addition of a larger quantity than was used in the first experiments, and advantage was taken of the sparing solubility of calcium sulphate in water.

The materials were mixed in the wet way, using a considerable quantity of water, and the mixture was allowed to settle for some days in tanks, when the water was, as far as possible, drained from the surface of the deposited slip. This now contained about 66 per cent. of water, and, after being again thoroughly mixed by stirring, was allowed to run upon a drying flat heated by coke ovens, the floor being constructed of fireclay slabs. These absorbed a considerable amount of water from the slip, which, of course, together with that previously drained from the surface, was saturated with calcium sulphate. The process is really the one originally adopted for the manufacture of Portland cement from chalk and clay which is still largely in use, and which is fully described in a paper by myself (this Journal, 7, 102). In this case, however, a larger quantity of water was used, and the slip, instead of being allowed to settle for from six to eight weeks in backs until the water is reduced to 40 or 50 per cent., was, as time was of importance, run upon the drying flats in a more liquid condition.

In the following table of analyses, No. 1 is that of one sample of the dry slip prepared from the alkali mud and clay. The other two are for comparison with it. No. 2 is that of ordinary Portland slip or slurry prepared from grey chalk and gault clay. No. 3, the same material from white chalk and a pit clay.

	No. 1.	No. 2.	No. 3.
Coke, water, and organic matter ..	1'032	..	..
Sand.....	1'349	..	1'842
Silica	12'220	12'836	13'779
Ferrie oxide.....	3'427	2'678	3'025
Ferrous sulphide.....	0'324	..	..
Alumina.....	4'993	6'351	6'812
Calcium carbonate.....	71'002	76'382	73'093
Calcium sulphate	2'455	0'342	0'044
Magnesium carbonate.....	1'955	0'759	0'168
Potash.....	0'671	Not determined.	
Soda.....	0'772		
Water and organic matter .....	..	..	..
	100'200	99'348	98'763

The dried slip was burned in a trial kiln with gas coke. The previous experiments had shown that the mixture was very fusible, and great care was necessary to prevent over-burning. No attempt was made to get good results by selecting the best clinker for grinding. The under-burned material was first picked out, as is the usual practice, and the remaining contents of several kilns were ground together.

The cement set slowly (in about 10 hours) and was tested immediately after being ground. The briquettes were made in Graut's form of mould 1-inch section, were put in water 24 hours after moulding and left there until the moment of testing. They were tested in a Michéle's machine, strain being applied at the rate of 400 lb. per minute, with the following results in pounds per sq. inch.

	Neat Cement. Water 16·3 per Cent.			1 Cement, 3 Standard Sand, Water 5·2 per Cent.		
	Highest.	Lowest.	Average of 6 Tests.	Highest.	Lowest.	Average of 6 Tests.
At 3 days	620	570	588	200	185	192
At 7 days	640	600	615	200	170	190
At 28 days	770	712	746	350	300	317

For comparison with the foregoing tests, those following are given. They are of six samples of ordinary commercial Portland cement taken without selection from a register of tests.

	Neat Cement.			1 Cement, 3 Standard Sand.	
	3 days.	7 days.	28 days.	7 days.	28 days.
Cement A..	416	595	697	126	162
Cement B..	386	436	581	199	241
Cement C..	..	615	625	195	212
Cement D..	..	563	436	..	160
Cement E..	..	566	545	..	307
Cement F..	..	478	549	138	182

It will be noticed that the cement made from the alkali waste far exceeds any of these in strength, both neat and with sand. This is to some extent due to the calcium sulphate, but principally to the extremely fine state of division of the calcium carbonate, which rendered possible a most intimate mixture with the clay before burning, a result not always obtained when dealing with some of the natural carbonates except at a great, and often a prohibitive cost.

In comparing these results it is but fair to remember that the tests with sand of all of those in the second table would have been much higher had the cement been more finely ground, but the strength neat, in which condition, however, cement is rarely used would have been rather less. Any of these cements, some of which possess far less strength than that made from the alkali waste would, for many purposes, be much more suitable as they all set more quickly.

In the following table the analysis of four cements are given. No. 1 is that made from the alkali waste, the others are three samples of ordinary commercial Portland of very good quality. It will be observed that Nos. 2 and 3 agree fairly closely in composition with No. 1, but it must at the same time be remembered that the analysis of a cement taken by itself is no guarantee of its quality:—

	1.	2.	3.	4.
Insoluble residue.....	2.749	3.302	2.815	1.642
Silica.....	18.215	19.156	20.264	21.366
Alumina.....	8.948	7.136	7.306	8.826
Ferrie oxide.....	6.563	4.678	6.894	4.304
Lime.....	56.682	56.170	56.905	60.672
Sulphate of lime.....	5.006	4.778	3.389	1.507
Magnesia.....	1.639	3.101	0.963	1.116
Potash.....	0.654	1.327	1.102	0.789
Soda.....	0.779	0.440	0.375	0.289
	100.335	100.115	100.013	100.551

The results of my experiments show, that if so far free from sulphur compounds as to give in the cement calcium sulphate in quantity not exceeding 5 per cent., alkali waste may, after treatment by the Chance process for the recovery of its sulphur, be successfully utilised for the manufacture of Portland cement. With this quantity, however, the cement would set very slowly, but it could be made to set more quickly, and would be more generally useful if the calcium sulphate was reduced to from 3 to 4 per cent.

This material may be easily dealt with by the methods generally adopted for the manufacture of Portland cement from chalk and clay, but Tables A. and B. show that as regards kilns, open ones of moderate capacity are the most suitable as the quantity of calcium sulphate in the cement, derived from the coke and the sulphides present will be materially reduced by their use.

Glasgow and Scottish Section.

Chairman: E. C. C. Stanford.
Vice-Chairman: A. Crum Brown.

Committee:

J. Christie.	R. Irvine.
W. J. A. Donald.	J. Falconer King.
D. B. Dott.	G. McRoberts.
C. J. Ellis.	T. P. Miller.
G. A. Fawcitt.	J. Pattison.
Wm. Foulis.	J. B. Readman.
J. Gibson.	E. Smith.
R. A. Inglis.	R. R. Tatlock.

Hon. Treasurer: W. J. Chrystal.

Hon. Local Secretary:

J. Stanley Muir, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next: *Chairman*: C. A. Fawcitt. *Vice-Chairman*: E. J. Mills. *Hon. Secretary and Treasurer*: J. Stanley Muir. *Committee*: G. Beilby, W. J. Chrystal, J. S. Macarthur, T. L. Patterson, E. C. C. Stanford, and G. Watson.

Meeting held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, 7th June 1892.

MR. E. C. C. STANFORD IN THE CHAIR.

NEW METHODS OF ESTIMATING CHROMIUM IN FERRO-CHROMIUM AND STEEL.

BY JOHN CLARK, F.R.S.

FERRO-CHROMIUM.

ON account of its technical importance, the estimation of chromium in ferro-chromium has engaged the attention of a considerable number of chemists, but the processes hitherto published are for the most part very tedious. This is to a large extent due to the difficulty which is experienced in getting the whole of the chromium into solution, as alloys rich in chromium are only partially soluble in nitric, sulphuric, or hydrochloric acids, or even aqua regia.

H. N. Warner, it is true (Chem. News, 65, 186), states that ferro-chromium is readily dissolved by heating with strong sulphuric acid, but I have not succeeded in completely dissolving in this way the alloys which I have had occasion to test, the best result obtained after heating with H_2SO_4 for a day giving 8.9 per cent. of insoluble chromium, and as they frequently contain aluminium his method of estimating the chromium by weighing the precipitates of oxide chromium and iron, and deducting the iron is, in my opinion scarcely entitled to be called accurate. According to R. Schöfel (Ber. Deutsch. Chem. 1879, 1863) even direct fusion with carbonate of soda and nitrate of potash is of no use, and he therefore recommends that the greater portion of the iron of the ferro-chromium should be dissolved out with the double chloride of copper and sodium or ammonium, and the residue fused with carbonate of soda and nitrate of potash, but he admits that this process is not suitable for alloys containing more than 8 per cent. of chromium.

A. Ziegler states that ferro-chromium can be dissolved by fusion with a large excess of bisulphate of potash or soda, but he recommends (Dingl. 279, 163) that the ferro-chromium should be fused with a mixture of 6 parts of caustic soda and 3 of nitrate of potash, and the chromium in the solution twice precipitated with ammonia after evaporation to dryness with hydrochloric acid to render the silica insoluble. In addition to this, the insoluble in water is dissolved in hydrochloric acid, and the oxide of iron tested for chromium.

In 1871 (Chem. News, 24, 286 and 301) I published a new method of estimating chromium in chrome iron ore, depending on the oxidation of the chromium by means of a mixture of caustic soda and magnesia, and subsequent titration of the chromic acid. In 1877, or fully five years afterwards, this process was reproduced by A. Christmann as his own in a paper read before the German Chemical Society (Ber. Deutsch Chem. 10, 16). I did not observe this publication at the time and would have taken no notice of it now, but I find that in Roseoc and Schorlemmer's Treatise on Chemistry (Vol. 2, Part 2, p. 183), Christmann's is referred to in a foot-note as the author of the process, and I therefore take this opportunity of pointing out my claim to priority. This process is very suitable for ores or oxide of iron precipitates, as the oxide of chromium is readily converted into chromic acid at the temperature of a Bunsen flame, but on applying it to poor ferro-chromium under the same conditions so little oxidation took place that I concluded it was necessary to oxidise the chromium before it could be converted into chromic acid by soda and magnesia. Unfortunately, ferro-chromium is only partially oxidised in the muffle or over a blowpipe, and even when heated in pure oxygen by means of a gas combustion furnace oxidation takes place very slowly. I found, however, on repeating my experiments with rich alloys of chromium, that when the temperature was lowered to a point at which it seemed scarcely possible that any action could take place the ferro-chromium, even when in coarse powder, was readily and rapidly oxidised by the soda and magnesia without the use of an oxidising agent such as chlorate or nitrate of potash, any excess of which would interfere with the subsequent titration of the chromium.

Magnesia and Soda Process.—One gram. of the finely pulverised ferro-chromium is intimately mixed in a platinum crucible with 5 grms. of magnesia mixture, consisting of two parts of freshly calcined magnesia, and three parts of finely pulverised hydrate of sodium, and the crucible is placed over a low Bunsen flame in such a manner that only the point of the flame touches the bottom of the crucible. Oxidation begins almost immediately, and takes place so rapidly that the contents of the crucible actually glow for several minutes. After heating at this temperature for about half an hour without stirring, the flame is raised and the bottom of the crucible maintained at a dull red heat for another half hour. The contents, which consist of an adherent powder, are then washed into a porcelain basin and boiled for some minutes to dissolve out the chromate, which is either pure yellow or slightly green in colour if manganese is present. To decompose the manganate peroxide of hydrogen is added drop by drop till there is no further change of colour, and after boiling for a few minutes to remove any excess of peroxide of hydrogen the solution is filtered, acidified with sulphuric acid, and the chromium estimated by adding an excess of ferrous ammonium sulphate, and titrating the unoxidised iron with a standard solution of bichromate of potash. Although the bulk of the chromium is rendered soluble in the first fusion, a little always escapes oxidation. To extract this the insoluble on the filter is ignited, ground in an agate mortar, and again fused with about twice its bulk of magnesia mixture for about half an hour, and the chromic acid is estimated as before. The insoluble is now washed into a beaker or basin, and the bulk of the magnesia is removed by adding dilute sulphuric acid till the reaction is neutral. The oxide of iron is then filtered off and again fused with magnesia mixture, when the last traces of chromium will be obtained.

Example.

	Found.	Per Cent.
	Grm.	
1st fusion.....	0.5491	54.91
2nd fusion.....	0.0320	3.20
3rd fusion.....	0.0096	0.96
4th fusion.....	..	..
Total.....	0.5907	59.07

Lime and Soda Process.—Rich ferro-chromium can also be oxidised by heating the finely pulverised alloy in the manner already described with five times its weight of lime (CaO) and sodium hydrate in equal proportion. In this case it is advisable before filtering to add about 2 grms. of bicarbonate of sodium to convert the lime into carbonate, but in other respects the process is the same. As a rule, however, at least four fusions are needed to extract the whole of the chromium.

Calcium Hydrate Process.—Although alloys of chromium are difficult to oxidise when heated alone either in air or oxygen, they are readily converted into oxide at high temperatures in presence of calcium hydrate, and this fact can be utilised for the estimation of the chromium as follows:—

One gram. of the finely pulverised ferro-chromium is mixed with three times its weight of calcium hydrate and heated in a platinum, nickel or porcelain crucible in a muffle or over the blow-pipe for about half an hour when oxidation is practically complete. The action takes place most rapidly in platinum or nickel, but the platinum is strongly acted upon, and the nickel usually gives way after being used two or three times. It is therefore more economical to use a porcelain vessel. The contents of the crucible consist of a green powder, which can easily be crushed with a glass rod and contains no chromate. The oxide of chromium thus formed may be converted into chromic acid by adding to the crucible 5 grms. of the magnesia and soda mixture above referred to, stirring with a rod and heating in the muffle or over a Bunsen for about an hour; but when the ferro-chromium is employed in coarse powder it is advisable to grind the lime fusion before the addition of the magnesia mixture. The contents of the crucible, which seem to have little or no action on the porcelain, are boiled with water and a little peroxide of hydrogen, filtered after the addition of about 3 grms. of bicarbonate of sodium, and the chromic acid titrated in the manner already described. As a small quantity of the chromium usually escapes oxidation, the insoluble is again heated with about its own bulk of the magnesia and soda mixture for about half an hour, and the chromate estimated as before. The insoluble should now be neutralised with dilute hydrochloric acid to remove the bulk of the lime and magnesia, and the residue subjected to a third fusion to ensure the extraction of the last trace of chromium.

Example.

	Nickel Crucible.		Porcelain Crucible.	
	Found.	Per Cent.	Found.	Per Cent.
	Grm.		Grm.	
1st fusion.....	0.5645	56.45	0.4994	49.94
2nd fusion.....	0.2321	2.31	0.0673	6.73
3rd fusion.....	0.0045	0.45	0.0323	3.23
4th fusion.....	..	..	0.0025	0.25
Total.....	0.5921	59.21	0.5925	59.25

This process works well, and is more suitable for poor alloys of chromium than those which I have already described.

The oxide of chromium produced by heating 1 grm. of the ferro-chromium with hydrate of calcium may also be converted into chromic acid by heating with 4 grms. of carbonate of soda in the muffle, but, as a rule, a smaller yield of chromate is obtained in the first fusion and more fusions are required. In other respects the process is the same and the results equally correct.

Example.

	Cr Found.	Cr Per Cent.
	Grm.	
1st fusion.....	0'4535	45'35
2nd fusion.....	0'1064	10'64
3rd fusion.....	0'0193	1'93
4th fusion.....	0'0083	0'83
5th fusion.....	0'0020	0'20
Total.....	0'5895	58'95

Sulphur Process.—The disintegration and oxidation of ferro-chromium can also be effected by means of sulphur instead of hydrate of calcium. For this purpose 1 grm. of the finely pulverised alloy is placed in a porcelain boat and subjected for about 30 minutes to the action of sulphur vapour in a porcelain tube heated by an ordinary gas combustion furnace. As soon as the vapour comes in contact with the heated ferro-chromium a strong action takes place, the metal glows and swells up to several times its original bulk, and a little powder is apt to be carried away mechanically by the sulphur vapour and scintillates. The product, which is greyish black in colour, is in the form of a fine powder and consists essentially of Cr_2S_3 and FeS . The sulphide thus produced is easily ground in an agate mortar, and may be at once converted into chromate by heating over a Bunsen with eight times its weight of the magnesia and soda mixture already referred to, or it may be converted into oxide by ignition in a porcelain crucible, then fused with five times its weight of the mixture, and the chromic acid titrated as already described after removing the manganese.

Example.

	(A.)		(B.)	
	Cr Found.	Cr Per Cent.	Cr Found.	Cr Per Cent.
	Grm.		Grm.	
1st fusion.....	0'5606	56'06	0'5713	57'13
2nd fusion.....	0'0229	2'29	0'0075	0'75
3rd fusion.....	0'0015	0'15	0'0029	0'29
4th fusion.....	..	..	..	..
Total.....	0'5850	58'50	0'5817	58'17

The results obtained by this method are rather lower than by the other processes, but this is in my opinion sufficiently accounted for by the slight mechanical loss sustained.

The ferro-chromium may also be completely converted into sulphide by heating with excess of sulphur in a covered porcelain crucible over a Bunsen, but in this case it is necessary to repeat the operation three times, as the action takes place chiefly when the bulk of the sulphur has been volatilised, and the scintillation and mechanical loss are greater.

Carbon Bisulphide Process.—Sulphurisation can also be effected by exposing the metal to the action of carbon bisulphide vapour in a porcelain tube heated by a combustion furnace. The product in this case also is a bulky

powder, a portion of which is apt to fall over the side of the boat, but otherwise there is apparently no mechanical loss. It requires no grinding, and is heated with magnesia and sodium hydrate either with or without previous roasting, and the chromium estimated as described. One grm. ferro-chromium gave with this treatment:—

	Cr Found.	Cr Per Cent.
	Grm.	
1st fusion.....	0'5789	57'89
2nd fusion.....	0'0056	0'56
3rd fusion.....	0'0018	0'18
4th fusion.....	..	..
Total.....	0'5863	58'63

STEEL.

On account of its greater solubility in acids, the estimation of chromium in steel is usually considered to be easier than in ferro-chromium, but I must confess it has given me more trouble. I have already indicated that poor alloys of chromium are very imperfectly oxidised when heated direct with sodium hydrate mixed with magnesia or lime, and the same holds good to a still greater extent with steel. Calcium hydrate works better, but the oxidation of the chromium seems to be prevented by the formation of a crust of oxide of iron; and when this method is used it is necessary to grind the lime fusion once or twice to expose a fresh surface. When this is done, fairly good results are obtained, but the sulphur and carbon bisulphide processes are by far the best. When steel turnings are exposed to the action of sulphur vapour, there is no indication of mechanical loss as in ferro-chromium, and the sulphide produced appears slightly fused. Sometimes it adheres to the porcelain, but it can generally be detached, in which case it is pulverised, then roasted in a porcelain crucible, and fused with four times its weight of the mixture of magnesia and sodium hydrate already referred to, and the chromium estimated as described.

When the sulphide adheres firmly to the porcelain, it is ignited in the boat itself till it can be detached and ground. Two fusions are generally sufficient for the extraction of the whole of the chromium.

Example.

Three grms. of a steel received from Mr. R. A. Hadfield, of the Hecla Works, Sheffield, and said to contain 1'60 per cent. of chromium, gave the following results by this process:—

	(A.)		(B.)	
	Cr Found.	Cr Per Cent.	Cr Found.	Cr Per Cent.
	Grm.		Grm.	
1st fusion.....	0'0480	1'60	0'0492	1'64
2nd fusion.....	0'0036	0'12	0'0024	0'07
3rd fusion.....	..	..	..	..
Total.....	0'0516	1'72	0'0513	1'71

Although the sulphur process works well, the carbon bisulphide method is, in my opinion, the best for steel. It is most conveniently carried out by attaching a flask containing carbon bisulphide to one end of the porcelain tube and a small condenser to the other, and passing a gentle stream of CS_2 vapour over the heated steel for about an hour. On the removal of the boat, it will be observed that the steel drillings have increased considerably in bulk and are soft and porous, but they retain their original form. As the product has no tendency to adhere to the porcelain,

it can at once be transferred to a crucible and roasted. Oxidation takes place very rapidly, and in the course of about half an hour the sulphide is converted into a fine powder without stirring or grinding, and may be at once heated with four times its weight of the mixture of magnesia and sodium hydrate, and the chromate extracted and estimated as described.

Example.

Two grms. of the steel from the Hecla Works treated in this way—

	Cr Found.	Cr Per Cent.
	Grm.	
1st fusion	0.0332	1.66
2nd fusion	0.0018	0.09
3rd fusion .....	..	..
Total	0.0350	1.75

These methods involve several fusions, but the time occupied in the estimation of the chromium should not exceed one day, and, of course, the filtrates from the different fusions can be united and titrated as one.

for a little while and then stopped by closing clip *x*. Some water is now poured into flask *R* and boiled down to expel all the air from the apparatus. At first clips *g* and *m* are open and clips *x* and *w* closed. After some time *m* is closed and the steam allowed to go out through *w*. When the water in flask *R* has been boiled down to about 5 or 10 cc. *w* is closed and the lamp withdrawn. Clip *e* is then closed and clip *x* is opened cautiously so as to prevent the water rushing too quickly into the collecting cylinder *S*. Clip *x* is now kept open to the end of the experiment. Any remaining air bells in *S* are forced out through *m*, and it is then connected with a Schiff's nitrogen measurer charged with mercury. *R* is then charged with 500 cc. of the water under analysis by means of the funnel and capillary delivery tube *i*, and the tube filled with mercury to prevent any gas lodging in it. The extraction is now carried out as usual. After the gases have been collected in *S* they are transferred to the Schiff and in many cases the analysis completed there.

The advantages of the apparatus over Jacobsen's are obvious, for both the troublesome process of sealing up the tube, and the still more troublesome operation of transferring the gas to an apparatus for its analysis are obviated, and also it is easy to test and find if all the gases are expelled.

A series of test analyses with the apparatus described gave very satisfactory results.

ON MAIZE OIL.

BY J. CRICKSBANK SMITH, B.S.C.

MODIFICATION OF KREUSLER'S NITRIC ACID APPARATUS FOR THE EXTRACTION OF DISSOLVED GASES IN WATER.

BY JAS. ROBSON.

Chief Assistant to the "Freeland" Professor of Chemistry in the Glasgow and West of Scotland Technical College.

SOME time ago, at the suggestion of the late Professor Dittmar, I carried out a number of experiments to see if Kreusler's apparatus could be adapted for the extraction of the dissolved gases in water. The first series of experiments was made with a combination of Jacobsen's and Kreusler's apparatus. Instead of Kreusler's nitrate flask I inserted a Florence flask and pear-shaped bulb. This method I found did not work well, as the pear-shaped bulb was liable to collapse when being pushed further into the Florence flask so as to establish communication between them.

The second series of experiments was carried out with the apparatus shown in the figure. The method of working the apparatus is as follows:—The bolt-head *T* is filled with

THE grain of the maize plant (*Zea Mais*), which is extensively used in the manufacture of starch, can be made to furnish an oil whose properties would seem to render it suitable for several technical applications. At the suggestion of Professor E. J. Mills, I have recently examined a sample of this oil which is believed to be genuine, and the results have been embodied in the present paper.

The sample was of a bright golden colour, it had a somewhat peculiar "starchy" odour, and its taste was mild and not unpleasant.

Specific Gravity, &c.—At different temperatures the specific gravity was as follows:—

At 10° C.	0.9267
At 15° C.	0.9244
At 20° C.	0.9218

The mean coefficient of expansion (corrected for glass) between 10° and 20° C. was 0.000706.

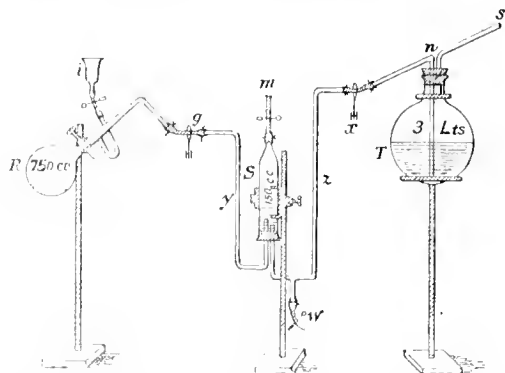
Schaeidler (Technologie der Fette und Oele) gives the specific gravity at 15° as 0.9215, and Professor Mills informs me that in 1884 he found a rather coarse brown sample to have a specific gravity of 0.9262.

At -10°, according to Schaeidler, the oil sets to a solid mass. I find, however, that when exposed to intense cold, the oil becomes turbid, owing to the deposition of solid matter at -10°, and that below that temperature it becomes very viscous, but is still fluid at -20°. The precipitated solid matter is entirely redissolved on warming up again.

Bromine and Iodine Absorptions.—These were as follows:—

	Per Cent.
Bromine absorption	66.50
Iodine absorption	122.90
Iodine absorption (calculated: Br absorption $\times \frac{127}{80}$)	165.50

It was observed that when the bromine solution remained in contact with the oil for more than 15 minutes, the results obtained were somewhat higher, and did not agree among themselves, owing, no doubt, to a secondary oxidising action.



from 2 to 3 litres of boiled-out hot distilled water, which is kept about boiling to the end of the experiment. The siphon *n z* is filled by blowing in at *s* and allowed to run

A thick dark-coloured sample was found by Professor Mills in 1881 to have a bromine absorption of 74.42 per cent.

Saponification and Action of Alkalis.—On saponification with alcoholic potash, the total KOH absorbed was 19.34 per cent., which gives a "saponification equivalent" of 290.07.

The free acid, estimated directly by titration with N_{10} soda, amounted to 0.55 per cent. in terms of KOH. On performing a cheek experiment, however, by placing in contact with the oil a measured excess of alkali of known strength, in presence of a little alcohol, and titrating back with standard acid, I found a much greater proportion of alkali absorbed, and examination showed this to be due to partial saponification. In order to determine how far saponification could proceed with this oil in the cold, the following experiments were carried out:—Solutions of caustic potash and soda in alcohol were prepared separately, the proportion of alkali to solvent being $5\frac{1}{2}$ per cent. in each case. Small quantities of the oil (1 to 2 grms.) were then placed in contact with a considerable excess of each of the solutions for four hours at the ordinary temperature. After that time it was found that the oil in the potash solution was completely saponified, 19.3 per cent. of KOH being absorbed, and a perfectly clear solution being obtained. On the other hand, the oil in the soda solution was only partially saponified, 10.36 per cent. of NaOH being absorbed, which is equivalent to 14.50 per cent. of KOH. In the latter case a pasty mass of soda soap, insoluble in the alcoholic solution, formed after a short time, and this may have had a retarding effect on the rate of saponification.

It was at first thought that this ready saponification in the cold might be made use of for the quantitative separation of maize oil from other oils; but while no other oil that I have examined gives such a high absorption in the cold as maize oil, many of them are undoubtedly acted upon under similar conditions, and concordant results could not be obtained.

The higher fatty acids present in maize oil seem to present no unusual features, but exact determinations as regards the proportion in which they are severally present were not made in the present instance.

The volatile fatty acids, separated by Reichert's distillation process, in 100 parts of the oil required for their neutralisation 0.56 parts of KOH.

Drying properties.—A tendency to oxidise or to gum is almost absent in this oil. No decided siccativ properties are communicated to it by simple "boiling," or by the addition of litharge to it. On passing a current of air through it for an hour at a temperature of about 150°C ., the oil becomes slightly darker in colour, and rather more viscous, but by no means to the same extent as cotton oil. If to the oil so treated a small quantity of borate of manganese is added, the oil acquires to a small extent siccativ properties, and a thin film on lead dries in from 10 to 20 hours, but not completely, being tacky to the feel at the end of that time. Like cotton-seed oil the elaidin reaction gives rise to a mass having a pasty or buttery consistency.

Maumené test.—The rise in temperature when 5 cc. of strong sulphuric acid were mixed with 15 grms. of the oil was 89.0°C . For a non-drying oil this is a high figure, but it is in keeping with what may be called the "tenderness" of this oil in the presence of chemical reagents. The so-called qualitative tests for oils with sulphuric and nitric acid, &c., fail to give with maize oil reactions sufficiently characteristic to warrant their application in identifying or detecting this oil. Hence its bromine and iodine absorptions, its high Maumené figure, and the ease with which it saponifies in the cold, must be looked upon as the features by which the oil may be best recognised.

Technical applications.—Specimens of the potash and soda soaps were prepared, and both of these proved to be of good quality, being light in colour, and readily and completely soluble in water. The soda soap is distinctly

the harder of the two, but the potash soap is harder than the average "soft" soaps. Soap-making, therefore, is a use to which the oil might with advantage be put. The ease with which it saponifies, also, might make it useful to mix with other oils to accelerate their saponification. As a lubricant it might in certain cases be applicable, its low acidity, and its small tendency to deposit solid matter or to "gum," being properties that recommend it for this purpose.

The oil dissolves readily in acetone and more sparingly in alcohol or glacial acetic acid.

The following numbers represent the volume of oil dissolved by 100 vols. of the three above-mentioned solvents.

Solubility.—In 100 parts (by vol.) of—

Absolute Alcohol $t = 16^{\circ}\text{C}$.	Absolute Alcohol $t = 63^{\circ}\text{C}$.	Commercial Acetone $t = 16^{\circ}\text{C}$.	Glacial Acetic Acid $t = 16^{\circ}\text{C}$.	Glacial Acetic Acid $t = 63^{\circ}\text{C}$.
2	13	24	3	9

Viscosity.—This was determined roughly by observing the time of flow of 5 cc. of the oil through a burette with a capillary point, and comparing the results with standard oils.

$t = 18^{\circ}$ to 19°C .

—	Maize.	Olive.	Colza.	Mineral "910."
Specific gravity.	0.924	0.918	0.915	0.910
Time of flow....	177.3"	214.5"	290.0"	243.5"
Viscosity.....	61.1	84.3	100	83.9
(Colza = 100)				
do. (water=1)	25.7	35.4	42.0	35.2

Maize oil thus possesses a striking individuality. In general it may be said that in properties it is somewhat akin to cotton-seed oil. At the same time there are differences between them which are very marked.

DISCUSSION.

The CHAIRMAN said that he gathered from the paper that castor oil was the nearest approach to this maize oil, and although it did not resemble it in appearance it did so by being soluble in alcohol. He wondered whether there were any particular acids present. He noticed too, that the potash soap was quite solid.

Dr. CLARK asked whether the sample of oil was obtained from the germ or from the whole maize.

Mr. SMITH, in reply to the Chairman, said that the exact determination of the acids had not been undertaken. Regarding the source of this sample of oil he could not give any particulars, but it seemed different from the sample which Professor Mills had some years ago. It, he supposed, was derived from the germ.

"BLOWN" OILS.

BY R. T. THOMSON AND H. BALLANTYNE.

The published analytical data of any value in the chemical examination of "blown" oils are very few, and indeed extend only to two or three isolated facts. About six years ago Messrs. Fox and Baynes showed that the percentage of insoluble fatty acids in rape oil was reduced to 85.5 per cent., and those in cotton-seed oil to 81.7 per cent., when these oils were oxidised by blowing air through them, at a temperature of 70 to 75 °C., until they reached a specific gravity near that of castor oil. Allen, in his second volume on "Commercial Organic Analysis," showed that the alkali-neutralising power of blown rape oil was considerably higher than that of the original unoxidised oils. Taken in conjunction with their high specific gravity, these are the main facts known, or at least published with regard to blown oils. In the following paper we have endeavoured to throw a little more light on the composition of these oils, in order that their detection and differentiation may be effected with somewhat more certainty than has been before possible. As our time has been limited we have confined our observations to blown rape, cotton-seed, and sperm oils; and the results of the experiments are embodied in the accompanying table.

The first three columns contain the results of experiments on rape oil at different stages of oxidation. After analysing the pure rape oil about 50 cc. of it were placed in a tall narrow glass, provided with a cork, through which passed two glass tubes, one above the level of the liquid and the other reaching to the bottom of the glass. The latter had a few minute perforations at the lower end to allow the passage of air in a finely divided form through the oil. The shorter glass tube was now connected with a suction pump, by means of which a rapid stream of air was drawn through the oil. During the passage of the air the vessel containing the oil was immersed in a large beaker of water maintained at a temperature of 72 to 75°. After five hours treatment the product, as shown in the second column, had increased in specific gravity and alkali-neutralising power, and decreased markedly in iodine absorption. After "blowing" for 20 hours the specific gravity of the oil had risen from 914.1 to 964.5, which is about the average gravity of castor oil. It is interesting to observe that the free acidity had at the same time increased about 2 per cent., and the potash-neutralising power more than 2 per cent.; while the iodine absorption had fallen more than 37 per cent. This loss of power to

absorb iodine appears to be directly due to the absorption of oxygen during the "blowing" with air, and the further the oxidation is carried the lower will the iodine absorption become. The increase in free fatty acid points to the fact of decomposition of the oil, but that it is no true measure of the extent of decomposition will be seen by a reference to the partial analysis of the oil next given in the table. While the pure rape oil contained 94.76 per cent. of insoluble fatty acids, the "blown" product contained only 85.94 per cent. of insoluble acids, with an additional 9.2 per cent. of soluble non-volatile acids, and 0.82 of soluble volatile acids. These results were arrived at by saponifying the oil with alcoholic potash, evaporating off the alcohol, dissolving in water, and liberating the insoluble acids with sulphuric acid. These were collected, washed with hot water, dried, weighed in the usual way, dissolved in alcohol, and their molecular weight determined by titration with standard alcoholic potash, using phenolphthalein as indicator. The filtrate was then distilled to dryness, the distillate neutralised with standard barium hydrate, the solution evaporated to dryness, the barium salt weighed, then converted into barium sulphate, and from these data the molecular weight and proportion of the soluble volatile acids were calculated. The soluble non-volatile acids were extracted by ether from the dry residue left after distilling off the volatile acids, weighed after expelling the ether, and their molecular weight determined by standard alcoholic potash.

With these facts before us it is scarcely necessary to point out how they can be utilised in the detection and estimation of blown rape oil in other oils. With regard to the molecular weight of the insoluble acids it may be mentioned that Messrs. Fox and Baynes state it to be 186, while our result shows 327. The first figure seems to us to be quite inconsistent with the alkali-neutralising power of the oil as given by Allen, and determined by ourselves.

In the fourth column of the table are given the results of an analysis of a commercial sample of blown rape oil, which confirm those just described. This sample, however, contains a somewhat large proportion of unsaponifiable matter, probably derived from some fish oil adulterant in the original rape oil.

The fifth column of the table contains the results of an analysis of commercial blown cotton-seed oil, and a similar change in constitution is observable by blowing with air as in rape oil. It will be noticed, however, that the molecular weight of the soluble volatile acids contained in blown cotton-seed oil is much higher than that of the product from rape oil. The true means of distinguishing them is

TABLE SHOWING RESULTS OF ANALYSIS OF OILS.

	No. 1. Pure Rape Oil.	No. 2. Partially Blown Rape Oil prepared from No. 1.	No. 3. Blown Rape Oil prepared from No. 1.	No. 4. Blown Rape Oil, Commercial Sample.	No. 5. Blown Cotton-seed Oil, Commercial Sample.	No. 6. Pure Sperm Oil.	No. 7. Blown Sperm Oil prepared from No. 6.
Sp. gr. at 15.5 °C. (water at 15.5 = 1000).....	914.1	927.5	961.5	967.2	971.0	879.9	898.9
Free alkali need..... Per cent.	5.10	5.01	7.09	1.93	5.38	1.97	3.27
Unsaponifiable matter..... "	0.65	"	0.76	2.80	1.00	36.32	34.66
KOH neutralised..... "	17.39	18.30	19.49	19.77	21.32	13.04	11.23
Iodine absorption..... "	100.5	88.1	63.2	63.6	56.1	82.1	67.1
Specific temperature reaction.....	135	"	"	251	227	"	"
Insoluble acids..... Per cent.	94.76	"	85.94	82.40	84.97	"	"
Soluble non-volatile acids.....	"	"	9.20	11.16	9.00	"	"
Soluble volatile acids.....	"	"	0.82	1.30	1.94	"	"
Iodine absorption of insoluble acids.....	"	"	60.5	70.2	62.7	"	"
Molecular weight of.....	"	"	327	317	291	"	"
" " Soluble non-volatile acids.....	"	"	241	"	"	"	"
" " Soluble volatile acids.....	"	"	72	76	164	"	"

to be found in the large difference in alkali-neutralising power, as all the other data approach too close to each other to provide any means of determining which oil is being tested. In making these comparisons it is apparent that the oils must have reached the same state of oxidation before correct deductions can be made. Thus, a blown rape oil of a specific gravity of about 960 ought to be compared with a blown cotton-seed oil of about 968.

The only other point to which special reference may be made is the largely increased power of developing heat when mixed with sulphuric acid, possessed by the blown over the unblown rape and cotton-seed oils. This is expressed as the specific temperature reaction, for the definition of which term, and method of determination, see our paper in this Journal for 1891, page 233. The increase in specific temperature reaction by oxidation of oils exposed to air and light has already been shown by one of ourselves (see "The Effect of Exposure under certain Conditions upon some Constants of Oils," by H. Ballantyne, in this Journal for 1891, page 29).

In the sixth and seventh columns of the table are recorded results obtained in the analysis of pure sperm oil, and the same oil after treatment for 25 hours with air in the same apparatus as was used in blowing the rape oil. Of course blown sperm oil is not an article of commerce, but it occurred to us that it might be at least interesting to observe the effect of oxidation on an oil having a totally different chemical constitution to that of rape or cotton-seed oil. It will be observed that the increase in specific gravity is not nearly so great with sperm as with rape oil, for while 25 hours treatment raised the specific gravity of the sperm oil 19 units, a treatment extending only to 20 hours sufficed to raise the specific gravity of the rape oil 47.4 units. This plainly shows that rape oil is more easily oxidised than sperm oil, a fact which almost goes without saying when their comparative qualities as lubricants are taken into account. These observations are corroborated by the iodine absorptions, which were reduced 15 per cent. only in the case of sperm oil, and 37.3 per cent. in that of rape oil. Thus, although these oils differ so entirely as regards their source and chemical constitution, yet their specific gravity and power of absorbing iodine rises and falls in almost exactly the same ratio during oxidation by air-blowing. If we assume that the change is regular from one extreme to the other, the fact is established that a unit of rise in specific gravity is equal to a decrease of 0.787 per cent. of iodine absorption in the case of sperm, and of 0.789 in that of rape oil. Another noticeable fact is the increase in free fatty acids, in which sperm agrees with rape oil, and which may be regarded as an invariable accompaniment of the prolonged oxidation of oils. Lastly, there is a fall in the proportion of unsaponifiable matters to the extent of 1.67 per cent., a circumstance which is not at all surprising, as these alcohols may be in part oxidised to acids during the blowing, and thus be lost in the subsequent saponification.

DISCUSSION.

The CHAIRMAN said that Mr. Thomson had gone into the subject with quite his usual minuteness. The experiment on sperm oil seemed to him to be remarkable.

Dr. CLARK said that Mr. Thomson had referred to the fact that experiments with oil blown on the large scale differed from those made on oil blown in the laboratory. Would this not be due to the fact that on the large scale a higher temperature was maintained while blowing the oil?

Mr. PATTISON asked if Mr. Thomson noticed any increase in the weight, or if there was any product driven off during blowing.

Mr. THOMSON, in reply to Dr. Clark, said, the only difference referred to was the difference in the unsaponifiable matter. With regard to the increase in weight mentioned by Mr. Pattison, they had that point in mind, but had not had time to investigate it. There was no doubt that gases were given off during blowing.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Iron Vessels for Molten Substances. Fahr. Chem. Zeit. 16, 503 and 532—533.

See under X., page 526.

PATENTS.

Improvements in the Process of and Apparatus for Evaporating or Drying. F. M. Robertson, London. Eng. Pat. 20,166, December 10, 1890.

THROUGH a horizontal cylindrical chamber, filled partly with the material to be dried, passes a shaft which carries a screw of about the same diameter as the vessel, which on rotating pushes the material towards the forward end. Openings near both ends of the chamber, on a level with its lowest point, are connected to large outside tubes which run parallel with it, and lead the materials back to the starting point, where they come again under the influence of the screw. A current of hot or cold air is maintained through the upper parts of the chamber, taking up the moisture from the materials and from the exposed surfaces of the screw.—H.

Improvements in Filters. R. W. Barker, London. From H. Goodacre, Lexington, U.S.A. Eng. Pat. 1817, March 12, 1891.

THE improved filter consists of an upright cylinder, with double walls packed with a non-conducting substance. It

* Any of these specifications may be obtained by post by remitting 5s. The price now fixed for all specifications, postage included—to Sir Henry Reader Luck, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

is provided with an air-tight cover connected to a pipe from the source of supply. The draw-off cock is at the lower end, and above it is a box carrying a removable ice-drawer. The filtering medium consists of an upper and lower circular disc, each disc having a central hole, and several concentric series of alternating flanges and slots. Between the two discs is a series of porous filtering cylinders graduated to fit one within the other, and arranged so as to form a number of annular filtering compartments, the upper disc being perforated opposite the upper end of each alternate compartment, and the lower disc opposite the lower end of each intermediate compartment, a bolt passing through the two discs keeping them and the cylinders in position. The unfiltered water passes through the slots in the upper disc at the upper end of each alternate compartment, through the filtering cylinders to the slots and compartments of the lower disc, and the filtered water is thoroughly cooled before being drawn off by flowing round the ice-box.—E. S.

Improvements in Digesting Apparatus. W. H. Munns, London. From G. Kallenberger, Cleveland, U.S.A. Eng. Pat. 6057, April 8, 1891.

The object of this invention is to produce a digesting apparatus in which the process may be carried on in a continuous manner. The invention comprises a conduit, which has a receiving and a discharge end. Two valves are arranged near the discharge end and a chamber is formed in the conduit between the valves. A similar arrangement is provided at the receiving end. Suitable horizontal cylinders, with piston and valves, open at one end into each of the above-mentioned chambers. For details of the mode of working, which here specially refers to the digestion of straw for paper-making, the specification must be consulted.—E. S.

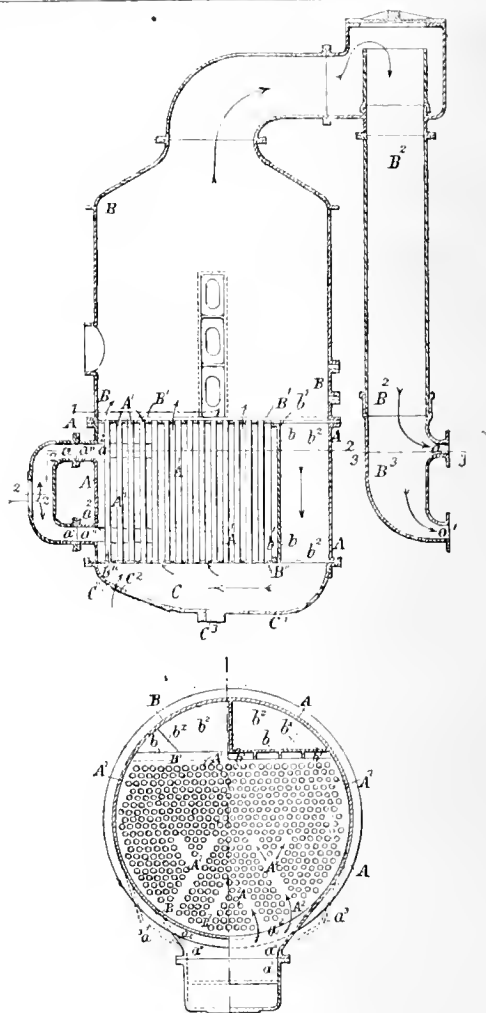
Improvements in Distilling and in Apparatus therefor. P. A. Attout, Paris, France. Eng. Pat. 21,698 (under International Convention), May 16, 1891.

A DESCRIPTION of a rather complicated apparatus is here given, by means of which the liquid to be purified is successively filtered, boiled, cooled, again filtered, and finally distilled.—A. L. S.

Improvements in and relating to Evaporating Apparatus. R. Harvey, Glasgow. Eng. Pat. 11,034, June 29, 1891.

THE improvements have reference to evaporating apparatus of the kind known as multiple effects, in which evaporation of the liquid, such as sugar juice, is effected by vertical steam-heated tubes, held between tube plates fitted in the lower parts of upright evaporating vessels. The improvement consists in filling the steam drum only partially with the evaporating tubes, and leaving a large return passage for the liquid at one side of the chamber, the space being partitioned off from the heating tubes, whereby a better circulation of the liquid is secured during evaporation. The tubes are further set out in such a way as to leave clear passages between them radiating from the point where the heating steam enters the drum or "calandria," with a view to the better distribution of the steam to all the tubes. The accompanying figures show one of the arrangements.

Here A_1 represents the tube, drum, or "calandria," with the enlarged passage, b_2 on one side thereof. The heating steam enters at 2, and reaches the "calandria" through the passages a_{11} , and the farther tubes by the channels A_2 (in plan). The resulting vapour passes through b_2 , and by the corresponding passages a and a_1 to the next evaporator.



EVAPORATING APPARATUS.

—B.

Improvements in Appliances for Saturating Air, Oxygen, and other Gases with the Vapours of Ether or other Volatile Fluids. A. T. Danks, Melbourne, Australia. Eng. Pat. 151, January 4, 1892.

A HORIZONTAL brass cylinder is secured in ends provided with feet or flanges forming a stand. One end is fitted with a cover, having a central hole for the admission of the required air or gas. Inside this cylinder are several concentric cylinders, plain and perforated, arranged alternately, the former being secured to the cover and the other end, the latter being held in position by discs. The annular spaces surrounding the perforated cylinders are filled with flannel, which is wrapped round them, the perforations being left uncovered for the free passage of the air or gas. The volatile fluid on being poured in is absorbed by the flannel; the air or gas is then admitted, preferably under pressure, through the hole in the cover, and after passing through, and between the concentric cylinders and the flannel, passes out at the other end thoroughly saturated.

—E. S.

Improvements in connection with the Use of Aluminium and Aluminium Alloys. G. Pickhardt, Bonn, Germany. Eng. Pat. 581, January 12, 1892.

THIS communication relates to the application of aluminium or any suitable alloy of it, either in the form of plates or

sheets, perforated by drilling or punching, or in the form of gauze woven from spun or drawn wire, to the construction of percolating surfaces of screens, sieves, and similar articles.—D. A. L.

Improvements in Apparatus for rapidly Heating Liquids. B. Zeitschel, Berlin, Germany. Eng. Pat. 1210, January 21, 1892.

THIS is an apparatus for quickly and continuously heating a small current of liquid, and consists essentially of a number of super-imposed hollow annular discs of thin metal connected together by numerous small tubes, encased within a jacketed cylinder of the same material and heated from below by means of a gas burner. The cold liquid enters the cylinder jacket at the lowest point, rising to the top where it enters the uppermost of the hollow discs, whence it finds its way gradually to the lowest. Here it reaches a central upright tube, by which it leaves the apparatus in a heated condition. The whole may be placed within an ornamental stand, its principal use being to provide hot water for baths and for other domestic purposes.—B.

Improvements in Apparatus for Distilling Water in the Presence of Air, and for communicating Heat thereto, and for Supplying Water and Air thereto, and Delivering Water therefrom. N. Hunting, Albany, N.Y., America. Eng. Pat. 3013, February 16, 1892.

THE patentee produces distilled water, aerated without special appliances, by evaporating the impure or saline water at low temperature, and condensing the vapour, in the presence of atmospheric air, thereby approximating to the action of the evaporating process in nature. One of the examples given is a domestic apparatus in connection with a hot-water supply of the ordinary description.

A hot water coil heated from the kitchen fire circulates and heats the water in a cistern from which the vapour rises through a large central tube into a casing overhead which carries a cold-water cistern, the bottom and sides of which are exposed to the rising vapours. These condense and collect in an intermediate annular water space where they remain at a moderately high temperature and can be drawn off as required. An overflow leads thence into another cistern outside, in which the water is allowed to cool and to serve as fresh water supply. Air is admitted and retained in the evaporating cistern and the casing, and circulates therein in contact with the vapours.—B.

Improvements in or Relating to Apparatus for Filtering Liquids. W. P. Thompson, Liverpool. From D. Williamson, New York, U.S.A. Eng. Pat. 3064, February 17, 1892.

THIS invention relates to rotary or centrifugal filters, in which the walls of the rotary vessel are composed of the filtering material and allow the liquid to pass through by the action of centrifugal force. The improvement consists in making the rotary vessel slightly conical, the wider part being at the top, in order to allow the precipitate to work its way slowly upward and out over the edge into suitable channels, thus preventing its accumulation on the sides.

The specification describes a filter constructed on this principle.—B.

Improvements relating to the Utilising of Heated Air in Drying Apparatus. H. Leydecker, Glückstadt, Germany. Eng. Pat. 4224, March 3, 1892.

WHEN materials are dried in direct contact with heated air the current is quickly saturated with moisture and is withdrawn from or drawn through the materials at a rapid rate, leaving them at a comparatively high temperature, whereby a certain amount of heat is wasted.

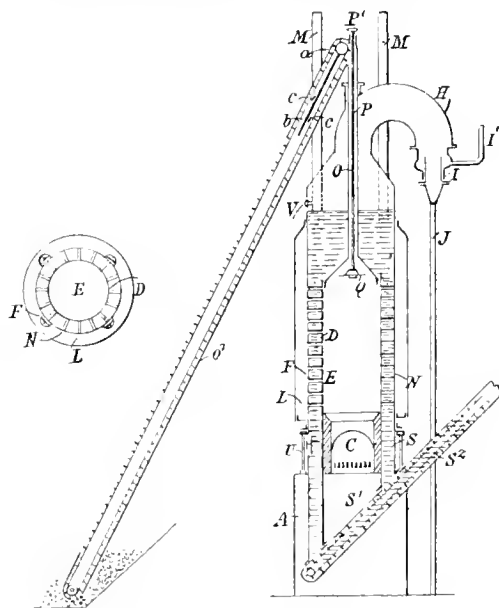
The patentee obviates that loss by passing the moisture-laden air through a range of pipes in a second heating chamber, which pipes give up the acquired heat to another current of air which passes directly through the materials in the second chamber. The second current may then be led through pipes into a third chamber where a third current of air is heated, and the operation repeated until nearly the whole of the heat has been extracted.—B.

Improvements in Indicators for Montejus and Similar Apparatus. J. M. C. Paton, Nottingham, Eng. Pat. 4367, March 5, 1892.

THIS improvement relates to indicators for montejus or other similar apparatus for forcing thick liquids into higher receptacles, filter-presses, or against pressure, in which case ordinary floats for indicating the upper and lower levels of the liquid are inconvenient or impracticable owing to the thickness of the liquid. The inventor inserts two tubes into the upper faces of the vessels, both projecting to a convenient height above the vessel and closed at the top. Small floats are inserted through the tubes, one to the upper and one to the lower level of the liquid, each provided with a rod, and with a cone at the upper end making electrical contact with the closed end of the tube as the liquid reaches the highest or lowest level respectively.—B.

Improvements in Evaporating Apparatus. H. H. Lake, London. From T. Craocy, Bay City, Michigan, U.S.A. Eng. Pat. 5325, March 17, 1892.

THE inventor proposes to evaporate brine and to produce salt in an apparatus indicated in the accompanying figures in vertical and cross section.



EVAPORATING APPARATUS.

F is the outer and D the inner shell of the vertical evaporating vessel. The inner shell forms a fire-box E into which the fuel is admitted through the conical top and passage O, raised thereto by the elevator O₁, and distributed over the fire-grate C by the spreader Q, shaft P, and gearing P₁. The products of combustion pass through the annular boiling pan by the tubes or passages N into the smoke-chamber L, whence they issue by the chimney shafts M M. The vapour is condensed in the hood H by means of the water jet I₁, the combined waters descending

by the well I and pipe J aided, if desired, by a suction pump. The lower end of the evaporating pan is fitted with two water legs S leading to the inclined passage S₁ with elevator S₂ for the removal of the deposited salt. The fuel may be admitted and the salt removed in other convenient ways. U and V are doors for access, and A brick walls supporting the whole.—B.

II.—FUEL, GAS, AND LIGHT.

The Determination of the Temperature of Steam arising from Boiling Salt Solutions. J. Sakurai. Proc. Chem. Soc. 1892 (111), 92—94.

See under Anal. and Scient. Notes, page 551.

Natural Coke in Australia. Eng. and Mining J., February 13, 1892, 206.

NATURAL coke, having a very close resemblance to the manufactured article, has been discovered at the Brelli Pass Mines, New South Wales. The seam, which occurs in a coal measure covering 550 acres, is composed partly of a coal of about the same description as ordinary Australian coal and this coke. The junction of the two is clearly defined, and can be traced through the entire workings. In comparison with the manufactured article, the natural coke is a little the heavier, and contains less fixed carbon and a much smaller percentage of ash and sulphur. It is said that it burns without smoke and can be mined at a cost much below that of the cost of manufactured coke.

—W. S.

The Use of Mineral Oil Residues as Fuel for Glass Furnaces. J. Malyschew. Zap. imp. russk. techn. obszcz. 1891, 25, 98; Chem. Zeit. 16 (Chem. Rep.), 85.

IN the first glass furnace using mineral oil residues put up at Bekunow's glass works in Astrachan, two Nobel hearths were used, the flames being led through a vertical tube into the actual furnace, which was of similar design to the French reflector furnaces. A high temperature was attained by this means, but after four or five days' work the tube which led the gases into the furnace and the stage on which the pots stood, fell in. The second furnace was of oblong form, and was large enough to take eight pots, four on each side, the Nobel hearths being in the middle. Last the flame should impinge directly on the pots, whereby they would have been destroyed after a single fusion, the space between the rows was increased to about two feet. The increased size of the furnace prevented its temperature rising as freely as before, and it was useless for refractory glass. It was, however, at work for four years.

In the plan now adopted, the glass is fused direct on the hearth of the furnace, which closely resembles a Siemens regenerator furnace. There are two gas regenerators and one regenerator for air on each side of the furnace. Into one of the gas regenerators, previously brought to a red heat by a previous part of the operation, petroleum residues are allowed to flow, and are volatilised by contact with the hot bricks, the vapours streaming through red-hot flues and entering the furnace in a gaseous state. Coke remains as a decomposition product of the residues and covers the walls of the regenerator. The layer gradually increases until it partially blocks the exit flues, and causes a rise of pressure in the regenerator which is indicated by the gas blowing off at a safety-valve. The stream of oil is then diverted to the next regenerator, air being at the same time let into the first regenerator, the coating of coke of which burns, and the products of the combustion (which are not completely oxidised) are allowed to enter the furnace

through the same tube as that conveying the mineral oil gas. Fresh air meanwhile is heated in a separate regenerator and meets the combustible gases in the glass furnace itself. While the gas and the air flow into the furnace from one side, the regenerators on the other side are in connexion with the chimney. The products of combustion pass through these regenerators and escape at a fairly low temperature; should coke from a previous operation remain in one of these regenerators, it is not burnt out because the spent gases are free from oxygen. The mineral oil is allowed to flow into the regenerator for a period of 20 to 30 minutes, at the end of which time the influx is stopped altogether for about five minutes in order that the residue in the regenerator may be completely gasified, whereupon fresh oil is turned into the second regenerator.

The furnace gives a high temperature, the flame being white and depositing soot only at the beginning of each period. The soot falls in flakes into the furnace upon the molten glass, an occurrence which is rather an advantage than not. An attempt to burn off the coke more quickly, by blowing in air, proved a failure, as the temperature produced was so high as to fuse the arches of the regenerator. According to the investigations of Schibaew and the author, the heating of glass furnaces by any atomising arrangement is impracticable. Eighty poods of mineral oil residues sufficed to melt 250 poods of glass.*—B. B.

PATENTS.

A Process for Recovering Cyanides from Coal-Gas. W. L. Rowland, Philadelphia, Penn., U.S.A. Eng. Pat. 22,347, December 22, 1891.

THE object is to remove the cyanides from coal-gas into the ammoniacal liquor, and to recover them therefrom. To the water in the washers or scrubbers a soluble salt of iron is added. On passage of the gas, first of all insoluble carbonate, sulphide, or hydrate of iron is obtained, but gradually ferrocyanide of ammonia is formed, the cyanides being thus removed. Excess of iron is to be guarded against, otherwise a large quantity of sulphide of iron is formed, which tends to clog the scrubber. The ammoniacal liquor is subsequently distilled in the usual form of still and the ferrocyanide recovered from the settled waste liquor by precipitation with an acid iron salt; or a second portion of salt of iron or oxide of iron may be added to the liquor just before or during distillation, when by the boiling off of the ammonia in the presence of an excess of the iron salt the soluble ferrocyanide of ammonia will be converted into an insoluble double salt, the ferrocyanide of iron and ammonia, which may be separated afterwards by settling or filtration, in which case it is mixed with insoluble lime salts if lime has been employed in the distillation. The settlings are treated with excess of lime, which decomposes the insoluble ferrocyanide, and a soluble lime salt is obtained which is removed by filtration. The liquor is boiled, and potassium or sodium chloride is added so as to precipitate all the ferrocyanide as double ferrocyanide of lime and alkali, or the liquor may be acidified and boiled, when the double ferrocyanide of lime and ammonia will be precipitated. On boiling with a carbonate of the alkali an alkaline ferrocyanide is obtained.—T. L. B.

Gas Generator for the Distillation of Mineral Oils and the Combustion at a Distance of a Part of the Whole of the Products of the Distillation applicable to Apparatus for Lighting and Heating. L. Sepulchre, Herstat, Belgium. Eng. Pat. 2367, February 8, 1892.

IF but a small portion of the exposed wick of a mineral oil lamp could be caused to ignite and burn, its flame and the heat therefrom would cause a distillation of the oil continually ascending in other parts of the wick, not ignited. It is conceivable that such vapours could be led off by a suitable conduit to a distance, and there ignited and burnt.

* One pood = 36·11 pounds.

It is to carry this idea into effect that the proposals of the patentee are made. The focus of distillation is kept as cool as possible by suitable air-currents arranged to act in jets upon the wick, and the intense focus of combustion is transported not only to a distance from the burner and the wick, but further above the metallic deflectors, and for heating flames, even very high above the deflectors. All the metallic parts of the burner and of the reservoir can thus be at a considerable distance beneath the intense focus of the flame and are consequently absolutely safe as regards heating. The petroleum contained in the reservoir does not vaporise, hence the following important results are obtained: (1) complete safety; (2) constant and uniform feeding of the focus of distillation insured; and (3) the wick being removed from the intense focus of combustion is consumed slowly. The distillation of the gases requiring the combustion of but a small quantity of gas, the result is that a very large part of the totality of the gases distilled is reserved (almost in a state of purity) for the intense combustion, thus effecting a considerable saving of oil per unit of light or of heat, compared with all other known apparatus. With this arrangement absolute suppression of all smell and of all smoke even of all redness at the extremities of the flame is secured; this result is due to the mixture of pure hydrocarbon gases and air, which mixture in the journey between the two distinct foci becomes intimate, and is thus under the best possible conditions for a complete combustion.—D. B.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Preliminary Heater for the Distillation of Petroleum.
F. Fuchs, Chem. Zeit. 16, 314—315.

The author describes the explosion of such heaters in two cases at one of the largest Austrian factories. Such heaters are used in petroleum factories for two purposes: (1) as fuel economisers, and (2) for separating mud-substances contained in petroleum.

The author accounts for the explosion of these heaters as having been occasioned by the pressure of gases produced by the formation of vapours of benzine (petroleum spirit), which had not sufficient room for evaporating, and suggests as a preventive the use of cylindrical heaters instead of the usual square ones, the former being capable of bearing a higher pressure.

The condensing pipes placed in the heater must not be put higher than the centre thereof to prevent them becoming uncovered when the quantity of petroleum in the heater decreases, thus avoiding the formation of benzine vapours.

Those heaters with a dome must also be supplied with two pipes for the removal of the benzine vapours formed, to the condenser, and, finally, they must also be furnished with a manometer and thermometer, which will give the opportunity of controlling both the pressure and temperature of the heater.—P. D.

Percentage of Guaiacol in Wood Creosote, &c. J. Bongartz, Apoth. Ztg. 1891, 6, 697; Chem. Ztg. Rep. 1892, 16, 6.

The official creosote from beech-wood tar consists of a mixture of guaiacol and varying quantities of different creosols and xlenols. The author showed that creosote contains 50—60 per cent. of guaiacol. The latter has a boiling point of 206—207° C. and the specific gravity of 1.133 at 15° C. (not 1.117 as stated in text-books). The guaiacol is soluble at 15° in 85 parts water and eight parts petroleum spirit. Concentrated sulphuric acid gave a slight yellow colour only, whilst the commercial preparations of guaiacol are at once more or less reddened by the concentrated acid.—J. L.

The Use of Mineral Oil Residues as Fuel for Glass Furnaces. J. Malyschew. Chem. Zeit. 16 (Chem. Rep.), 85.

See under 11., page 510.

PATENTS.

Improvements in Apparatus for Extracting Tar and Ammonia from Gas. A. A. Lister, London. Eng. Pat. 7092, April 21, 1891.

THE improved "washer" or apparatus for removing the tar and ammonia from gas consists of a circular drum or casing standing vertically and containing two wooden perforated discs, nearly fitting the interior of the drum and arranged to revolve in opposite directions. The washers are placed in series in line one behind another on a foundation built in ascending steps. Clean water flows into the highest washer and leaves it by an overflow syphon-pipe at about the centre, so that the drum is always about half full of water; thence it flows to the next washer, and so on in succession, emerging from the last or lowest one of the series charged with tar and ammonia removed from the gas. The gas flows through the washers in the opposite direction, entering at the lowest one and leaving at the highest. The wooden discs carry up the water, and by reason of their revolving in contrary directions in each casing, cause the gas to thoroughly mix with the water and so remove the tar and ammonia. Partitions may with advantage be placed in the drums to more completely bring the gas in contact with the wet perforations and surfaces of the discs. Each disc is mounted on a short horizontal shaft entering the side of the casing, the inner ends being supported in bearings carried on a central standard or cross-bar. A pulley is fitted on the outer end of each shaft, and a series of pulleys to correspond is fixed on an over-head shaft, revolution of the discs in opposite directions being obtained by means of open and crossed belts. The wooden discs and their perforations are left quite rough in order more effectually to carry up the water.—D. B.

Improvements in the Manufacture of Ammonia and Tar from Nitrogenous Organic Substances, and in Apparatus relating thereto. W. P. Thompson, Liverpool. From P. Kuntze, Asschersleben, Germany. Eng. Pat. 9052, May 28, 1891.

THIS invention relates to the manufacture of ammonia and tar from nitrogenous organic substances whereby as a source of nitrogen the extensive turf moors and peat bogs are proposed to be utilised. The treatment referred to consists in:—

(a.) Subjecting the broken-up and dried material to charring in a charring furnace, which is heated by producer gases, generated at a later stage of this process, while the resulting mixture of tarry, aqueous, and nitrogenous vapours is submitted to an igniting process for decomposing the organic nitrogenous vapours, in the presence of superheated steam and great surfaces of light red-hot porous refractory matter, into ammonia and hydrocarbons, which are separated and absorbed in the usual manner; and

(b.) Treating the residue from the charring process in a generator situated below the charring furnace by means of hot air and superheated steam in order to liberate the fixed nitrogen and convert it into ammonia, the resulting mixture of ammonia and permanent gases being separated in any well-known manner and the gases applied for heating purposes. The generator for converting the residue into gas is arranged below the charring furnace in order to allow of the residue from the latter dropping directly from the charring furnace into the generator, whereby the process becomes a continuous one.—D. B.

Improvements in Methods of Storing Inflammable Spirits or Highly Volatile Hydrocarbons. B. H. Thwaite, Eng. Pat. 9180, June 1, 1891.

AROUND the storage tank, which may be circular or rectangular, the patentee provides an annular space to serve as a water seal of such depth as will allow the side plates of a cylindrical movable cover to be sealed. Even when the contents of the tank have been withdrawn the cover, which resembles the dome of an ordinary gasometer, is so arranged that there is a continual and close contact of the top plates thereof with the surface of the oil. The upper part of this storage tank cover is made to serve as a water tank, in which a layer of water is maintained. For balancing the weight of the cover an arrangement similar to that used for counterbalancing the moveable part of ordinary gas holders is provided. In order to withdraw from the holder any possible accumulation of gas an escape pipe arrangement is provided, the vertical limb of which works in a vertical and annular hydraulic seal—this allows for the lift of the cover plates. In ordinary gas works the outlet of this seal is connected to the gas mains—the upper part of the space (if any) between cover of oil tank and surface of oil is then connected with the gas distributing mains, by which means any accumulation of gas simply diffuses with the ordinary town lighting gas, and there is always established under the cover a pressure of gas which will itself prevent the admission of air. For tank steamers the patentee uses a sheet iron float cover having flexible connexions to the store tank sides. This cylindrical cover, with its annular or surrounding hydraulic seal, is so formed that it floats on the surface of the oil, and as the latter is withdrawn it falls with the oil, there being sufficient play in the flexible sides to allow this, and thus as the oil is withdrawn there is not left behind any serious accumulation of combustible gas.—D. B.

Gas Generator for the Distillation of Mineral Oils, and the Combustion at a Distance of a Part or the Whole of the Products of the Distillation applicable to Apparatus for Lighting and Heating. L. Sepulchre, Herstat, Belgium. Eng. Pat. 2367, February 8, 1892.

See under 11., page 510.

Improvements in the Manufacture of Asphaltum. J. A. Dubbs, Allegheny, Pennsylvania, U.S.A. Eng. Pat. 3026, February 16, 1892.

THIS invention relates to the manufacture of asphaltum from crude petroleum or petroleum residues, and consists in the combination of the crude petroleum or petroleum residues, when subjected to heat, with sulphur.—D. B.

IV.—COLOURING MATTERS AND DYES.

A Nitro-ketone derived from Camphorsulphophenols. P. Cazeneuve. Compt. Rend. 114, 838—840.

AMETHYLCAMPHOPHENOL-SULPHONE, $C_{11}H_{13}(SO_2)(OH)_2O$, and the isomeric amethylecamphophenolsulphonic acid $C_{11}H_{13}(SO_2.OH)(OH)O$ are the most important camphorsulphophenols derived from camphor.

On treating these compounds with dilute nitric acid, their sulphur is eliminated, with formation of sulphuric acid and at the same time a nitro-compound, $C_{11}H_{11}O.NO_2$. This compound crystallises from alcohol in beautiful yellow needles, melting at from 47 to 48 °C. In small quantities these crystals can be sublimed without alteration, larger quantities distil at about 262 °C. with partial decomposition. The nitro-compound is capable of decomposing the alkaline carbonates, and combines easily with the caustic alkalis, forming salts of the general formula $C_{11}H_{10}M'O.NO_2$, some

of which are distinguished by the dichroism of their crystals. The reaction of this compound with phenylhydrazine, with which it forms an azone, proves it to be a nitro-ketone, which, by means of tin and hydrochloric acid, is converted into a base of very remarkable properties. The nitro-ketone dyes silk yellow without intervention of a mordant, and is, according to the author, probably a derivative of a hydropropylbenzene.—C. O. W.

Grawitz' Recent Patent Improvements in Aniline Black. H. Schmidt. Chem. Zeit. 16, 502—503, and 531—532.

See under VI., page 519.

The Origin of Colour. The Constitution of Coloured Nitro Compounds. H. E. Armstrong. Proc. Chem. Soc. 1892, 112, 101.

IN a communication in March 1888 (Proc. Chem. Soc. 1888, 27), in which the relation between colour and constitution was discussed, it was maintained that in the case of azo-dyes, the rosanilines, methylene-blue, &c. colour was conditioned by a quinonoid structure. The author states the opinion at which he has arrived, viz., that in the case of coloured compounds which have been fairly well studied, it is so generally true that a quinonoid formula is applicable, that the reconsideration of the formula of any coloured substance is warrantable if it do not come within the rule. The term "quinonoid" must, however, be understood to include compounds of the type of benzil; and it is to be noted that in the case of closed chain compounds, it appears to be essential that at least one of the quinonoid carbon atoms be associated with a dyad radicle, and that the ring itself be unsaturated; the presence of two ortho- or para-carbonyl groups in a saturated ring apparently does not condition colour.

Nitro-compounds have from an early period attracted the author's attention, as he states that they do not come within the suggested "colour rule." It is well known, however, that nitro-compounds are not all coloured, many which are commonly described as yellow being obtained white when prepared from pure materials and precaution is taken to remove the phenolic compounds which are so frequently formed even from hydrocarbons during nitration; from this it follows that the nitro-group does not *per se* condition colour. A comparison of ortho- with para-nitrophenol affords striking confirmation of the correctness of this conclusion; the former alone is coloured, being intensely yellow, very volatile, and insoluble in water; whereas para-nitrophenol does not volatilise with steam, and is fairly soluble in water. To what is the difference ascribable? It can scarcely be otherwise than to a difference in structure beyond that involved in a mere difference in the relative positions of the radicles. On comparing the methoxynitrobenzenes prepared from ortho- and para-nitrophenol, Dr. Kipping and the author find not only that they are both colourless, but that they agree as closely in their general properties as do most isomeric compounds containing the same radicles; it is particularly noteworthy that they are about equally volatile with steam. The non-correspondence of the two nitrophenols is rendered far more striking by the correspondence of the compounds prepared from them by methylation, and the conclusion is strengthened thereby that they are not mere position isomerides: it therefore appears justifiable to represent ortho-nitrophenol by a quinonoid formula, which may readily be done by transferring the hydroxylic hydrogen to the NO_2 group, thus transforming it into a dyad group, NO_2H , a change which admittedly attends the formation of so-called nitrosophenol (quinonehydroxime) (cf. Nietzki, Organische Farbstoffe, Berlin, 1889). On this hypothesis, the name *quinoneorthonitroxime* may be suggested for "ortho-nitrophenol."

Para-nitrophenol, although itself colourless, yields coloured metallic derivatives, in the formation of which a change of structure must be involved, according to the view here advocated.

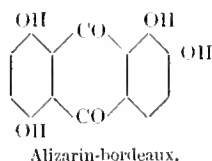
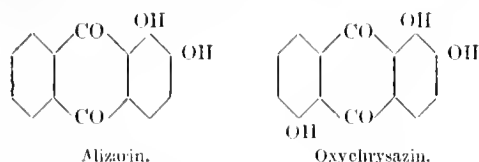
As only para- and ortho-compounds can have quinonoid formulae, it would follow that metanitro-derivatives must be colourless; but actually metanitraniline has an intense yellow colour. There are but two ways out of this difficulty: to assume that metanitraniline either is not (as ordinarily obtained) a uniform substance, or that its structure is not really that of an aminonitrobenzene. There is, however, no other obvious mode of representing it; and although Dr. Kipping and the author have spent much time in trying to deprive it of its colour, they have been unsuccessful; they have found, however, that it yields a practically colourless benzoate, a result regarded as strong presumptive proof in favour of the view that metanitraniline is not what it is supposed to be, and it is therefore proposed to submit it and similar compounds the closest study.

PATENTS.

Improvements in the Manufacture of Colouring Matters derived from Anthraquinone. B. Willeox, London. From the "Farbenfabriken vormals F. Bayer und Co.," Elberfeld, Germany. Eng. Pat. 4871, March 18, 1891.

This specification, comprising 18 claims, is an extension of several earlier patents, and also describes certain new dyestuffs belonging to the alizarin class.

I. Oxychrysazin (oxyanthrafin), as shown by the following formulae, occupies an intermediate position between alizarin and alizarin-bordeaux.



If oxychrysazin be treated according to Eng. Pat. 8725 of 1890 (this Journal, 1891, 537) it is converted into a colouring matter resembling alizarin-bordeaux, the reaction in this case also taking place in two stages. By substituting erythroxyanthraquinone for oxychrysazin in the above process a dyestuff is obtained resembling in its properties that prepared from anthraquinone according to Eng. Pat. 18,729 of 1890 (this Journal, 1891, 917).

II. In Eng. Pat. 18,729 of 1890 and Eng. Pat. 1883 of 1891 (this Journal, 1892, 29) the preparation of colouring matters is described from anthraquinone or dichloro- or dibromo-anthracene by the action of sulphuric anhydride. The same process can be applied to substances such as tribromo- and tetrabromo-anthracene, dibromo-anthracene-tetrabromide, bromo-anthraquinone, and anthranol. The colouring matters are similar to those already described, and dye wool mordanted with alumina salts a violet, and with chromium salts a blue colour.

III. By treating alizarin-bordeaux in a sulphuric acid solution with oxidising agents according to Eng. Pat. 12,715 of 1890 (this Journal, 1891, 759) it is converted into a new colouring matter which is now termed "Alizarin-cyanine R." According to Eng. Pat. 17,712 of 1890 (this Journal, 1891, 917), an intermediate product formed in this process gives a new colouring matter when treated with ammonia. It has now been discovered that two cyanines are produced according to the conditions under which the oxidations are performed. If the temperature be kept low and an insufficient quantity of manganese dioxide added, a product is obtained called "alizarin-pentacyanine." By employing a higher temperature and more manganese dioxide, using

arsenic acid or acting on alizarin-pentacyanine with sulphuric acid alone, alizarin-hexacyanine is produced. The two substances are pentahydroxy-anthraquinone and hexahydroxy-anthraquinone. The former is more easily soluble in nitrobenzene and glacial acetic acid, whereas the latter dissolves in sulphuric acid to a redder colour than the pentacyanine and possesses a stronger fluorescence. The solutions exhibit characteristic absorption bands.

IV. In the preparation of the above-mentioned alizarin-penta- and hexa-cyanines by means of manganese dioxide, intermediate compounds are formed which have been termed anthra-diquinones, since they contain a true quinone group in addition to the double ketone group of anthraquinone. By reduction with sulphurous acid they are converted into hydroquinones which are the cyanines, and hence these quinones may be produced by oxidation of the cyanines. By dissolving Alizarin-cyanine R in potash solution and passing air through the liquid the potassium salt of the quinone separates out. The salt is then decomposed with an acid at a low temperature.

V. The formation of these quinones and their reduction to the cyanines points to an improvement in the method for the production of the latter on that described in Eng. Pat. 12,715 of 1890. The melt obtained by treating alizarin-bordeaux with manganese dioxide in a sulphuric acid solution is poured into water and treated with sodium sulphite until it smells of sulphurous acid. The mixture is then boiled up, filtered, and the dyestuff re-dissolved.

VI. By oxidising the cyanines in an ammoniacal solution by means of air, or by the action of ammonia on those quinones described under IV. corresponding to the cyanines described under III., similar colouring matters to Alizarin-cyanine G are obtained, the preparation of which is described in Eng. Pat. 17,712 of 1890.

VII. The processes described under IV. and V. can also be applied to the quinoline derivative of alizarin-bordeaux or dihydroxy-alizarin blue of Eng. Pat. 8725 of 1890, or to the hexahydroxy-anthraquinone produced according to Eng. Pat. 17,712 of 1890, or Eng. Pat. 18,729 of 1890. The diquinones obtained from these bodies can also be treated with ammonia forming quinone-imides and giving somewhat greener shades than the original products.

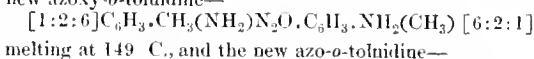
—T. A. L.

The Production of New Bases and of Azo-Colouring Matters therefrom. Brooke, Simpson, and Spiller, Limited, and A. G. Green, Hackney Wick, Middlesex. Eng. Pat. 6376, April 14, 1891.

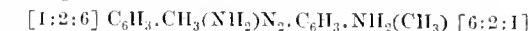
New azoxy- and azo-derivatives of *o*-toluidine are obtained by the alkaline reduction of nitro-*o*-toluidine—



which melts at 92° C. The nitro-*o*-toluidine is formed by reducing fluid binitro-toluene (Bernthsen, Ber. 15, 3016, this Journal, 1883, 169), and is also obtained together with the nitro-*o*-toluidine melting at 107° C. by the nitration of *o*-toluidine in sulphuric acid at a low temperature. In the latter case the nitro-*o*-toluidine melting at 92° C. is precipitated from the mother-liquor from which that melting at 107° C. has separated, by the addition of an alkali. The new azoxy-*o*-toluidine—



melting at 149° C., and the new azo-*o*-toluidine—



melting at 175° C. are produced in a similar manner to that described in Eng. Pat. 14,304 of 1889 (this Journal, 1891, 131) for the production of isomeric bodies from the nitro-*o*-toluidine melting at 107°. They are similarly employed for the production of dyestuffs by diazotisation and combination with naphthol and naphthylamine sulphonic acids, and with phenols and amines generally and their sulphonic acids. A colouring matter dyeing unmordanted cotton a brilliant scarlet unaffected by acids is obtained by combining diazotised azoxy-*o*-toluidine with 1:4 naphthol sulphonic acid in an alkaline solution. If azo-*o*-toluidine be employed the shade is somewhat bluer.—T. A. L.

The Manufacture and Production of New Diazo-Dyes, and of Intermediate Products in their Preparation. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 7713, May 4, 1891. Second Edition.

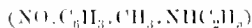
THE 1:1'-amido-naphthol sulphonic acid described in Eng. Pat. 9676 of 1890 (this Journal, 1891, 538) is capable of combining with diazo-compounds to form disazo derivatives, which dye wool a deep blue black from an acid bath. Various amines may be employed such as aniline, *o*- and *p*-toluidine, *m*- and *p*-xylylene, *p*-anisidine, α -naphthylamine, and acetyl-*p*-phenylene diamine. Also the isomeric 1:1' amido-naphthol sulphonic acid, obtained by fusing with a caustic alkali the naphthylamine disulphonic acid prepared by sulphonating naphthylamine sulphonic acid 8 of Ger. Pat. 40,571, can be substituted for the above mentioned 1:1' amido-naphthol sulphonic acid in the formation of these disazo compounds. The combination is performed in the well-known manner, but preferably by allowing one molecular proportion of the diazo-compound to combine in a faintly acid solution of one molecular proportion of the amido-naphthol sulphonic acid, and afterwards making the solution alkaline and running in the second molecular proportion of the diazo-compound which may be derived from the same amine as the first or from a different one or from a sulphonic acid such as sulphanilic acid.—T. A. L.

Production of Blue Colouring Matters. O. Imray, London. From the "Farbwerke vormals Meister, Lucius, and Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 7961, May 8, 1891.

THE acid colouring matters known as "Patent Blues," described in Eng. Pat. 12,796 of 1888 (this Journal, 1889, 701; 1890, 286), and Eng. Pat. 11,822 of 1888 (this Journal, 1889, 980), which are sulphonic acids of *m*-oxy- and *m*-amido-tetra-alkyl-diamidotriphenyl carbinols yield blue colouring matters of great value when oxidised. The oxidation may be performed by means of fuming sulphuric acid, but preferably it is conducted in an aqueous solution by means of iron salts or chromic acid. 24.6 kilos. of tetra-ethyl patent blue (the monocalcium salt of the disulphonic acid of *m*-oxy-tetra-ethyl-diamido-triphenyl carbinol) are dissolved in 200–300 litres of water, boiled, and a solution of 8 kilos. of CrO_3 in water slowly added. After about two hours, when the oxidation is complete and the solution is free from chromic acid, the liquid is filtered and evaporated to dryness. The colouring matters dye wool and silk in uniform blue shades from an acid bath fast to soap, light, and air.—T. A. L.

Production of Blue Dyestuffs. S. Pitt, Sutton. From L. Cassella and Co., Frankfurt-on-the-Maine, Germany. Eng. Pat. 8407, May 15, 1891.

A PROCESS for obtaining blue dyestuffs for mordanted cotton of the thionine class from *o*-toluidine. 16.5 kilos. of the nitro-amine of mono-ethyl-*o*-toluidine, are dissolved in 150 kilos. of concentrated hydrochloric acid at about 5° C. After standing some time, the clear solution, which contains the hydrochloride of *p*-nitroso-ethyl-toluidine—



is diluted with water, cooled with ice and reduced with 15 kilos. of zinc dust. When the solution is colourless, the free acid is neutralised and 24.8 kilos. of sodium thiosulphate and 10 kilos. of potassium bichromate are added. A solution of mono-ethyl-*o*-toluidine hydrochloride is then poured in, and after the addition of 120 kilos. of zinc chloride, the whole is oxidised by means of 30 kilos. of potassium bichromate, raised to the boil and kept boiling for an hour. The dyestuff which separates out is mixed with chromium oxide, from which it is separated after filtration by extraction with hot water and precipitation with salt, when it forms small green crystals.—T. A. L.

The Manufacture and Production of Colouring Matters derived from Anthraquinone and Alizarin Blue. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 8702, May 21, 1891.

THE anthraquinones (alizarin cyanine quinones) described in Eng. Pat. 4871 of 1891 (see above) for new mordant dyestuffs by condensation with phenol, dihydroxy-benzenes and their homologues, α - and β -naphthol and their carboxylic acids or other substitution products. The condensation is most easily effected by means of sulphuric acid, and hence the formation of these new dyestuffs starting with alizarin bordeaux may be performed in one operation without separating the quinone. New colouring matters are also obtained by condensing with resorcinol, salicylic acid, *p*-hydroxy-benzoic acid, and *o*-eresotinic acid, the quinone of hexa-hydroxyanthraquinone isomeric with alizarin hexacyanine described in Eng. Pat. 18,729 of 1890, and Eng. Pat. 17,712 of 1890 (this Journal, 1891, 917). The alizarin bordeaux described in Eng. Pat. 8725 of 1890 (this Journal, 1891, 537), its analogues and the polyhydroxy anthraquinones obtained therefrom by further oxidation, and other compounds of this class such as Alizarin blue-green, Alizarin-green, and Alizarin indigo blue described in Eng. Pat. 14,353 of 1888 (this Journal, 1889, 770) and Eng. Pat. 15,121 of 1888 (this Journal, 1889, 772), form new dyestuffs by treatment with ammonia. The reaction taking place appears to be the substitution of an amido for a hydroxy group. It is generally complete at ordinary temperatures, but heating with an excess of ammonia on the water-bath is sufficient in all cases. The dyestuffs thus obtained differ from the originals by the redder or yellower colours of their solutions in sulphuric acid, and this test serves to indicate the end of the reaction. With chromium mordants on wool, these colouring matters dye a greenish blue.—T. A. L.

Production of Blue Colouring Matter. O. Imray, London. From the "Farbwerke vormals Meister, Lucius, and Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 9943, June 11, 1891.

By the action of fuming sulphuric acid on anthrachrysone (a derivative of anthraquinone) a new colouring matter is obtained which gives blue shades on chrome-mordanted wool and cotton, fast to light and fulling. Anthrachrysone is stirred into fuming sulphuric acid at a temperature not exceeding 50° C. until the solution becomes bluish-green. It is then poured on to ice, boiled, dissolved in an alkali, and precipitated by an acid from this solution. The colouring matter forms a black powder dissolving in concentrated sulphuric acid with a violet red, in ammonia with a bluish violet, and in dilute caustic soda with a reddish-brown colour.—T. A. L.

The Manufacture and Production of New Basic Dyestuffs. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 10,619, June 22, 1891. Second Edition.

AN extension of Eng. Pat. 4476 of 1888 (this Journal, 1889, 280), which describes the preparation of dyestuffs of the Nile blue series obtained by the condensation of the nitro-*o*-dimethyl- and diethyl-*m*-amido phenols with α -naphthylamine and its derivatives, such as ethyl- α -naphthylamine and di-methyl- α -naphthylamine. The present specification describes the employment of benzyl- α -naphthylamine in place of α -naphthylamine and its derivatives mentioned in the preceding patent. Benzyl- α -naphthylamine has been obtained by the action of benzylamine on α -naphthylamine, but is more easily prepared by condensing two molecules of α -naphthylamine with one molecule of benzylchloride in toluene at the temperature of the water-bath. The hydrochloride of the base is obtained by passing hydrochloric acid gas through its ethereal solution. The following proportions are given for preparing a greenish-blue dyestuff. About 69 kilos. of nitroso-diethyl-*m*-amido-

phenol hydrochloride and 54 kilos. of benzyl- α -naphthylamine hydrochloride in 100 litres of spirit are heated on the water-bath under a condenser. The reaction sets in at about 60° C., and sufficient heat is evolved to raise the solution to the boil. It is kept boiling for 3 to 4 hours and then allowed to cool, when a crystalline precipitate separates which can be used directly for dyeing and printing. Other salts than the hydrochlorides may be employed in the above condensation, or one of the components may be in the form of base, but in this latter case it is preferable to use acetic acid as a solvent. The colouring matter obtained from nitroso-dimethyl-*m*-amido-phenol gives a redder shade of blue, and its hydrochloride is sparingly soluble in water, so that it is best employed as its more soluble sulphate.

—T. A. L.

Improvements in the Manufacture of Colouring Matters.

H. H. Lake, London. From K. Oehler, Offenbach-on-the-Maine, Germany. Eng. Pat. 10,861, June 25, 1891.

By combining diazotised benzidine or tolidine with one molecule of amido-hydroxy- α -naphthalene disulphonic acid, and then with *m*-hydroxy-diphenylamine or tolylphenylamine, blackish-blue colouring matters for cotton are obtained. Eleven kilos. of tolidine (or the equivalent quantity of benzidine) in 75 kilos. of muriatic acid of 12.5 per cent. strength and 500 litres of water are cooled to 0° C., diazotised with 7 kilos. of sodium nitrite, and poured into a solution of 18 kilos. of amido-hydroxy- α -naphthalene disulphonic acid in 700 kilos. of 1.5 per cent. caustic soda. The intermediate compound thus formed is converted into the new dyestuff by adding a solution of 9.25 kilos. of *m*-hydroxydiphenylamine, or of 10 kilos. of *m*-hydroxy-tolylphenylamine, in 250 litres of water and 2 kilos. of caustic soda. The colouring matter is precipitated by salt, pressed, and dried. The sodium salts of the new dyestuffs are blackish, bronze-coloured powders, soluble in water, giving red to bluish-violet solutions, from which concentrated hydrochloric acid precipitates a bluish-violet acid, which dissolves in concentrated sulphuric acid with a blue colour.—T. A. L.

The Manufacture and Production of New Dyes of the Rosaniline Series and of New Materials therefor.

J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 11,275, July 2, 1891.

By condensing resorcinol with *p*- or *o*-toluidine, or with *m*-xylylene the following compounds are respectively obtained:—*m*-hydroxy-phenyl-*p*-tolylamine, *m*-hydroxy-phenyl-*o*-tolylamine, and *m*-hydroxy-phenyl-*m*-xylylamine. It has been discovered that the alkylated derivatives of these compounds when condensed with tetra-alkyl-diamidobenzophenones yield basic colouring matters of the rosaniline series, and these on sulphonation give soluble acid dyestuffs. The following details of the various operations are given:—

1. About 100 kilos. of *m*-hydroxyphenyl-*p*-tolylamine, 20 kilos. of caustic soda, 400 kilos. of methyl alcohol, and 40 kilos. of methyl chloride, are heated in an autoclave for 24 hours to 115°–120° C. The methyl alcohol is then distilled off, and the residue washed first with caustic soda, then with water, and finally dried at 100°. The *m*-methoxyphenyl-*p*-tolylamine thus obtained is sufficiently pure for the preparation of dyestuffs. It forms a thick oil, distilling with decomposition at about 360° C., and is preferably distilled in vacuo. After standing some time it solidifies, and can then be crystallised from benzene, when it melts at about 68° C.

2. The condensation with tetramethyldiamidobenzophenone is performed in a similar manner to that described in Eng. Pats. 4850 and 5038 of 1884 (this Journal, 1885, 204, 279). About 22 kilos. of *m*-methoxyphenyl-*p*-tolylamine, 27 kilos. of tetramethyldiamidobenzophenone, and 35 kilos. of phosphorus oxychloride are diluted with 8 kilos. of toluene, and heated on the water-bath in a vessel provided with a stirrer for about half an hour. The melt is then poured into brine, boiled and extracted with toluene or heavy oil. The colouring matter which remains behind

is dried at 60° C., and powdered. It is slightly soluble in water, more readily in alcohol, and gives violet-blue shades on wool and on cotton mordanted with tannin.

3. This product is sulphonated by mixing it with an equal weight of anhydrous sodium sulphate, and adding the mixture to 2½ times its weight of fuming sulphuric acid containing 24 per cent. of SO₃, the temperature not being allowed to rise above 10° C. When a sample is completely soluble in alkali, the melt is poured into ice water, and the solution nearly neutralised with caustic soda. The dyestuff is then precipitated with sodium sulphate, filtered, and dried. It dyes wool violet-blue from an acid bath.

—T. A. L.

New or Improved Colouring Matter or Dye and Methods of Extracting and Utilising the Same. E. Schweich and E. Bucher, Wittington Park, Chester. Eng. Pat. 11,298, July 3, 1891.

A BROWN mordant colouring matter, to which the name "Prosopine" is given, is obtained from the "heartwood of the species '*prosopis*' commonly called cashaw tree," by some process of extraction, and the extract can be used, together with a mordant, either by itself or with some other dyewood, for dyeing, printing, or staining, &c.—T. A. L.

Process of Dyeing Silk Solid Black, by Means of Alizarine, Flacopurpurine, Anthrapurpurine, and Mixtures of these Bodies. O. Imray, London. From the "Farbwerke vormals Meister, Lucius und Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 11,327, July 3, 1891.

THE methods for dyeing silk black and dark brown with logwood do not give colours fast to acids, soap, or alkalis. The process described in the present specification gives fast blacks, produced as follows:—Boiled silk is mordanted with ferric sulphate of 30° B., well soaped and treated with the quantity of potassium ferrocyanide and hydrochloric acid corresponding to the oxide of iron on the fibre. The silk in this way receives a grounding of Prussian blue. It is then passed into a bath at the boil containing cutch and tin salt corresponding to the degree of weightening required, and after washing, having been worked in a second bath of cutch, it is ready for dyeing. It can also be prepared by mordanting the crude or boiled silk with tin salt solution of 30°, washing and treating with ferric sulphate and potassium ferrocyanide as described above, and finally passing it through a boiling bath of cutch, when after washing it can be dyed. For this purpose the silk, treated according to either of the foregoing methods, is worked for about half an hour at 65° C., in a weak soap bath containing 2–2½ galls. of water to every pound of silk, a quantity of soap, varying from 15–20 per cent. of the weight of the silk, according to the hardness of the water, and a quantity of alizarin from 20–50 per cent. of the weight of the soap, sufficient to produce the desired shade. The temperature is then raised to the boil, and the silk worked at 95° C. for three-quarters of an hour. Finally, a further quantity of soap is added, the bath is heated to boiling, and the silk worked for half an hour, in order to give it lustre and touch. After dyeing, the silk is washed for a few minutes in a bath at 30° C., and made slightly alkaline with sodium carbonate. It is then well washed, treated with an acid, some size, and an oil emulsion, and is finally shaken out and dried. The colour thus obtained is said to be fast to acids, alkalis, and sunlight.—T. A. L.

Manufacture of Yellow Azo-colouring Matters Striking on Mordants and Absolutely Fast against the Action of Felling, Soap, and Light. O. Imray, London. From the "Farbwerke vormals Meister, Lucius und Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 11,328, July 3, 1891.

THE colouring matters described are obtained by combining diazotised diamido-sulphobenzide (diamido-

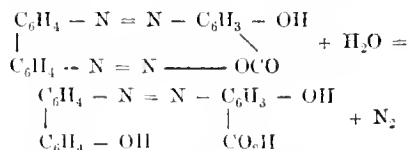
diphenylsulphone), its derivatives and homologues with hydroxy carboxylic acids. The colouring matters dye chrome-mordanted wool fast to fulling, soap and light. In the case of the colouring matters from diazotised diamido-diphenylsulphone and salicylic acid and from diazotised diamido-diethoxy-diphenyl-sulphone this fastness is absolutely perfect. 12.4 kilos. of diamido-diphenyl-sulphone and 12 kilos. of hydrochloric acid are dissolved to a 10 per cent. solution in water and diazotised by the addition of 12 kilos. of hydrochloric acid and a solution of 6.9 kilos. of sodium nitrite in 35 litres of water. The tetrazo compound which separates out from moderately dilute solutions is added at 0° C. to a 10 per cent. solution of 16 kilos. of *o*-cresotinic acid and 33 kilos. of calcined sodium carbonate. The combination is complete in 12 hours when hydrochloric acid is added, the colouring matter filtered off and used preferably as a paste. In addition to the derivatives and homologues of diamido-diphenyl-sulphone, the diamido-dinaphthyl-sulphones may also be employed.—T. A. L.

Improvements in the Manufacture of Basic Naphthalene Colouring Matters, and of Sulpho Acids thereof. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik" Ludwigshafen, Germany. Eng. Pat. 11,629, July 8, 1891.

By heating together rosindone with *o*-toluidine or *m*-xylydine and the hydrochlorides of the two latter, colouring matters are obtained which give red shades different from those given by phenyl-rosinduline. These homologues of phenyl-rosinduline as well as that one obtained by employing *p*-toluidine give mono-sulphonic acids when treated with ordinary sulphuric acid at the temperature of the water-bath (cf. Eng. Pat. 15,259 of 1888; this Journal, 1889, 877). On further sulphonation with fuming sulphuric acid, disulphonic acids are obtained which are homologues of azo-carmines and are yellowish-red to bluish-red dyestuffs readily soluble in hot, but sparingly soluble in cold water, especially in presence of mineral acids. The bases *o*-tolyl-rosinduline and *m*-xylyl-rosinduline yield higher sulphonic acids on further sulphonation which are readily soluble in cold water. The *p*-tolyl-rosinduline decomposes on further sulphonation.—T. A. L.

Improvements in the Manufacture of Colouring Matters for Dyeing and Printing derived from Benzidine and its Analogues. B. Willeox, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 11,663, July 9, 1891.

By reacting with one molecule of tetrazo-diphenyl chloride or one of its homologues or derivatives on one molecule of an aromatic hydroxy carboxylic acid, such as salicylic acid, *o*- or *m*-cresol carboxylic acid or resorcylic acid, an intermediate product is obtained which, on boiling in an alkaline, neutral or acid solution evolves nitrogen and is converted into a derivative of *p*-amido-hydroxy-diphenyl. The following equation illustrates the course of the reaction—



The dyestuffs obtained by this process are valuable not only on account of their dyeing mordanted wool, but also because they can be employed in calico-printing, in this respect resembling alizarin. The colours produced are yellow varying from a red to a brown shade.—T. A. L.

The Production of Fast Yellow Mordant Dyeing Azo Dyestuffs. A. Bang, Leeds. From G. A. Uahl, Barmen, Germany. Eng. Pat. 960, January 18, 1892.

SUBSTITUTES for fustic are obtained by diazotising the α -, β -, γ -, or δ -, β -naphthylamine sulphonic acids or the α -naphthylamine sulphonic acids of Laurent or Piria, and combining them with salicylic acid and *o*- and *m*-cresotinic acids. On chromium mordants these colouring matters like fustic are absolutely fast to milling and have moreover the advantage of being faster to light. They also dye unmordanted wool fast to milling and light. The shades obtained from the β -naphthylamine sulphonic acids are greenish yellow, those from the α -naphthylamine sulphonic acids being more orange-yellow. Similarly salicylic acid gives a greener shade than the cresotinic acids. (cf. Eng. Pat. 17,583 of 1887; this Journal, 1888, 839).—T. A. L.

Improvements in the Manufacture of Colouring Matters H. H. Lake, London. From A. Leonhardt and Co., Mühlheim-on-the-Maine, Germany. Eng. Pat. 1231, January 21, 1892.

By oxidising the rhodamines obtained, for instance, from dialkylated *m*-amidophenol or *m*-amidocresol and phthalic acid, by means of potassium permanganate, dyestuffs of a more yellowish-red shade are produced. The colouring matters themselves or their leuco-compounds may be employed. Eight kilos. of rhodamine from succinic acid are dissolved in 400 litres of water and 20 litres of acetic acid, and oxidised in the cold by the addition of 4 kilos. of potassium permanganate in 100 litres of water. The whole is then boiled up, filtered, and the colouring matter precipitated by the addition of zinc chloride and salt. By employing less permanganate the product is more bluish-red. The dyestuffs obtained according to this invention are basic, forming salts with acids. They dissolve in water or spirit, giving scarlet solutions with a brilliant green fluorescence, and are adapted for dyeing or printing mordanted or unmordanted cotton or silk, the latter when dyed showing a yellowish fluorescence.—T. A. L.

Improvements in the Production of Black Dyes suitable for Dyeing Wool. S. Pitt, Sutton. From L. Cassella and Co., Frankfurt-on-the-Maine, Germany. Eng. Pat. 2718, February 11, 1892.

AN extension of Eng. Pat. 9214 of 1885 (this Journal, 1889, 700), and of Eng. Pat. 7067 of 1889 (this Journal, 1890, 385). A diazotised amine or sulphonic acid thereof is combined with α -naphthylamine monosulphonic acid (1.6 or 1.7). The amidazo-sulphonic acid thus obtained is diazotised again and combined with phenols or amines or their derivatives. 24.5 kilos. of sodium naphthionate are diazotised and combined with 24.5 kilos. of 1.6 or 1.7 α -naphthylamine sodium sulphonate in presence of sodium acetate. The amidazo-disulphonic acid thus formed is diazotised by means of muriatic acid and 7 kilos. of sodium nitrite, and separates as the diazo compound. If combined with 35 kilos. of β -naphtholdisulphonic acid R in an alkaline solution a black dyestuff is obtained which resembles naphthol black.—T. A. L.

The Manufacture of New Colouring Matters or Dyes. P. Monner, St. Fons, Lyons, France. Eng. Pat. 4677, March 9, 1892.

COLOURING matters to which the name "Anisolines" is given are produced by heating salts of the rhodamines with the haloids of methyl, ethyl, amyl, or benzyl, forming alkylated rhodamines.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Vulcanisation of Waterproof Fabrics. Industries, 12, 1892, 498.

Of late years there has been a great development of the waterproof trade in the direction of increased variety in the fabrics employed. In fact, 15 years ago the number of cloths used for the purpose were very few, but at present we see an almost endless variety of wool, silk, and cotton goods, alone and in combination with each other. Scotch and Yorkshire woollen tweeds now constitute the largest portion of the dealer's stock-in-trade, the black or blue paramatta—a mixture of wool and cotton—being conspicuous. The nature of the cloth has to be considered before it is submitted to any vulcanising process. To briefly summarise the "spreading" part of the process, it may be said that the rubber is mixed with sulphur or other curing agents and is rolled out into thin sheets and dissolved to a paste in coal naphtha. This paste is then spread on the cloth by the knife edge of what is known as the "spreading machine." The spread cloth passes then over a steam chest, whereby the naphtha is volatilised and the rubber left as a thin coat. Several of these coatings are required to make up the necessary thickness of proof, and then the material is ready to be vulcanised. This is done by one of three processes, viz., (1) steam cure, (2), cold cure (Parke's process), (3) dry heat.

In the first process the proofed cloth is rolled round a sheet-iron drum, and exposed in a "vulcan pan" to high-pressure steam at about 275° F. for an hour or more. This process is not much used for fabrics, as it is found impossible to ensure equal heating owing to the non-conducting nature of the material, whereby the outside layer is overheated before the inner is heated sufficiently. In the second, or cold cure process, the vulcanising agent is chloride of sulphur. This is dissolved in bisulphide of carbon in the proportion of 1 to 40 parts by volume. In applying this process the rubber surface is made to pass over a roller which is kept revolving in the solution. In spite of the disagreeable nature of the chemicals, this process has been and is very largely used, though the "cure" is not a complete one, being merely effected on the surface where the solution has come in contact with the rubber. This process is not considered a very satisfactory one, and the use of the mercuric liquid bisulphide of carbon, with its attendant fire risks, is likely to become obsolete, a satisfactory substitute having been found for it. The liquid being merely a vehicle for the chloride of sulphur to ensure the absorption of the latter by the rubber, it is clear that as long as it has a solvent action on the rubber its chemical constitution is of no great moment.

The cold cure, so long without a rival, has been supplanted to a great extent by the third, or "dry heat process," which, although used to a certain extent for some time, was not worked on a large scale until, in 1877, Mr. Waddington invented his improved dry-heat stove. This stove consists of a long wooden chamber lined with zinc and fitted in its interior with a system of rollers so arranged that the cloth occupies, in its passage, the necessary time to effect vulcanisation at the one operation, and, being continually on the move, no portion can receive more or less heat than another. In this way the rubber coating is vulcanised all through, and not merely on the surface, as in the cold cure. It may be asked whether the dry heat injures the textile fabrics? There is no fear of this if the process is carefully carried out, and the heat not allowed to rise higher than is absolutely necessary. When cured by this process the goods can be depended on to remain soft and pliable during cold weather, and, what is even of more importance, they will not decompose by being kept in stock in a hot climate. It is to this dry heat method of vulcanising that Mr. Fawcitt referred (this Journal, 1889, 368), and he claims that, by the employment of metallic iodides—notably those of antimony, lead, and tin in conjunction with sulphur—the proof can be cured in a shorter time and at a lower heat than when sulphur alone is used. The writers agree with the author that the cost of the iodide is likely to militate against its adoption.

How is this vulcanising action to be explained? The reply is made that there really is very little known regarding the true nature of the change, whether it is a true chemical reaction or merely a physical fact. It is generally stated that in the ordinary vulcanising process, when a mixture of rubber and sulphur is submitted to high-pressure steam for an hour or so, 3 per cent. of sulphur is chemically combined, the rest being physically held and capable of abstraction by solvents. Some expert experience, however, leans to the opinion that not more than $\frac{1}{2}$ per cent. of sulphur is chemically held if insolubility in caustic solutions is to be taken as a proof of chemical combination. The reaction with chloride of sulphur is generally allowed to be due to the substitution of hydrogen in the rubber by chlorine. That a substitution compound exists is shown by passing a current of chlorine gas into a solution of rubber in chloroform, when a white solid body is formed, and hydrochloric acid is evolved. A similar reaction occurs in the case of bromine, though we have it on the authority of Gladstone and Hibbert that no reaction whatever occurs in the case of iodine. Chloride of sulphur is found to be the most practicable way of applying chlorine to rubber, though many other compounds of chlorine act in a similar manner.

—W. S.

PATENTS.

Improvements in the Treatment of Vegetable Fibrous Matters to obtain Fibres therefrom. P. W. Nicolle, Portland Place, Jersey, and J. Smith, Camberwell. Eng. Pat. 18,284, November 13, 1890.

For obtaining the fibrous portions of vegetable substances, e.g., *Behmeria nivea*, flax, hemp, New Zealand flax, &c., these materials are steeped in a solution of creosote or phenol, or of any tar acids. A solution of any of these acids in combination with an alkali, of a strength of about one-half per cent. by weight, may also be employed. For flax and hemp a cold solution is used for 24 or 48 hours. Refractory vegetable substances, such as ramie bark, should first be placed in a cold solution for 24 hours, then passed through rollers, and finally treated with a boiling solution for three to six hours. The pulpy substance of New Zealand flax is removed by means of corrugated rollers or knives, &c. At the end of the process the fibres are passed through rollers and washed.—H. S.

Improvements in Machines for Decorticating Ramie and other Textile Plants. G. E. N. I. E. Subra, Paris, France. Eng. Pat. 19,100, November 25, 1890.

The object of this invention is the complete removal of the ligneous matter and of the leaves of ramie, as well as of the epidermis which covers the fibrous parts of the plant. The machine used for this purpose consists of two pairs of cylinders, one pair being smooth or slightly fluted and both turning in the same direction. This pair is for the preliminary crushing of the ligneous matter of the stalks. The second pair, the stripping cylinders, by which the wood, the leaves, and the epidermis are entirely broken and disengaged, are formed of metal blades or plates firmly fixed upon the parallel shafts, and forming grooves. Their speed is greater than that of the crushing cylinders, and the latter therefore detain the stalks long enough to give the stripping cylinders sufficient time to effect their work. The plates of these cylinders are so arranged that they pass between each other when rotating. The edges of the blades are either rounded, square, or sharp, the last form being specially intended for green ramie. The disengaged wood, leaves, and epidermis fall to the ground without the possibility of choking the stripping cylinders. When the operation has taken place upon half the length of the stalks, the operator removes them and presents the opposite or unworked half to the cylinders. The two pairs of cylinders may be arranged horizontally, vertically, or obliquely, and are mounted upon wooden or metal frames of suitable shapes and dimensions. The machine may be driven by hand or other power.—H. S.

Process for Cleansing or Purifying Woollen Fabrics. C. D. Abel, London. From Philips and Mathée, Rheinland, Germany. Eng. Pat. 19,252, November 26, 1890.

THE patentees have found that sulphurous acid, sodium bisulphite, and all compounds which give off sulphurous acid on the addition of an acid, have the property of removing from woollen fabrics the impurities which are accumulated during the spinning, weaving, and fulling processes. These impurities become to a certain extent insoluble under the influence of the usual carbonising process, and are detrimental to the dyeing of the fabrics, producing stripes, spots, and other defects. To effect their removal the fabrics are, after the carbonising process, soaked in pure water together with mineral acids, and then treated for some time with aqueous sulphurous acid or with sodium bisulphite, &c. The liquid is then drawn off and the remainder of the sulphurous acid and of the impurities are removed by means of soda-lye or of any other alkaline liquid. Finally the fabrics are thoroughly rinsed with water. Without the previous treatment with sulphurous acid the solution of the impurities by means of soda only is stated to be very imperfect.—H. S.

An Improved Fireproof Fabric. L. Allard, Paris, France. Eng. Pat. 19,579, December 1, 1890.

THIS fabric is composed of a mixture of animal fibres and asbestos, felted together in varying proportions by any suitable means. It is designed to replace ordinary felt where the latter is unable to withstand extraordinary heat.

—H. S.

Improvements in the Cleansing, Treating, or Washing of Wool and like Animal Fibres, and in Apparatus employed therefor. A. Ambler, S. Ambler, and F. Ambler, Willesden. Eng. Pat. 20,267, December 12, 1890.

THIS refers to a modification of Eng. Pat. 13,626 of 1889 (this Journal, 1890, 856). The liquor and wool passes along a series of superposed channels, first in one and then in another (usually the opposite) direction, and then returning, and so on, the object being to cause the liquor and wool to come into close contact without felting. Near the end of the channel, and below a perforated portion of it, is fixed a sand box to receive precipitated solid matters.

—H. S.

Improvements in or relating to the Preparation and Dressing of Silk and other Fibre. G. F. Priestley, Halifax. Eng. Pat. 123, January 3, 1891.

SILK-TUFTS have hitherto been made by means of the so-called "filling engine" which produces them looped at one end and fringed at the other, which is an objectionable form of tuft. Instead of this machine the patentee uses an ordinary form of gillbox provided with fallers and heckle pins, made to travel by screws through the fibrous material. The "film of fibre," as it issues from the machine, is wound round a fluted roller, and afterwards severed by means of a knife, and the strips, thus cut, are then formed into tufts. The circumference of the fluted roller must be such as to produce the required length of tuft.—H. S.

An Improved Machine for Decortiating Ramié. P. Faure, Limoges, France. Eng. Pat. 1445, March 7, 1891.

THE stalks to be decorticated are placed on a table, where they are seized by a pair of feeding rollers, conveyed to a trough, and subjected to the action of a beater drum, whereby the woody parts are broken and partially separated from the fibrous elements of the plants.—H. S.

Improvements in the Waterproofing of Textile Materials. J. G. Smith, Liverpool. Eng. Pat. 6698, April 18, 1891.

IN this invention the solutions employed in the process of waterproofing textile fabrics are described, and the inventor avails himself of the property of paraffin wax, stearin, or any fatty acid to dissolve as much as 100 per cent. of its own weight of gutta-percha or india-rubber, when heated to from 100° to 110° C. Generally such a solution of 15 parts of india-rubber in 100 parts of paraffin wax is prepared, and the solution so obtained is either directly or after suitable dilution with benzine or benzol (benzene) applied to the material to be waterproofed.—C. O. W.

Improvements in the Treatment of Samples of Crude Wool for Estimating Purposes. A. Frayssé, Antwerp, Belgium. Eng. Pat. 11,717, July 9, 1891.

THIS invention has to do with the detection of the so-called rendement of crude wool which is usually done by mere inspection and touch, but this frequently gives rise to errors. The patentee, therefore, subjects a sample of crude wool to the action of two machines, which remove therefrom first all foreign substances, e.g., thistles, grain, sand, &c.; and secondly, the grease of the wool; then the pure wool is dried and weighed, and the absolute yield of wool hereby ascertained. The thistles, &c., are removed by a rinsing and carding machine, in which a jet of cold water under pressure first removes all the grains, sand, and other granular impurities; then the fibres are freed from thistles, &c., by passing the wool between a carding cylinder and a series of carding rollers. The washing machine in which the wool is afterwards subjected to the action of a number of boiling baths or lye washes for the removal of the grease, consists of two rectangular tanks, and of a feeding apparatus between them. The machine is further provided with two rollers, so that the wool can be alternately conveyed from one tank to the other. The tanks can be heated from below, and have perforated false bottoms, below which each tank has a tap for discharging the lyes when exhausted. After the grease is removed, the wool is dried in the open air and weighed, and finally some small samples of it (about 200 grms. each) are weighed, then absolutely desiccated, and weighed again. For the last two operations one of the tanks is used as a sort of wool-conditioning apparatus. It is stated that from the results thus obtained the proportion of wool in the whole sample, and thence in the whole bale, can be calculated.—H. S.

Improvements in or connected with the Manufacture of Textile Articles with Fringed Edges. A. Bancroft, Manchester. Eng. Pat. 15,056, September 5, 1891.

THIS invention is for making upon textile fabrics fringed edges the threads of which will not fray or become loose, by saturating certain parts of the fabrics with gum, size, &c., and then cutting them into fringes the threads of which are cemented together. This is effected by stamping upon the material in the piece a quantity of gum or size, &c., in suitable forms, allowing it to dry, and then cutting these parts of the fabric into fringes which are stiff and not liable to curl. The gummed parts, while still soft, may be coated with gold, silver, or other metallic leaf, or the parts forming the fringe printed upon or dyed.—H. S.

An Improved Compound Fabric. F. J. Bugg, Ipswich. Eng. Pat. 18,003, October 20, 1891.

SHEETS of "composition compressed or lay leather" are covered with felt, woollen cloth, flannel, canvas, calico, or other suitable textile fabric by sizing one surface of each sheet, placing the sized surfaces together, pressing, and drying. Both sides of the leather may be so covered or several sheets stuck together to give the required substance.

—A. G. B.

VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

So-called "Decolourised" Tannin Extracts. V. H. Soxhlet. Chem. Zeit. 1892, 16, 15—16.

DECOLOURISED tannins are required for three distinct purposes:—(1.) As a stiffening and weighting material for silk; such must be absolutely colourless and is prepared from oak-galls. (2.) As a mordant for cotton, for which sumac is particularly applicable, chestnut-wood, divi-divi, bablah, and others being also used. (3.) For the actual process of tanning, the object being to remove either an excess of colouring matter or an objectionable colour, as in the case of quebracho and hemlock. The mixture of one extract with another will sometimes serve to correct the colour; a French sample of "*Extrait de quebracho decoloré*" was found by the author to be a mixture of quebracho and chestnut-wood.

Gondolo's method of decolourising by means of bullocks' blood gives good results, particularly with Virginian sumac and chestnut-wood, although the latter does not, as a rule, require decolourising for the tanner.

Lead acetate can be very successfully applied under certain conditions; the addition of 0.4 kilo. per 1,000 litres of tannin-liquor, the boiling of the liquor and its subsequent filtration and evaporation are the features of the process. The method gives good results with chestnut, oak, and larch, but is not adapted for sumac, valonia, and other bloom tannins, such as divi-divi and myrabolans, because it leaves such extracts opalescent—a fatal fault in the eyes of dyers. Lead nitrate has been patented for the same purpose in Germany.

Foelsing's patent has appeared in this Journal, 1892, 237; in a recent method by the same author the use of electricity is dispensed with, and he employs antimony oxalate as a precipitant; but Soxhlet points out that a considerable amount of tannin is thus lost.

The author finds that most salts will effect the decolourisation required, to a greater or less extent. Iron, copper, and chromium salts are of course beyond the pale, but sodium sulphate, zinc acetate, magnesium sulphate, ammonium sulphate, and bismuth nitrate can be employed. The last mentioned works well, but is high-priced. To apply these salts, a weak extract (3°—4° B.) is prepared either by the diffusion method or by extraction under pressure at 112°, and to every 1,000 litres of this 250—500 grms. of the salt are added; the liquor is run into basins and allowed to remain with frequent stirring, at 60°—70°, for 1—3 hours. Neutralisation is then effected by addition of borax or sodium phosphate, and the warm liquor passed through a filter-press. The neutralisation is of great importance, because if left acid the liquor will become turbid during the subsequent and concluding process of evaporation to 30° B.

In a very recent patent (this Journal, 1892, 81) strontium compounds are proposed. (Compare also Villon, this Journal, 1890, 820; Jean, this Journal, 1892, 46.)—A. G. B.

Grawitz' Recent Patented Improvements in Aniline Black. H. Schmidt. Chem. Zeit. 1892, 16, 502—503 and 531—532.

GRAWITZ has patented a process (French Pat. 212,082, 1891) which claims to be an improvement on that of Lightfoot (1863), in which aniline hydrochloride, alkali chlorate and copper or vanadium are used. He employs an excess of alkali, or acetates of the alkaline earths, tartrates, oxalates, citrates, &c., to combine with the hydrochloric acid which is set free in the reaction. The following is an example of the bath:—Aniline hydrochloride (1,295 grms.), crystallised sodium acetate (1,020 grms.), tartaric acid (100 grms.), sodium chlorate (207 grms.), and ammonium vanadate (5 grms.), dissolved in water (1,300 cc.). He has since confirmed Nietzki's view that the tetramine (aniline black) resulting

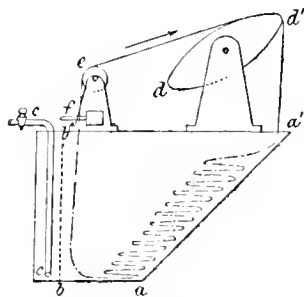
from the condensation of the four aniline residues is a mon-acid base, and therefore three molecules of hydrochloric acid are set free in the reaction. The author points out that hydrochloric acid is also produced by the decomposition of the chlorates; in this respect chromates are superior as oxidising agents. The hydrochloric acid from the "chlorate black" impregnates the fibre, and when the latter is dried slowly the cellulose is converted into hydro-cellulose. In printing, in which one surface only is concerned, the hydrochloric acid does not exert so harmful an effect, and the thickening medium protects the fibre: ferric hydroxide, lead dihydroxide, and lead chromate have been used advantageously, especially the last salt, in aniline black printing. For dyeing, however, these are inadmissible, and it has long been the custom to partially basify the aniline hydrochloride employed by ammonia, and ten years ago exact directions were given for the application of aniline partially converted into hydrochloride. C. Koechlin several years ago proposed the use of aniline tartrate and later of aniline acetate in conjunction with ammonium chloride, substantially in this respect, as now again patented by Grawitz, and it is well known that in the Prud'homme steam aniline black process. An amount of sodium acetate proportional to that of the aniline black formed must be used. Grawitz employs vanadium in the form of ammonium vanadate, and the author finds that the bath prepared according to his directions (see above) becomes turbid within an hour after its preparation, and can no longer be used; in a word, Grawitz' improvement is impracticable. The author shows that the amount of chlorate employed by Grawitz is only sufficient to convert 55 per cent. of the aniline salt into black; taking this into account, therefore, the sodium acetate must be present in large excess, the more so if it be calculated on Kayser's formula for aniline black $C_{12}H_{10}N_2$ instead of Nietzki's $C_{15}H_{15}N_2$.

With regard to the weakening of the fibre, it is remarked that the oxidising agent as well as the free acid is concerned in this, and that in addition to hydrocellulose, Witz' "oxycellulose" is produced. When the oxidation is carried in the dry way to the stage of emeraldine and then completed in the wet way by potassium chromate, a black is obtained which does not rub off the fibre.—A. R. L.

Contribution to our Knowledge of Sumac. W. Eitner. Der Gerber, 1892, 18, 51.
See under XIV.—page 539.

The Dyeing of Smooth Mohair Fabrics and Plushes. E. Weiler. Färb. Zeit. 1892, 155.

MOHAIR piece goods offer considerable difficulties in dyeing as compared with other woollen fabrics or unions. These difficulties are caused through the great stiffness and water-repellent nature of mohair yarns, which prevent the rollers of the "jiggers" from properly gripping the cloth, which consequently keeps slipping upon the rollers. This is the reason why in the dyeing of mohair fabrics the old hand-worked dye-vats are still used. The above-mentioned



JIGGER FOR DYEING MOHAIR FABRICS AND PLUSHES.

drawbacks of the automatic dye vat can be overcome by taking into account in their construction the peculiarities of the material to be dyed.

The side $a a'$ of the jigger is arranged at an angle of 45° ; the perforated diaphragm $b b'$ partitions off that part of the vat in which the steam pipe $c c'$ is arranged. The latter enters the jigger from the right or left and goes to the bottom, where it is bent at a right angle and is then conducted right along the bottom. The horizontal part of the pipe is perforated in such a manner as to allow the steam to go upward only. In $d d'$, instead of the usual circular roller, an elliptical roller is arranged, with as large a longitudinal diameter as possible and well gripping edges. The second roller, e , is a circular grooved roller.

For the dyeing of yarns in this jigger a rake f is arranged along the guiding roller e , which keeps the skeins always in position. In the dyeing of piece goods a gauge is employed instead of the rake.—C. O. W.

The Use of Mineral Pigment Colours in Cotton Dyeing. V. H. Soxhlet. Farb. Zeit. 1892, 151.

THE employment of mineral pigments for the dyeing of cotton has, since the introduction of the coal-tar colours, decreased in a very considerable measure, chiefly owing to the greater ease with which the latter allow of the production of brilliant and cheap shades. There is no doubt, however, that in many cases mineral pigments, even at present, may with advantage be used upon the fibre.

The application of "iron buff" from iron salts is still practised to a considerable extent, on account of its great cheapness and fastness against air and washing. Toluylene orange and cresotine yellow are probably the only coal-tar colours capable of producing similar shades, and are in this way particularly employed for "padding" calicoes. The "buff" obtained by these dyes is superior to "iron buff," as far as fastness against acids is concerned. The production of "iron buff" is exceedingly simple. It is sufficient to treat the cotton to be dyed with the solution of a ferrous or ferric salt, following with a passage through an alkaline bath. The iron salt generally employed for this purpose is "nitrate of iron," i.e., ferric sulphate 40°B. (77°Tw.); very seldom ferrous sulphate is used. The cotton is treated in baths of ferric sulphate at from 2° to 5°B. , hydro-extracted, and then introduced into a sodium carbonate bath at 2°B. Instead of the sodium carbonate bath a lime passage may be adopted. These operations can be repeated in order to obtain darker shades.

On passing yarns or cloth dyed with this "iron buff" through a cold bath containing a solution of ferrocyanide acidulated with sulphuric acid, very fine blue tints are obtained the depth of which is in direct proportion to that of the "iron buff." This blue is scarcely ever produced at present, the artificial dyes yielding brighter and very much faster shades. The only property which might commend this blue to the dyer for occasional application is its great fastness against acids. In dyeing this blue it is advantageous to add to the "nitrate of iron" bath in which the buff is dyed 2 per cent. of "tin crystals." The buff is fixed in the ordinary way in an alkaline bath, and subsequently the blue is developed in a bath of yellow prussiate containing about 2 per cent. of sulphuric acid.

Of other blue colours which might be produced upon the fibre, only molybdenum blue is worth mentioning, which, however, has not, and probably never will, find industrial application.

Nature favours us in every respect with an abundance of yellow colours. They are very numerous amongst the natural dyestuffs, as well as amongst mineral pigments and artificial dyestuffs. But owing to the existence of such a variety of yellow and orange dyes, mineral pigments of these shades are only employed but to a very limited extent. The chromates of lead are almost the only yellow and orange pigments used, and are obtained by the interaction of bichromates and soluble lead salts. The practical method of the application of these colours to the cotton

fibre has been originated by Lassaigue in 1820. Since then chrome-yellow, and especially chrome-orange, has been very extensively used on cotton, the colours being fast to light and washing, and exceedingly simply produced. The modern benzidine and diamine dyes are, however, superseding the chrome pigments, although the latter are much faster to light. The process of dyeing cotton yarns with these chrome pigments consists in well handling the previously boiled yarn in a 2°B. solution of acetate of lead, the hanks are then wrung, and without washing worked in a cold bath containing per 100 of water $4\frac{1}{2}$ kilos. of sodium bichromate and $1\frac{1}{2}$ kilo. of sulphuric acid. The shade being developed, the yarns are well washed and dried. Golden yellows, i.e., redder shades of yellow, are obtained by using for the first bath basic acetate of lead instead of the normal acetate. A beautiful orange is obtained by first treating the cotton in a 5°B. solution of basic acetate of lead (subacetate), then developing the yellow in a second bath with 20 per cent. of sodium bichromate, and finally working in a hot bath containing 12 per cent. (of the weight of the cotton) of lime. The tendency of the yarns dyed with chrome pigments to "rub" or "dust off" may be reduced to a minimum by oiling them.

Cadmium yellow is scarcely ever used on cotton, although nitrate of cadmium is used in calico printing to prevent the sulphuretted hydrogen, given off by the albumen used in the process, from damaging the printed chrome yellow. In order to produce cadmium yellow alone upon cotton, the latter is heated for half an hour in a bath containing $4\frac{1}{2}$ per cent. of cadmium chloride at 60°C. The hydro-extracted cotton is then transferred to a bath containing 4 per cent. of sodium sulphide, whereby the yellow is developed.

Of other mineral salts suitable for dyeing cotton yellow, antimony-orange and sulphide of arsenic may be mentioned. These two compounds, however, are no longer in practical use for dyeing purposes. On impregnating cotton yarns or fabrics with concentrated solutions of tartar emetic or oxalate of antimony, and exposing them subsequently to a current of sulphuretted hydrogen, good orange shades are obtained, although the shades obtained with arsenic are very fugitive if treated with alkaline liquids. This fact and the poisonous nature of the sulphide of arsenic entirely prohibit its use in dyeing. For similar reasons the green chromium arsenite and copper arsenite are never used.

Of considerable importance, especially in calico-printing, are the salts of manganese for the production of a variety of brown shades, technically termed "Bistres." The production of these colours consists in the fixation of manganic hydroxide upon the fibre. For these purposes the fabrics are impregnated with manganese salts and then taken through a chloride of lime solution, when a full brown shade at once appears. Well as this process answers for calicoes, it gives very poor results on hanks. Nor does a passage first through permanganate and then through an acidulated solution of ferrous sulphate answer the purpose any better. Of importance are, however, those processes in which sulphate of manganese together with permanganate is used. The yarns are worked in a solution of sulphate of manganese at 2°B. , hydro-extracted, and subsequently immersed in a bath of permanganate at 1°B. A very good brown shade is obtained, which may be made darker by repeating the operations. These colours darken considerably in the process of drying, though in a very irregular manner, thus causing unevenness. This tendency to unevenness can be counteracted by passing the yarns before drying through a bath of acetate of iron at $\frac{1}{2}^\circ \text{B.}$

Extremely fast shades of grey may be obtained by passing yarn through a solution containing 4 per cent. of mercuric nitrate, hydro-extracting and then treating in a solution of sodium sulphide. Owing to the great fastness of the grey shades obtained in this manner no poisonous effect need be apprehended, although special precautions may be required to protect the workmen who are treating the yarns in the solution of the mercuric salt.—C. O. W.

PATENTS.

Improvements in Transparent Coloured Materials for Decorative Purposes. A. McLean, West Kensington, Middlesex. Eng. Pat. 8296, May 14, 1891.

GELATIN dyed with aniline colours is made into thin sheets which are dipped in a bath of thin oil varnish and hung up to dry. The sheets thus prepared may be cut up into pieces of various shapes and patterns and applied by means of some adhesive material to the surfaces to be decorated. Patterns in more colours may be produced by cutting out from the coloured gelatin certain portions, which will constitute the pattern. By running over this gelatin uncoloured or suitably coloured gelatin, a number of colour effects may be obtained.—C. O. W.

Improvements in the Process of Dyeing, Tanning, and Mordanting Leather, Teazled Fabrics, or other Porous Materials, and in Apparatus employed therefor. J. Goldschmidt, Fürth, Bavaria, Germany. Eng. Pat. 19,397, November 10, 1891.

THE distribution of dyes on surfaces of leather and other fabrics has heretofore been effected by the application of centrifugal force or by means of brushes or rolls. These methods are tardy and liable to damage the grain of the leather or surface of the fabric. By this invention the dye and mordant are distributed by means of compressed air. The hides are placed on discs superimposed on one another, with sufficient working distance between each, in an air-tight vat; as each disc is put in its place the dye is distributed over the hide by means of a rubber pipe leading from the reservoir of dyestuff, from which the dye is forced by compressed air. When all the discs are in position the vessel is closed and the compressed air turned on; the dye is thus forced into the fabric. The mordant may be applied in the same manner. For drawings of apparatus for which claims are made the original specification must be consulted.

—A. G. B.

Improvements in Process and Apparatus for Bleaching by Electrolysis. O. Murray, London. From T. Y. Montgomery, New York, U.S.A. Eng. Pat. 2329, February 6, 1892.

See under XI., page 535.

ERRATUM.

This Journal, May issue, page 432, col. 1, the figuring to be reversed, Fig. 2 becoming Fig. 3. Fig. 1 to remain as it is.

VII.—ACIDS, ALKALIS, AND SALTS.

Sulphuric Acid Manufacture in 1891. R. Hasenclever. Chem. Ind. 1892, 15, 69.

It is now recognised that the reactions that take place in a vitriol chamber can be aided by bringing about a more intimate contact of the gases by causing them to traverse narrow tubes in their passage from one lead chamber to another, the advantage being more marked at the end of the operation, and several small chambers at the exit end being therefore provided through which the gases are driven and in which they are intimately commingled. At Petrowitz in Austria, and at Ghent in Belgium, lead chambers in the

form of gasometers are in use, but nothing has yet been published to prove that they possess any particular advantages. The coke, both in the Gay-Lussac and Glover towers, can be replaced by brick or stone exposing sufficient surface for the work of absorption, the reason for the change being that the coke generally used becomes gradually clogged and inefficient, and further that it reduces nitrosulphuric acid, yielding carbonic acid and nitric oxide, the latter being useless at that part of the process at which it finds its way back to the chambers.

A considerable proportion of the impurities in sulphuric acid can be avoided by freeing the gases from dust after leaving the pyrites burners and before entering the chambers. A further quantity can be got rid of by deposition before the chamber acid goes to be concentrated. By pursuing this system at Griesheim, the residue left by evaporation can be reduced to one-third or one-fourth of its usual amount, e.g., from 0.009 to 0.003 grm. per litre.

On account of the high price of platinum, considerable alterations have been made in the methods of concentrating sulphuric acid to 66° B. Faure and Kessler have proposed an improvement consisting in the use of a flat platinum vessel provided with a leaden head. A construction specially recommended is that in which a series of tubes are arranged spirally and soldered to a cylinder the lower edge of which enters the liquid seal of a platinum dish. The system adopted by Négrier consists of porcelain dishes, arranged one above the other in terrace form, resting upon iron plates and heated from beneath,—the sulphuric acid dripping from one to the other. Scheurer-Kestner has devised an apparatus of which the lower part is of cast iron while the head is of platinum. The acid first flows into a still wholly of platinum, and then into the cast-iron still with the platinum head. In such an apparatus 4,500 kilos. of sulphuric acid of 95 per cent. strength can be prepared in 24 hours. The weight of the platinum is 18.8 kilos., and that of the cast iron 250 kilos. The amount of platinum dissolved is about 0.15 grm. per ton of acid of sp. gr. 66° B. The cast iron is more attacked when less concentrated acid is produced, the product moreover becoming turbid, but it withstands the action of 95—96 per cent. acid better. Heraeus has made the observation (this Journal, 1891, 460) that platinum alloyed with 10 per cent. of iridium is about twice as resistant as pure platinum. For very concentrated sulphuric acid the same technologist has constructed an apparatus of platinum plated with gold, with which the loss of metal is only about one-seventh that of pure platinum. The plates are prepared by casting gold round platinum 1 cm. thick previously heated to the melting point of the former metal, an alloy being formed at the point of contact, and plates perfectly coated with a thin layer of gold being obtained on rolling. Taking the price of gold at 2,800 marks, and that of platinum at 1,800 marks per kilo., the cost of the metal dissolved by the action of the acid is only 22 per cent. in the case of the gold-plated retort of what it is when unprotected platinum is used. L. Kessler has endeavoured to concentrate sulphuric acid by leading heated air through it in an apparatus made of lead and stone now in use with satisfactory results at Clermont-Ferrand.

The quantity of sulphuric acid produced in Germany in 1890 is estimated at 627,392 German tons.* In the Rhine provinces, Westphalia, Upper Silesia, and Belgium, the output has exceeded the demand, a result contributed to by the fact that in Germany 80 per cent. of the total amount of soda is now made by the ammonia process. An outlet might be found for it in the preparation of artificial manures. It is calculated that the agricultural products of Germany require yearly 640,276 tons of phosphoric acid, of which 156,026 tons are supplied in the form of superphosphate, basic slag, and guano. The balance of 484,256 tons could be supplied by human and animal excrement, which accounts for 553,572 tons, provided no loss occur. Assuming 50 per cent. to be lost (a very moderate estimate) a quantity of 207,170 tons of phosphoric acid is still lacking. This deficiency in phosphoric acid explains the inferiority of Germany in the amount of the crops compared with other lands. The following table shows the yield per hectare in tons of England and Germany respectively:—

	England.	Germany.
Wheat.....	1790	1733
Barley.....	1793	1731
Oats.....	1751	1715
Potatoes.....	1713	821
Pee.....	1772	081

The quantity of phosphoric acid needed in Germany would be 960,000 tons instead of 640,270 tons if the weight of the crops per hectare were as great there as in this country. In the author's opinion, the increased use of artificial manures is a necessity.—B. B.

Concentrating Sulphuric Acid in Gold-lined Platinum Stills. G. Lunze. Eng. and Mining J. 53, 1892, 374.

THE stills in question were brought out by W. C. Heraeus, of Hanau, in Germany, in January 1891 (this Journal, 1891, 460—461). Since that time 15 of them have been supplied to various customers. It was found in all cases which have hitherto come under examination that gold is far less attacked by boiling strong sulphuric acid than platinum, the proportion being 1 to 7 or 10. But a mistake was committed at first in constructing the stills, which has now been detected. At first it was thought that it was sufficient to apply the gold lining merely to the bottom of the stills, or, at most, as high up the sides as the liquid acid reaches. But a year's experience has proved that this is not sufficient; the gold, and therefore the bottom, is certainly perfectly unchanged, but the upper portion of the still, where the platinum is not protected by gold, is corroded as much as before, especially at the point of junction between the platinum and the gold. This has led to ordering new stills to be lined entirely with gold, but keeping the lining much thinner at the upper portion than at the bottom.

At the Gröschel Chemical Works a still was set to work in April 1891, composed of an old platinum dome joined to a platinum-gold bottom.

The still was run night and day, mostly for acid of the highest concentration (96 per cent.). In December 1891 it was examined, and the upper (platinum) portion was found to be corroded, but the gold-lined bottom did not show a trace of either mechanical or chemical action. Therefore a new still, entirely lined with gold, was ordered forthwith.

At the Mansfield Copper Smelting Works a Faure and Kessler still was started in June 1891, furnished with a platinum bottom of 0.4 mm. thickness, lined with 0.1 mm. gold. On January 15 the still was dismantled, having furnished 646 tons of strong vitriol, because the side portions, not lined with gold, were corroded. The bottom, however, plainly showed the hammer marks and exhibited no signs of corrosion whatever.

At the Corbetta Chemical Works a Prentice still was put up on March 9, 1891, lined at the bottom and 3 in. up the sides with 0.05 mm. gold. In January 1892, after having furnished 1,700 tons of strong vitriol, partly up to 96 per cent., it was examined, and the loss in weight was found = 32 grms., all of which was from the upper unprotected portion.

At the Augry works a similar still was started in February 1891, and stopped for examination in February 1892, after having furnished 1,163 tons of strong vitriol, half of it at 96.7 per cent. The loss of weight was 120 grms., or a fifth of what would be expected from an ordinary still under favourable circumstances. Here also the loss manifestly extended only to the unprotected platinum portion.

There cannot be any reasonable doubt that the loss of a stock entirely protected by a gold lining would be less than one-tenth of that of an ordinary platinum still. But two questions may be asked now. First, why must the Heraeus combination be employed instead of an ordinary gilding of the platinum? Secondly, if gold is the only metal in

contact with platinum, why not employ a copper still lined with gold? The first question may be answered as follows: Any ordinary gilding, whether galvanic or igneous, does not at all effect the purpose of protecting the platinum, as the minute film of gold is always more or less porous: the imperfections are speedily found by the boiling acid, and the gold film is soon detached from the underlying metal. But in the Heraeus system a sound and thick lining is produced by pouring melted gold on to the surface of a platinum ingot brought to a white heat, beyond the fusing point of gold. Thus an intimate junction is produced, and a substantial, solid coat of gold is left on the inside, which is never at any point detached from the platinum, and behaves toward sulphuric acid as if the metal consisted entirely of gold. Nor is it possible to employ a base metal in lieu of platinum, for the slightest accidental injury to the thin gold lining would allow the boiling acid access to the base metal which would be instantly dissolved and would cause the still to collapse.

It is true that a gold-lined still costs a good deal more than an ordinary one. Taking a Delpace still, weighing 37½ lb., an inner gold lining of 0.1 mm. for the bottom, and 0.025 mm. for the dome will weigh about 5½ lb., and will raise the cost by about 1,000 dollars, deduction being made for the value of an equal thickness of platinum. This means a small amount for additional interest on plant. But allowing for a yearly production of 2,000 tons of acid, the annual saving of platinum, otherwise dissolved and carried away by the acid, would be at least 2½ lb., worth nearly 300 dollars, and the saving would be in reality very much greater than that, seeing that the total renewal of a still, in which case only two-thirds or three-quarters of the price of new platinum is realised, will occur at very much rarer intervals than at present. It may be assumed that the additional expense of a Heraeus still will be paid for in from one to two years.—W. S.

Notes upon the Estimation of Chlorine in Electrolysed Solutions. L. M. Norton. Technol. Quarterly, 1891, 361.

See under XXIII., page 548.

PATENTS.

Improvements in and connected with the Manufacture of Alkali Aluminates. E. Fleischer, Wiesbaden, Germany. Eng. Pat. 7437, April 29, 1891.

THE improvements are in the process for manufacturing alkali aluminates, alumina, caustic alkalis, and carbonates of soda and potash, the alkali aluminate being obtained from aluminous substances by means of alkali sulphates, &c.

The chief difficulty in obtaining sodium aluminate by fusing bauxite and sulphate of soda with the addition of coal has hitherto been the formation of liquors containing quantities of compounds of sodium, sulphur, and iron; furthermore, the fused mass seriously attacks the melting pot. The author avoids the production of the deleterious compound by using in the fusion quicklime or carbonate of lime, so that, as it is stated, the sulphide of iron partially combined with calcium sulphide may be produced in insoluble form. The following rule is given:—"Add to the aluminous substance (clay or bauxite) for every molecule of alumina one molecule of alkali sulphate, and ensure by the addition of iron or its oxides that fully one molecule of iron (including that already contained in the clay) be present for the formation of FeS for every molecule of alkali sulphate or alumina. The lime or chalk is to be reckoned as two molecules for every three molecules of silica, and a further quarter molecule of lime or chalk is to be added for every molecule of alumina." To this must be added, of course, the necessary amount of charcoal.

Fusion is performed at a moderate red heat, not too high, after which the mass is cooled, preferably in closed iron vessels. Lixiviation is performed in the usual way.

To obtain alumina and alkali carbonates, the colourless solution of aluminate is saturated at nearly boiling point with carbonic acid.

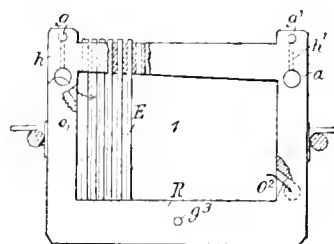
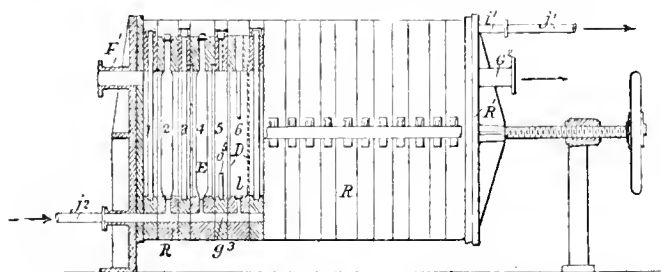
Should it be desired to obtain caustic alkali liquor direct from the aluminate solution, the alumina may be precipitated by lime.—T. L. B.

Improvements in the Manufacture or Production of Chlorine and Alkaline Carbonates. C. Kellner, Vienna, Austria. Eng. Pat. 20,713, November 27, 1891.

For the simultaneous production of chlorine and an alkaline carbonate, a heated saturated solution of an alkaline chloride is caused rapidly to circulate in two separate streams through an electrolytical decomposing apparatus, one of these streams, viz., that which flows past the anodes of the apparatus, and to which a small quantity of sulphuric

acid or of a sulphate of the base used has been added, being conveyed, after leaving the apparatus mentioned, through a vessel provided with the alkaline chloride in a solid state, whereby the liquid is again completely saturated before being conveyed back to the anodes; the other stream, viz., that which flows past the cathodes of the apparatus, being subjected, after leaving the said apparatus, simultaneously to a cooling action, to contact with solid alkaline chloride, and to the action of carbonic acid, whereby a carbonate of the alkali present is formed and precipitated from the solution, which is afterwards conveyed back to the cathode cells of the apparatus.

To facilitate the escape of hydrogen set free, carbonic acid is introduced into the cathode cells. The electrolyte is also maintained at such a velocity and temperature as will prevent carbonate of soda from settling within the decomposing apparatus.



IMPROVEMENTS IN THE PRODUCTION OF CHLORINE AND ALKALINE CARBONATES.

To carry out this process an electrolytical decomposing apparatus, consisting of a succession of frames R (Fig. 1) in which the electrodes are arranged, is proposed; these frames, being separated from each other by diaphragms, and having in their upper parts passages $g g'$ (Fig. 2) connected by other passages $h h'$ with the passages $o \dots$ and a , through which the electrolytes are caused to circulate, the passages $g g'$ allowing the gases set free during the electrolytical decomposition to escape separately from the ions. Diaphragms D of a permeable fabric or porous clay are used, the pores of which are filled with gelatinous material mixed with a solution of salt corresponding to that to be decomposed. This is to prevent injurious mechanical diffusion from one cell to another of the liquids treated, and to facilitate circulation of the ions.

The electrodes are made by mixing together powdered retort carbon, thickened solution of wood cellulose in zinc chloride, kneading to a paste, moulding, washing, and then heating in a muffle, impregnating with a hydrocarbon, and then heating several times.

Electrodes are also claimed, the pores of which have been filled up with peroxide of lead obtained either by covering these electrodes with a layer of litharge and sulphate of ammonia mixed together, or by boiling them in a saturated solution of lead acetate, and afterwards electrolytically transforming the lead or oxide of lead thus obtained into peroxide of lead.—J. C. C.

A Process for Recovering Cyanides from Coal-Gas. W. T. Rowland, Philadelphia, Penn., U.S.A. Eng. Pat. 22,347, December 22, 1891.

See under II. page 510.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

The Application of certain Rare Metals for Ceramic Colours. Sprechsaal, 1892, 25, 85.

THE following results are described:—Tungstic oxide (1 part) and a vitrifiable pigment flux (4 parts) yield an extremely stable bright yellow colour. The endeavour was made to replace chromic oxide by vanadic oxide. Pure ferric oxide (64 parts), marble (32 parts), ammonium vanadate (4 parts), and vanadic oxide (2 parts) finely powdered, give a beautiful light rose-coloured sub-glaze for stoneware.—A. R. L.

The Use of Mineral Oil Residues as Fuel for Glass Furnaces. J. Malyschew. Chem. Zeit. 16, (Chem. Rep.) 85.

See under II., page 510.

PATENTS.

An Improved Composition or Compound designed to serve as a Substitute for Wood, and also applicable for the Manufacture of Bricks and Crucibles, Retorts, and other Articles of Earthenware. W. A. Kerr, Rhyl. Eng. Pat. 7040, April 23, 1891.

"A VARIETY of tale containing hydrated silicate of magnesia and alumina," or kaolin either free from or containing sand, or other clay or clayey loam is mixed with "sphagnum, which is a kind of moss, or with peat, either in the condition of fibre or granules, or with the said sphagnum and peat combined." The tale or clay is weathered before use, and after having been ground is mixed with the peat by making a pile of the two materials in alternate layers, allowing the mass to "ripen" for 48 hours, and slicing down the pile vertically and passing the mixture into a mixing-press consisting of a hollow cylinder provided with an axial shaft bearing blades inclined so that the mixed material is conveyed to one end of the cylinder and forced out through any

suitable die. The column of clay and vegetable-matter as it issues from the die, is cut into blocks by a buzz-saw, dried by waste heat and fired, the peat serving as an auxiliary fuel.—B. B.

Improvements in Kilns or Ovens for Firing Terra-Cotta and other like Materials. C. D. d'Enghein, A. D. d'Enghein, and S. D. d'Enghein, Belgium. Eng. Pat. 18,281, October 24, 1891.

In these kilns the hearths are at a sufficient distance from one another to leave between them compartments in which delicate articles can be baked. Uniformity of baking is secured by causing the draft to follow two conduits of equal dimensions placed one at each side of the oven. Either wood or coal can be used for heating. The floors of the heating compartments are not horizontal but inclined, an arrangement which facilitates the charging and emptying of the baking compartments.

It is claimed that these kilns effect economy of fuel and of labour, secure uniform baking, do not require close watching, and can, if desired, be charged entirely with glazed goods.—V. C.

A New and Improved Process of Marking Glass by Acid. W. Leader, London. Eng. Pat. 1974, February 2nd, 1892.

This process consists in "steeping brown paper stencils in hydrofluoric acid and pressing on the articles to be marked with heated silver sand."—V. C.

Improvements relating to the Marbling of Enamelled Articles and to Apparatus therefor. G. Güntel Saxony. Eng. Pat. 3024, February 16, 1892.

HITHERTO enamelled kitchen utensils have been given a marbled surface by squirting a liquid upon the surface of the enamel and then shaking the vessel so as to distribute the liquid in lines or veins. This needs care and skill on the part of the operator and at best does not permit of an uniform marbling.

In this invention a plate is used provided with pins or bristles which are dipped in the liquid. From the points of the bristles drops of uniform size are deposited on the enamel in a regular manner. By gently knocking the utensil the drops are caused to run out into veins or lines, and a uniform marbling is thus produced.—V. C.

Improvements in Kilns or Ovens for Burning and Glazing Sanitary Ware and the like. C. Armstrong, Burnley. Eng. Pat. 3586, February 24, 1892.

THE invention relates more particularly to kilns in which sanitary ware is burnt and glazed. In the ordinary kilns sooty matter becomes mixed with the salt and the excessive heat at the roof of the kiln often causes the salt deposited there to liquefy and fall on the goods beneath, producing unsightly blotches. In this invention a midfeather is placed in the fire box projecting downwards into the incandescent fuel, and leaving a space at the back closed by a damper. Instead of disturbing the hardened crust at the top of the fire when the salt is to be deposited (which inevitably produces a cloud of soot) the damper is raised and the salt is introduced at the back of the midfeather where the fire is burning hotly. This prevents the contamination by soot.

To prevent the liquefaction of salt on the roof and the consequent staining or blotching of the goods, air is admitted near the base of the kiln and is carried upwards by flues and discharged along the roof, thereby reducing the temperature at this part of the oven, and thus preventing the formation and adhesion of liquid salt.—V. C.

An Improvement on the Method of Treating Glass Cullet known as "Blacks." J. S. Williams, Brierley Hill. Eng. Pat. 9097, February 29, 1892.

"BLACKS" is the trade term for the glass removed from the blowing irons. Hitherto the adhering rust has been removed from the "blacks" by means of cold acid.

In this invention the acid bath is heated, thereby accelerating the cleansing of the "blacks." The method of heating recommended is by blowing steam into the bath.

—V. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

The New Regulation for the Supply of Portland Cement in Russia. Thonind. Zeit. 1892, 16, 21 and 40.

PORTLAND cement is made either from a calcareous marl or a mixture containing clay and chalk, by burning until friable, and then grinding to a fine powder. The hydraulic modulus, or ratio of the sum of the parts by weight of CaO and (K₂O + Na₂O) to that of the parts by weight of SiO₂, Al₂O₃, and Fe₂O₃ ought not to fall below 1·7 nor to exceed 2·2, for Portland cement.

$$\frac{\text{CaO} + \text{Na}_2\text{O} + \text{K}_2\text{O}}{\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3} = 1\cdot7 \text{ to } 2\cdot2$$

The percentage of sulphuric acid and magnesia should not be greater than 1·75 to 3 in Portland cements ready for use.

The specific gravity of Portland cement must be not less than 3·05.

The cement should not set in less than one hour, or take longer than eight hours. A sieve with 4,900 meshes per sq. cm., should not pass less than 50 per cent., and one with 900 meshes per sq. cm. should pass all but 15 per cent. of residue.

The cement after seven days setting should be able to show a limit of elasticity of 20 kilos. per sq. cm., and after 28 days 25 kilos. per sq. cm. A test piece, prepared with 3 parts sand and 1 cement, should be able to stand, after seven days, 5 kilos. and after 28 days, 8 kilos. per sq. cm.—A. L. S.

The Fifteenth Annual General Meeting of the Association of German Portland Cement Makers. Chem. Zeit. 1892, 16, 371.

At the meeting of the Association held in Berlin on the 26th and 27th of February last, it was stated that there were about 80 members, representing a production in Germany alone of 7,850,000 casks of Portland cement. In the report of the council it was stated that efforts were being made to restrict the use of the name Portland cement to those commercial products which alone had a right to the title. With respect to the magnesia question, two cements had been examined which contained 4·5 and 6·5 per cent. of magnesia respectively, and it would be necessary to ascertain whether they showed a retrograde tendency in course of time. Similar scrutiny was requisite with such cements as contained no admixture of foreign matter nor any abnormal amount of magnesia, but gave unusual results in respect of the loss on ignition, specific gravity, and tensile strength when tested by the standard rules. Brands of cement in the manufacture of which slag was known to figure as a raw material, were also to be examined, lest they should contain slag added subsequently to the manufacture. The question whether it was permissible to add more than 2 per cent. of colouring matter, not with a view of altering the time of setting, but for

bringing the colour of the product to a standard tint, was decided in the negative, it being ruled to be a deception to alter the colour of cement in order to hide the results of careless manufacture. The question as to the permissible

limits of magnesia has not yet been completely decided, and was referred back to the committee. Schumann communicated some results on the influence of oils on Portland cement.

Age of Test Pieces.	Tensile Strength in Kilos. per Square Centimetre.							
	1 Cement; 1 Sand.				1 Cement; 3 Sand.			
	Water.	Petroleum.	Vulcan Oil.	Rape Oil.	Water.	Petroleum.	Vulcan Oil.	Rape Oil.
8 weeks.....	34.8	34.3	35.0	26.4	27.5	26.4	25.4	20.1
20 weeks.....	37.0	33.4	35.7	21.6	28.5	26.0	26.8	Destroyed
52 weeks.....	44.4	34.1	31.1	19.5*	33.3	7.6	22.3	..
8 weeks.....	34.4	34.7	..	39.6	28.4	28.1	..	26.3
26 weeks.....	40.3	38.9	..	45.1	31.0	30.9	..	19.0*
52 weeks.....	46.2	44.9	..	51.3	35.3	32.0	..	22.0

* Cracked on the outside.

The first series of test pieces were hardened one week in water, three weeks in air at about 30° C., and were then placed in the various liquids mentioned in the table. The test pieces of the second series were differently treated, inasmuch as after the first week in water they were kept for two weeks in air at the ordinary temperature, during which time they were placed in water for half an hour each day. Finally they were immersed in the liquids experimented with as before. The question of the best method of determining the time of setting of Portland cement is now being considered in collaboration with the Director of the Royal Prussian Testing Station for Materials of Construction.

—B. B.

The Action of certain Chlorides on Portland Cement.

Dobrzynski. *Thonind. Zeit.* 1892, 16, 64.

THE author has examined the action of the chlorides of magnesium, barium, sodium, and ammonium upon cement, with the following results. The quantity of water necessary to produce a paste of normal consistence is greater the more difficultly soluble the chloride used. The time of setting is lengthened, in the case of the more difficultly soluble chlorides, as the percentage added is increased. In the experiments on the influence of the various chlorides on the tensile strength, the test pieces were kept in solutions of the same salts at the same degree of concentration as had been used in gauging them. Barium chloride had the most marked effect—a result which the author attributes to the tendency of barium oxide to behave towards the silica and alumina of the cement in the same manner as lime, the resulting compounds however possessing a greater tensile strength. The cement used had a tensile strength of 9.75 kilos. per sq. cm.* at 7 days and 12.83 at 28 days, when tested under normal conditions, that is to say, gauged with three parts of sand to one of cement, using clean water only.

The following results, expressed in kilos. per sq. cm. were obtained when the chlorides above-mentioned were used:—

	Percentage of Chloride.					
	1%	2%	3%	4%	5%	6%
	7 Days.					
Magnesium chloride.	11.0	10.85	11.0	9.25	9.25	8.75
Barium chloride	10.5	10.5	12.6	12.75	12.75	13.25
Ammonium chloride.	10.5	10.25	9.0	8.75	8.75	8.50
Sodium chloride	10.75	10.5	10.0	9.75	11.0	8.6

* To convert kilos. per square cm. into pounds per square inch multiply by 14.2545.

	Percentage of Chloride.					
	1%	2%	3%	4%	5%	6%
	28 Days.					
Magnesium chloride.	13.75	13.5	13.5	11.5	11.0	10.5
Barium chloride	13.5	13.5	14.75	14.75	15.0	15.25
Ammonium chloride.	12.75	12.75	12.0	11.5	11.25	10.75
Sodium chloride	13.0	12.5	12.75	11.5	12.25	11.0

—B. B.

PATENTS.

A Process or Method of Treating Meerschaum to render it as Porous and as Absorbent in the Manufactured State as in the Natural, and to Adapt it to Various Uses.
J. S. Weingott, London. Eng. Pat. 11,244, July 2, 1891.

THE meerschaum either in the rough state or cut to any desired shape, such as a pipe bowl, which may or may not have been previously polished or waxed in the usual way, is gradually heated so as without cracking to carbonise and blacken it. The operation may be conducted by placing the articles to be treated between layers of dry sawdust (preferably oak) and igniting the sawdust, or in a closed vessel and heating the exterior thereof. The meerschaum is then plunged into melted wax or oil and re-heated, until a deep black colour is produced, after which it may be polished with waxed cloths. It may also be dipped in a solution of pyrogallie acid with a view of neutralising the nicotine from the tobacco; other solutions of similar efficacy may be employed. Meerschaum prepared according to the invention is capable of being used for crucibles, cups and the like.—B. B.

The Manufacture of an Improved Compound for Coating Walls and other Surfaces and for the Production of Casts or Mouldings and for Analogous Purposes.
R. Norwood, Denmark Hill. Eng. Pat. 21,199, December 4, 1891.

THE object of the invention is to produce an adhesive compound similar to that described in Patent 1620 of 1882, commercially known as "alabastine," but different therefrom in respect of the fact that it can be used with cold water instead of hot. One hundredweight of gypsum is calcined, and while it is hot, five to eight pounds of glue dissolved in water are added, and from half a pound to one pound and a half of zinc sulphate or some equivalent substance, the

object being to retard the setting of the glue and gypsum and produce a harder compound. An alternative method consists in adding the glue dry, relying on the moisture liberated from the gypsum during its calcination for the necessary water. The mixture is heated until both the water from the gypsum and that added with the glue are driven off, the dry mass ground and coloured if desired.—B. B.

Improvements in the Manufacture of a Resistible Material chiefly Designed for Building Purposes. H. Hartmann, Mannheim, Germany. Eng. Pat. 2957, February 15, 1892.

MATERIALS such as "lime, trass, cement, and gypsum," with or without gravel or sand, are mixed with metal strips, shavings, turnings, or wire-like particles, and made into a mass with water, the metal fibres more or less uniting or "felting" together and forming a coherent product. It may be used as a building material for ceilings, floorings, walls, &c., either alone or with a core of ordinary cement concrete, the chief strain on the structure being taken by the outer layers containing the metal wires or strips.—B. B.

Improved Artificial Stones. J. S. Holliday, Camberwell. Eng. Pat. 4496, March 7, 1892.

Two compositions are patented, one for the face and the other for the body of the stone. That for the face consists of whiting 0.25, clean Bath stone dust 0.3, Portland cement 0.3, and yellow ochre 0.15 parts respectively. They are mixed together with water to a suitable consistency, and poured into a mould to a depth sufficient for the face of the block. The backing is composed of crushed slag, washed clean, 0.5, crushed granite 0.2, and Portland cement 0.3 parts respectively, and is poured into the mould after the facing has been prepared. The object of the separate facing is to provide a material capable of being carved or similarly ornamented.—B. B.

An Improved Distemper for Walls, Ceilings, and the Like. A. T. Morse, London. Eng. Pat. 5746, March 23, 1892.

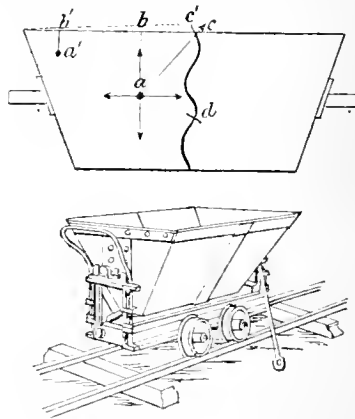
FIFTY parts of gilder's whiting, $12\frac{1}{2}$ parts of gelatin, 10 parts of zinc oxide, 1 part of manganese sulphate, 10 parts of terra alba, 12 parts of Paris white, 14 parts of heavy spar, $\frac{1}{2}$ part of salt, 1 part of alum, and 1 part of bichromate of potash, are separately crushed, then ground and mixed together with colours such as are usual in distempers. The composition may be used with hot or cold water.—B. B.

X.—METALLURGY.

Iron Vessels for Molten Substances. Foehr. Chem. Zeit. 1892, 16, 503 and 532—533.

THE iron boilers, retorts, autoclaves, &c., at present obtainable are much more durable than those formerly made; for example, cast-iron dishes for desilvering zinc are now furnished, which will withstand the wear and tear of 150 operations. The cast iron of which these vessels are constructed is very dense and fine grained, and ferro-manganese, ferro-silicon, ferro-chromium, tungsten, and recently also aluminium are added to it in its manufacture. Very frequently the requisite qualities are attained by mixing various sorts of crude iron, the proportions being kept secret. When two samples of cast iron are compared, of the same composition, that having the highest specific gravity will invariably be found the best to withstand chemical influences and high temperatures. The form of the vessel is of great importance, especially when molten substances are suddenly introduced into them. Steel vessels are more liable to crack than those of cast iron, whilst it is difficult to remove a solidified mass from wrought-iron vessels. To avoid unequal strain, the best form is that of a hemisphere, but this form is impracticable, being difficult to empty and to transport, especially with large quantities of material. After mentioning in detail several forms of iron tilting troughs, all of which have disadvantages, the

author describes the following apparatus which was patented by R. Leder (Quedlinburg, Germany). It consists of a cast-iron trough made in two pieces, which are bound together by a riveted wrought-iron band. In the sketch, *d* is the boundary curve of the two halves of the trough.



IRON VESSELS FOR MOLTEN SUBSTANCES.

When, for example, a stream of slag touches the point *a*, the surroundings of this point expand in all directions, and the trough, if made in one piece, generally splits in the direction *a b*, whereas, when it is made in two pieces, the force acts in the direction *a c*, so that, instead of a fracture, the upper rim *b c* of one half takes the position *b' c'*. The composition of the cast iron of which these vessels are made is kept secret. One of these vessels has been daily in use for several years, and is in excellent preservation. An entire waggon weighs about 500 kilos., and holds 1,000 kilos. of slag. They are so convenient for transport that a wide application for various molten substances is considered probable.—A. R. L.

Alloys of Nickel and Iron. H. Wedding. Verhandl. d. Vereins. z. Beförder. d. Gewerbl. 1892, 52.

FOR general use the alloys should contain but little carbon, less than 0.5 per cent., otherwise they are difficult to work, the amount of nickel should not exceed 5 per cent., otherwise the limit of elasticity is insufficient, and for practical purposes the cost must be kept down, in view both of the amount of nickel used and the difficulty of working. To prepare nickel iron alloy, a mixture of ore containing iron and nickel oxides may be reduced in a blast furnace, but the crude alloy thus obtained is not suitable for the preparation of a malleable alloy (*i.e.*, one poor in carbon). According to Gautier, on refining, nickel oxide is produced, which remains dissolved in the iron and causes it to be brittle.

In order to obtain a malleable alloy, metallic nickel must be added to the fluid malleable iron. The metal should be free from arsenic and sulphur. The alloy is not a chemical compound, but only a mechanical mixture. The addition of aluminium is useful. Experiment must determine how much manganese on the one hand, or magnesium on the other, is necessary to remove the oxygen. The required carbon is best introduced directly.

Further particulars as to the details of preparation and best composition of alloys are at present wanting, but it is hoped that further experiments will remedy this.

—A. L. S.

The World's Production of Gold. Eng. and Mining J. 53, 1892, 272.

BEGINNING with the older gold-fields of the world, California in all probability made about the same out-turn in 1891 as in the previous year, but the mines of Deadwood, South Dakota, have made an increase, and there has also, without doubt, been an increase from the silver mines the ore of which carries some gold. It is estimated that the total production of gold in the United States in 1891 had

amounted to 33,250,000 dols., against 32,845,000 dols. in 1890, as reported by the Director of the Mint. Australia will in all probability show about the same yield in 1891 as in 1890, for although there has been a falling-off in the product of the Mount Morgan mine, the great gold producer of Queensland, and perhaps also in New South Wales, the returns from Victoria show an increase of 37,216 oz., which will do much to make up for the deficiencies of the other colonies, not in any case likely to be large. The latest statistics from Russia, those for 1890, show an increase of over 75,000 oz. over the production of 1889, and although the returns for 1891 have not yet been compiled, it is officially reported that all indications point to another notable increase.

In the Transvaal the year 1891 was a phenomenal one, the output of the Witwatersrandt mines having amounted to 729,223 oz. against 494,801 oz. in 1890. The regularity of the advance in the yield of these mines month by month for the past four years, or since they were first opened, leaves no doubt that their maximum capacity has not yet been reached. Indeed the year 1892 has been commenced by a remarkable increase, the production during the month of January having amounted to 84,560 oz. against 80,312 oz. in December, this having been the greatest output in any one month in the history of the district. The production of the four principal gold mines of Mysore, India, which practically represents the total gold output of that country, was also considerably greater in 1891 than in 1890, amounting to 130,140 oz. against 104,500 oz. Here, too, the output has shown such a regular expansion during the past three years that it is probable that the climax has not yet been attained, and a steadily increasing yield may be expected from this source.

According to statistics, the United States, Australasia, Russia, Africa, and India produced in 1890 a trifle more than 83 per cent. of the total amount of gold produced in the world. In 1891 each of these countries or natural divisions made an increased output, with the possible exception of Australasia, and in the case of Africa, Russia, and India the increase was large and important.

But there is every reason to expect that new deposits of auriferous gravel and auriferous quartz lodes will be found within the next few years, particularly in the United States, Africa, and Siberia, while it is certain that the extensive and rich beds of gravel in Brazil will not remain unworked much longer. The vast expanse of country forming the north-western portion of the United States has by no means been thoroughly prospected, and new gold mines are constantly being found and opened there. Africa, an unexplored country, bids fair to yield a constantly increasing amount of gold. Pioneers are just going into Mashonaland and Matabele-land, and the reports that they send out are generally favourable. Eastern Siberia is also a land of great promise. Only within the past month has come news of new gold fields at Nertschink, in the valley of the River Boon, which are said to be rich. In Brazil there are immense beds of auriferous gravel, which can be worked without difficulty. No doubt is felt that the production of gold in the world will show as great an increase in the present decade as it did from 1880 to 1890, when it rose from 160,152 kilos. to 174,556 kilos.—W. S.

The Basic Bessemer Process applied to the Metallurgy of Lead. Rev. Univ. des Mines et de la Met. Jaouary 1892; Eng. and Mining J. 53, 1892, 431.

DR. ROESING, formerly director of the Friedrichshütte works in Upper Silesia, has applied the basic converter to the treatment of base bullion. By this process the lead is oxidised to litharge, which is then reduced by carbon or by galena. A part of the lead may be desilverised by zinc and refined in the converter. The following processes constitute the new system: A. treatment in the converter; (1) of base bullion for pure litharge and enriched lead; (2) enriched lead for impure litharge and lead-silver; (3) desilverised lead for refined lead. B. reduction of the pure litharge by carbon for merchantable lead. C. treatment of the galena with molten litharge for base bullion. The most interesting and most important of these innovations is the treatment of the base bullion in the converter.

Calorific calculations having led to the anticipation of favourable results, experiments were made with this process in the laboratory in quantities of 500 grms.; then with charges of 6,000 kilos. in a Thomas converter at the Friedrichshütte in Upper Silesia. The method presented no difficulty; the charge of 6,000 kilos. of base bullion was blown for 15 minutes with air pressure of $1\frac{1}{2}$ atmospheres. The lead had been heated previously a little above its melting point. The litharge formed had a temperature of more than $1,200^{\circ}$ and was very fluid. It crystallised in mass on cooling without formation of any amorphous litharge, and fell in scales. The silver contents of the litharge were 0.0036 per cent., but could be diminished in regular working.

In treating poor, impure and zinciferous lead the refined lead obtained in a few minutes was of excellent quality and the following composition: Lead (by difference), 99.9934 per cent.; antimony, 0.0007 per cent.; arsenic, 0.0005 per cent.; copper, 0.0013 per cent.; iron, 0.0022 per cent.; zinc, 0.0015 per cent.; silver, 0.0004 per cent.

In consequence of the great increase of temperature in the converter during the blowing, new charges may be worked immediately without reheating the vessel, so that there is no delay in the process. In regular operation it would possibly pay even to utilise the heat obtained in the converter for the fusion of the lead.

The basic lining of the converter stood perfectly. The engineers of the Friedrichshütte steel works declared "that they are satisfied that the basic lining will last better in treatment of lead than in the manufacture of steel."

The impurities of the lead (zinc, arsenic, and antimony) are removed in a more rational manner than in the common process since the blast acts uniformly throughout the mass and not merely upon the surface of the bath; the latter is to-day, purified first, then uselessly oxidised, while the impurities contained in the lower strata of the metal are a long time withheld from the action of oxygen. There results therefore an oxidation, which is superfluous and injurious to the lead. In the new process it is necessary to take into account the reduction in the expense of treatment and the loss in the working of intermediary products. As for the loss in blowing there is produced naturally in that operation very thick lead smoke, but as it is of very short duration, the amount is small and it can be easily recovered because it is not mixed with combustion products. In this process there is a saving in comparison with cupellation, according to the calculations made at the Friedrichshütte, of 18 marks and 94 pfennig (4.50 dols.) per 1,000 kilos. of base bullion. As for enrichment of the lead it is recommended not to carry it too far at once, but rather to interrupt the blowing at intervals and unite the lead of several charges which can be submitted to a new operation for enrichment.

In the experiments at the Friedrichshütte with base bullion containing 0.0425 per cent. of silver, lead assaying 0.673 per cent. silver has been obtained as a maximum and condensed fumes with 75 per cent. lead and 0.0086 per cent. silver.

The litharge obtained is very liquid and can be reduced in a very simple manner by pouring it on a bed of incandescent carbon in a special furnace by which it is immediately reduced. The same furnace may be employed for the treatment of the galena. The latter is comminuted to fine grains and heated to the point where roasting commences. If the liquid litharge is spread on this galena it is rapidly decomposed with the evolution of sulphurous acid gas which is mixed neither with an excess of air nor with combustion products, and consequently can be recovered easily. The rapidity of the decomposition of the litharge by carbon or by the galena permits of a large production in small apparatus, and the consumption of fuel amounts only to that required in the preliminary heating. The amount of labour necessary and the loss in metal are both very small.—W. S.

The Passive State of Iron and Steel. Part II. Thos. Andrews. Proc. Royal Soc. 50 [303].

In Part I. of this research (Roy. Soc. Proc. 48, 116; this Journal, 1890, 951), the author showed the influence of

magnetisation on the passive state of iron and steel, and now the results of a further study of certain temperature and other conditions affecting the passivity of these metals in concentrated nitric acid are given. The experiments of Series III. in this paper relate to the effect of temperature, and the observations of Series IV. refer to the influence exerted by nitric acids, of various degrees of concentration, on the passive condition of iron and steel.

SERIES III.

Effect of Temperature on the Passivity of Iron and Steel.—The bars selected for these observations were unmagnetised polished rods, which had been previously drawn cold through a wortle; a pair of bars of each metal were cut adjacently from one longer bar, and then placed securely in the wooden stand W; each bar was $8\frac{1}{4}$ ins.

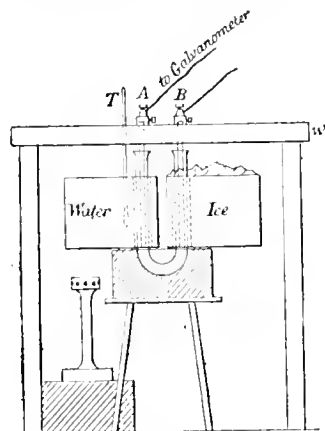


Fig. 1.

long, 0.261 in. diameter. The U-tube, containing $1\frac{1}{4}$ fluid ounce of nitric acid, specific gravity 1.42, was rigidly placed in an arrangement as shown in Fig. 1. One limb, A, was surrounded by a tank containing water, the other limb, B, by a tank of the same capacity, containing powdered ice; the arrangement was such that the water-tank could be heated by a Bunsen burner, and its tem-

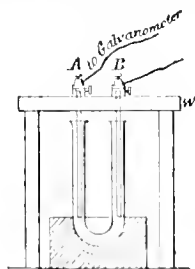


Fig. 2.

perature slowly raised, whilst the ice-tank was kept full of powdered ice. A non-conductor of wood was put between the ends of the two tanks so as to prevent the melting of the ice; the bottom or bent portion of the U-tube was also enclosed in a thick non-conductor of wood. A thermometer, T, was placed in the water-tank. The bars were in circuit with the galvanometer, and soon after immersing them in the nitric acid heat was applied to the water-tank, and the temperature of the nitric acid in that limb of the U-tube slowly raised to the temperatures required, whilst the acid in the other limb of the U-tube was meanwhile maintained at a temperature of 32° F. The arrangement will be understood on reference to Fig. 1. Current between two bright "passive" bars of the same composition, one in warm, the other in cold, nitric acid, sp. gr. 1.42. The electro-chemical position of the bars in the warm nitric acid was positive. The experiments show that the wrought iron was less passive in the warm nitric

TABLE III.

Time from commencement of Experiment.	Current between two bright "passive" wrought-iron or various steel bars of the same composition, one in cold nitric acid, specific gravity 1.50, the other in cold nitric acid, specific gravity 1.42. The electro-chemical position of bar in weaker acid positive, except otherwise stated.				
	E.M.F. in Volt.				
	Wrought Iron.	Soft Cast Steel, combined Carbon 0.57 per Cent.	Hard Cast Steel, combined Carbon 1.60 per Cent.	Soft Bessemer Steel, combined Carbon 0.55 per Cent.	Tungsten Steel, combined Carbon 1.75 per Cent.
Seconds.					
0	0.086	0.041	0.055	0.055	0.038
30	0.077	0.040	0.055	0.052	0.038
Minutes.					
1	0.076	0.036	0.054	0.053	0.041
2	0.074	0.036	0.053	0.056	0.043
3	0.073	0.038	0.053	0.058	0.048
4	0.072	0.040	0.052	0.060	0.048
5	0.072	0.041	0.052	0.061	0.049
7½	0.071	0.041	0.050	0.067	0.050
10	0.069	0.041	0.049	0.071	0.050
15	0.066	0.040	0.048	0.074	0.050
20	0.064	0.037	0.046	0.077	0.049
25	0.062	0.035	0.043	0.074	0.049
30	0.060	0.034	0.042	0.072	0.048
35	0.059	0.033	0.040	0.071	0.048
40	0.058	0.031	0.038	0.071	0.047
15	0.056	0.030	0.038	0.070	0.047
50	0.055	0.029	0.036	0.068	0.046
55	0.054	0.029	0.036	0.067	0.046
Hours.					
1	0.053	0.028	0.035	0.066	0.045
1½	0.051	0.025	0.034	0.061	0.044
2	0.049	0.022	0.033	0.058	0.043
2½	0.048	0.020	0.033	0.055	0.041
3	0.047	0.019	0.033	0.052	0.041
4	0.046	0.018	0.034	0.050	0.043
5	0.045	0.017	0.034	0.049	0.040
6	0.044	0.016	0.034	0.048	0.038
7	0.044	0.015	0.034	0.047	0.037
8	0.044	0.015	0.034	0.047	0.037
10	0.040	0.009	0.030	0.047	0.037
18	0.040	0.006	0.029	0.046	0.037
20	0.040	0.008	0.029	0.046	0.037
21	0.040	..	0.029	0.031	0.040
22	0.040	..	0.024	..	0.043
24	0.038	..	0.019	..	0.043
26	0.038	..	0.016	..	0.043
28	0.039	..	0.013	..	0.043
29	0.038	..	0.012	..	0.043
30	0.040	..	0.011	..	0.043
40	0.042	..	0.006	..	0.024
45	..	..	..	..	0.034

TABLE IV.
CHEMICAL ANALYSIS OF THE WROUGHT-IRON AND STEEL BARS USED IN THE EXPERIMENTS.

Description.	Combined Carbon.	Silicon.	Sulphur.	Phosphorus.	Manganese	Tungsten.	Iron (by difference).	Total.
	Per Cent. Trace	Per Cent. 0·224	Per Cent. None	Per Cent. 0·239	Per Cent. 0·071	Per Cent. ..	Per Cent. 99·466	Per Cent. 100·000
Wrought iron (Wortley best scrap)...								
Soft cast steel.....	0·570	0·032	Trace	0·066	0·147	..	99·185	100·000
Hard cast steel	1·600*	0·145	0·002	0·025	0·183	..	98·045	100·000
Soft Bessemer steel	0·550	None	0·032	0·175	0·216	..	99·027	100·000
Tungsten steel.....	1·750*	0·135	0·069	0·139	0·720	9·270	87·917	100·000

* By combustion.

The terms "soft" and "hard" relate only to difference of percentage of combined carbon, and not to their having undergone annealing or hardening processes.

TABLE V.
PHYSICAL PROPERTIES OF THE WROUGHT-IRON AND STEEL BARS USED IN THE EXPERIMENTS.

Description.	Original.		Ultimate Stress.			Fractured.				Stress per Square Inch of Fractured Area.	Extension in 10 in.		Appearance of Fracture.
	Size.	Area.	Total.	Per Square Inch of Original Area.		Size.	Area.	Difference.			Inch.	Per Cent.	
								Area.	Per Cent.				
Wrought iron (Wortley best scrap.	In. 0·296	Sq. In. 0·0688	Lb. 6,628	Lb. 87,618	Tons. = 39·1	In. 0·284	Sq. In. 0·0633	0·0055	7·9	Lb. 95,229	0·11	1·1	100 fibrous.
Soft cast steel.....	.. ..	.. ..	.. ..	.. ..	55·42	.. ..	.. ..	.. ..	22·0	.. ..	.. ..	2·0	.. ..
Hard cast steel	0·298	0·0697	10,967	157,346	= 70·2	0·289	0·0656	0·0041	5·8	167,179	0·12	1·2	100 granular.
Soft Bessemer steel ...	0·297	0·0693	9,851	142,150	= 63·4	0·275	0·0694	0·0099	14·2	165,811	0·16	1·6	100 granular.
Tungsten steel.....	0·300	0·0700	12,561	179,443	= 80·1	0·270	0·0570	0·0130	18·6	229,368	0·73	7·3	10 silky. 90 granular.

acid than the soft cast steel; the average E.M.F. of 94 observations with wrought iron was 0·030 volt; whereas in the case of the 94 observations on cast steel the average E.M.F. was only 0·010 volt. The behaviour of the steel, under the conditions stated, was more irregular than that of the wrought iron.

In the whole of the series of experiments the nitric acid was raised to a temperature of 175° F.; the cold nitric acid in the limb of the U-tube A remained perfectly colourless, and the steel or iron therein absolutely passive; but the steel or iron in the warm nitric acid in tube A commenced to be gradually acted upon as the temperature increased, a pale yellow tint beginning to appear in the solution in the tube A shortly after commencement. When the temperature of about 170° to 175° F. was reached, a faint evolution of gas in the form of bubbles was manifest, adhering to the steel, in the warm tube only. No powerful solvent action or violent evolution of nitric-oxide gas, however, occurred in any of these experiments even up to the temperature of 175° F., and these experiments were not continued beyond this temperature. These results show that iron or steel does not fully lose its passivity up to a temperature even of 175° F., though the passivity is shown to have been considerably modified by temperature only. The critical point of temperature of transition from the passive to the active state is therefore higher than 175° F., and is shown in the experiments of Part I., Series II., Table II., to have been about 195° F. (this Journal, 1890, 951).

SERIES IV.

The Passivity of Iron and various Steels increases with the Concentration of the Nitric Acid.—Schönbein considered that "by immersing an iron wire in nitric acid 1·50 sp. gr., it became likewise indifferent to the same acid of 1·35 sp. gr.," and to all outward appearance this is so. Scheurer-Kestner considered that the passivity of iron was not dependent on the greater or less degree of saturation of

the acid. The author, however, ascertained by the delicate electro-chemical mode of experimentation employed, and hereafter referred to, that the passivity is materially influenced according to the concentration of the nitric acid. The following experiments indicate that the property of passivity in iron is not absolutely fixed or static, but that its passivity is modified to a certain extent in relation to the strength of the nitric acid used. The *modus operandi* was generally similar to that previously employed. Pairs of unmagnetised polished steel bars, 6 in. long and 0·310 in. diameter, each pair being of the same kind of steel, and cut adjacently from one longer bar, were placed as before in the wooden frame W (Fig. 2), and then instantly and simultaneously immersed in nitric acids, of two different degrees of concentration, contained in the U-tube arrangement, one limb of the U-tube containing red fuming nitric acid of sp. gr. 1·50, the other containing nitric acid of sp. gr. 1·42, circuit being made through the galvanometer in the usual manner. The results, the average of repeated experiments in each case, are given in Table III., and show that the passivity of iron increases considerably with the strength of the nitric acid.

The steel rods selected for this set of experiments were of the kinds given in Table IV.; they were drawn cold through a worte, and were of the general physical properties and chemical composition given in Tables IV. and V. The reduction of the E.M.F. towards the close was probably owing to partial diffusion between the two acids of different concentration. The above results show that wrought iron was less passive in the weaker acid than most of the steels, the soft Bessemer steel being found similar in passivity to the wrought iron. The average E.M.F. was as follows:—With wrought iron, 0·054 volt; soft cast steel, 0·028 volt; hard cast steel, 0·036 volt; soft Bessemer steel, 0·059 volt; tungsten steel, 0·039 volt.—W. S.

Parting Bullion. F. Gutzkow. Eng. and Mining J.
53, 1892, 497—498.

It is stated that the process works regularly and with best success, the refining costs being 0.35 cents per ounce. Considering that in Argentine, Kansas, the wages of the men employed at the plant are 3 dols. and 4 dols. per day, and the cost of sulphuric acid $1\frac{1}{2}$ cents per pound, elsewhere refining may doubtless be done at 0.25 cent per ounce. Parting charges average 1 cent per ounce in the eastern half of the United States and 2 cents per ounce in San Francisco, so the pecuniary advantage is apparent. In the following is described the plant and the operations of one of those small establishments having a maximum capacity of parting, say, 6,000 oz. of doré in the day-shift by the author's improved process. Fig. 1 shows the plant in top-view and Fig. 2 in section.

1. *Parting.*—It is assumed that the bullion is of the common high grade character, containing 90 per cent. or more of silver. It may be placed in the kettle in the shape in which it leaves the mill or smelting works; that is, as retorted amalgam or in large and irregular bars as they are ladled from the cupelling furnace, or in slabs of more uniform size and thickness if the bullion is re-melted in order to charge it to the parting works by weight and assay. The charge may vary according to local convenience, the maximum being about 400 lb. of doré. The commercial sulphuric acid is admitted into the kettle by gravitation from the wrought-iron drum which serves as a reservoir, and ought to be large enough to hold the 50,000 to 60,000 lb. of acid shipped in a "tank car." One or more old steam boilers may be arranged for this purpose, and the acid may be raised into them by exhausting the air therefrom by a steam jet. The consumption of sulphuric acid of 66° B. need not, and after some practice will not, exceed materially the stoichiometrical proportion, which is 1 lb. of acid for one of silver, as all surplus acid evaporated or required for dissolving the silver sulphate is regained and utilised in the course of the process.

For a beginner it is advisable to employ between the kettle and acid reservoir a small cast-iron tank as an intermediate reservoir in which the acid required for the charge of bullion under treatment may be measured off.

It will be noticed in the figure that the usual half-globe shape of the parting kettle is discarded, but a flat bottom with a pocket or well in the centre in the shape of a spherical segment is used. To gain more capacity for equal height is one reason for this construction, but the most important one is that the bottom can be reached everywhere by a straight-edged stirrer or paddle, and, practically speaking, that every particle of gold can be scraped into the pocket and be taken therefrom with a ladle. This is not possible in a round-bottom kettle in the position in which the refiner has to work.

The dissolving of the stated maximum charge takes from four to six hours, according to the heat employed. When the larger half of the bullion appears to be dissolved "mother-acid" is added from 7, a pitcher or two at a time, until the charge is completely dissolved.

The fire is now moderated and the kettle is gradually filled with mother-acid within an inch or two from the top. These gradual additions are regulated by the temperature of the solution in the kettle, which ought to be so that only faint fumes are discernible. If the fuming stops entirely it signifies that the temperature has become too low, and that silver sulphate may separate. The gold ought to keep its bright colour during this operation, which presents no difficulty. At larger works, for instance at Argentine, the mother-acid is lifted by steam power, but lifting by hand is sufficiently convenient for the small plant under description. The well-stirred contents are now ready for settling, and the fire is still further moderated. Ten minutes is all the time required and given for settling, that is, for obtaining a perfectly clear solution of silver sulphate, which may be safely siphoned off the insoluble residue without carrying any gold along. This rapid settling is due to the change of the iron sulphate formed during dissolving from a yellowish slowly subsiding salt into a greenish flocculent compound, which carries all suspended matter readily to the bottom. The solution is now siphoned into the open cast iron pan 6.

A $\frac{3}{4}$ -in. gas pipe, which is suitably bent and ends in a "return elbow" resting on the bottom of the kettle, is used as a siphon. The proximity of 6 to 5 has the advantage that only a short siphon is required.

2. *The Gold.*—The residue in the kettle contains, besides silver solution, the gold and the insoluble sulphates of iron, lead, antimony, mercury, &c., together with sulphate of copper, if the bullion contained more than a certain amount of this, and sulphate of silver if the heat has not been well regulated. It is ladled into a portable copper kettle (the solution settling therein is poured back into 5), which is carried to the lead-lined tank 8. Here it is emptied, and the contents are boiled with water until the sulphates soluble in water, viz., those of iron, copper, and silver, have dissolved. The fairly settled solution runs on the "gold filter," which is a piece of cotton cloth spread over a false bottom in the tank 9. The filtered solution finds yet a chance to settle underneath the false bottom and overflows into the "silver filter" 10. The gold is brushed and washed through a pipe toward which the bottom of 8 pitches from all sides into a large earthen dish resting on the cloth of 9. In this dish it is stirred with hot water and decanted over the cloth until the insoluble sulphates have been washed off and the gold is left bright and clean. It is then scraped into a smaller dish and delivered to the superintendent to be melted in the assay office when sufficient weight has been accumulated for a commercial bar.

Of course it will be just as well or better to deliver the copper kettle with its acid contents to the care of the superintendent, and to make one job of the washing of the several batches of gold when there has been enough collected. The cloth on 9 is scraped and sponged into an earthen jar, and, after settling, is decanted back on 9. The stuff collected is occasionally dried and melted with the fluxes from melting the gold and silver into a button. The appearance of the latter decides whether it can go at once into the parting kettle or is to be cupelled with addition of some lead in a bone-ash cupel, stamped into a worn-out crucible, and heated in the melting furnace.

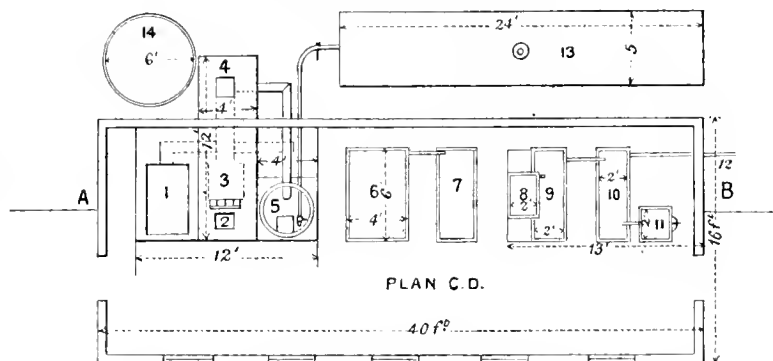
3. *The Silver.*—The great bulk of the silver is in the hot solution which stands in 6, about 6 in. high, when the plant works to its maximum. Steam is now blown in and the solution is tested for sufficiency of dilution in the manner fully described in my previous article. The diluted acid, which is caught in the leaden condenser-pipe leading from 5 to the chimney, may occasionally be mixed in for utilisation when the steam has raised the temperature high enough to allow such addition without causing a precipitation of silver sulphate. The solution is now allowed to cool over-night.

In Argentine, water cooling is used, but it is hardly necessary in San Francisco. In the morning the mother-acid is allowed to run off into the cast-iron reservoir 7. Through an iron pipe toward which the bottom of No. 6 slopes, the crystals are detached by an iron shovel, and are thrown on the false bottom of the draining-box 11, which runs on wheels and has been moved to 6. They are sprinkled with water, and the first drainage, down to a certain specific gravity, is run back into 6. The box 11 is then moved into the position shown in the Figure. Here cold water is allowed to percolate through the crystals until the free acids and the sulphates of iron and copper are removed. The liquid runs on the silver filter 10, where all silver which it holds in solution is retained, and it escapes finally through the pipe 12. The silver filter is a lead-lined box provided with a false bottom. It is filled to about 6 in. above the false bottom with precipitated copper. The silver separates on the top of the copper as a spongy sheet, a corresponding amount of copper being dissolved. Once or twice the sheet is loosened and turned in order to expose what copper may cling to it to the first action of the silver liquid entering. When the sweetening of the crystals has been finished and the crystals have been removed from 11 for further treatment, the silver separated in 10 is thrown on the false bottom of 11, a shovel of crystals is added, and 11 is filled with hot water and left at rest. By the time that 11 is again required to receive another batch of crystals from 6 all copper which the silver sponge may have still

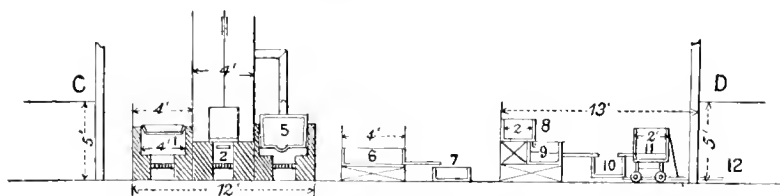
retained has been dissolved, the liquid is run on 10, and the silver is left in 11 to be mixed with the new charge of crystals. In practice the total amount of silver thus

rendered metallic does not exceed 3 per cent. of the whole, as the crystals of silver sulphate are only slightly dissolved by cold water.

GUTZKOW'S PARTING PROCESS.



ARRANGEMENT OF PLANT.



BULLION PARTING PLANT.

1, drying pan; 2, melting furnace; 3, dust chamber; 4, chimney; 5, parting kettle; 6, crystallising pan; 7, reservoir for mother-acid; 8, lead-lined tank for boiling gold; 9, do. for "gold filter"; 10, do. for "silver filter"; 11, do. for draining crystals; 12, outlet of all liquids; 13, reservoir for commercial acid; 14, hot water tank.

The sweetened crystals from 400 lb. of bullion, which measure about 2 cb. ft., are now thrown on the drying-pan 1. When dry they are mixed with 5 per cent., more or less, of charcoal, the weight of the charcoal which is necessary being ascertained approximately from the known weight of the bullion which has furnished the batch of crystals under treatment. The mixing is done on the pan 1 itself and the mixture is at once fed into the hot crucible in the melting furnace 2. The silver sulphate is reduced at a very low temperature, that is, at just red heat, into metallic silver, carbonate and sulphurous gases being evolved and escaping without causing any trouble whatever, every trace of these gases having been removed by the time the temperature of melting silver is reached. The surplus of charcoal is finally lifted off the molten silver and reserved for mixing with the next charge of crystals. The silver is cleared by borax and toughened with nitre until the so-called "boiling" indicates that spitting needs to be apprehended no further. After cooling to the proper temperature it is ladled into moulds, a little assay bar being cast from the first and last ladle, and the crucible is again charged with the mixture of crystals and charcoal.

Those who are familiar with the author's old San Francisco process from its description in "Percy's Metallurgy" will notice that the treatment of the silver as here described contains three essential novelties, namely: First, the dilution of the original silver solution by steam, which forms the claim of his patent, and enables him to work with only one-third of the volume of "mother-acid" previously employed. In addition, it dispenses with certain cumbersome apparatus. Second, the desilverisation of weak silver solutions over a bed of precipitated copper, which replaces their storing in capacious lead-lined tanks for re-utilisation or for treatment with copper, or iron, or salt. Anybody who knows of the difficulty of getting a plumber who understands lead burning with the hydrogen flame to an out-of-the-way place, or has heard of the lead-burners' union, will appreciate the reduction of size and number of lead-lined tanks. The few small

tanks used are shipped ready-made from Chicago. Third, the direct reduction in the crucible of the silver sulphate with charcoal. His former practice had been to reduce the crystals to the metallic state by percolating them in the draining-box 11 with a hot solution of ferrous sulphate. The ferric solution which was thus formed was made again ferrous by metallic iron and used over again. The silver was sweetened with hot water, then dried and melted. The advantages of the new method need hardly be discussed.

4. *The Copper.*—The liquid which flows from 12 removes all the copper which the bullion did contain, and all that which has been dissolved in the silver filter 11. In parting works, which treat only high grade bullion, the weight of the copper thus escaping is so small that it hardly pays for its recovery. The liquid from 12 may run to waste, and the copper in the silver filter be replenished by preparing occasionally a quantity of it at the works by dissolving bluestone in 8, and precipitating the solution by iron in 9, or by buying some in the market. When, however, the bullion contains a larger percentage of copper than can be economically neglected, the liquid issuing from 12 is carried in the usual manner through troughs or other vessels containing old iron.

This process is common enough, but it requires some judgment. It ought to be known that precipitated copper ought never to be exposed to the atmosphere before sweetening, because certain basic salts of iron are formed which are insoluble even in boiling diluted acid, and that in an acid ferrous sulphate solution, even in this absence of iron, a continual consumption of acid takes place, because the ferric sulphate formed by the atmosphere absorbs more acid than the ferrous sulphate from which it was generated continued, and, lastly, that no copper precipitated from cold or merely warm solution is fit for sweetening by filtration, on the large scale at least, before it has been violently boiled in acid water and thus has been made dense. For parting very low grade bullion with 30 or more per cent. of copper,

the author modifies the process of dissolving in the kettle 5 in a novel manner which he may publish at some future occasion.

5. *The Lead*.—It has been said already that the lead sulphate is washed from the gold by decanting. The amount of lead in the residue taken from the parting kettle is, however, very small, much less than is generally assumed, and almost *nil* when, as ought to be done in larger establishments, the gold is subjected to a second boiling with sulphuric acid. The sulphuric acid process in this surpasses the electrical method of parting. By the latter a number of substances, among which are quite unusual ones, as, for instance, tellurium, separate with the gold and have to be removed by special treatment. The vaunted simplicity of the electrical process may well be questioned when it is known that it includes a boiling of the gold with nitric acid with all the appliances and operations of a miniature parting plant working by that old-fashioned process. In the sulphuric acid process, at least by his method, all the gold in the bullion which is placed into the parting kettle in the morning is delivered in the evening as a fine and tough bar, except what traces cannot be scraped from the kettle, and what the sponging of the gold filter may have removed. The principal part of the lead in the bullion, provided the latter contains of it only a few per cent., is dissolved in the hot silver solution.

In the old style of parting this solution is poured into a tank containing water and copper, and every trace of lead sulphate consequently intermingles with the silver to be removed therefrom by fluxing and toughening. By the author's modification the lead sulphate separates on diluting the solution by steam, and has subsided by the time the formation of crystals commences. It coats, therefore, the crystals where they have touched the crystallising pan. The following method for removing the lead sulphate is employed, whenever the character of the bullion makes it necessary to do so:—The crystals of silver sulphate are not directly shovelled from 6 into the draining-box 11 as described above, but are thrown into a small lead-lined tank filled with water, are stirred therein, and finally taken out with a wooden shovel and thrown into 11. The powdery sulphates of lead, antimony, &c. are very readily washed off the heavy, hard, and large-sized crystals. What is left behind in the wash-tank is heated by steam, the solution is run over the silver filter, while the residue of lead sulphate, &c. is made metallic by adding some iron, and finally washed, melted, and cupelled.—W. S.

The Gold and Platinum Industry of the Ural. Annales des Mines, 18, 537, and Eng. and Mining J. 53, 430.

The auriferous deposits of the Ural have been classified by Karpinsky into primary and secondary groups. In the former gold is found either in quartzose vein-stuff, or interspersed through the mass of crystalline rocks, such as diorite and serpentine, while the secondary deposits are auriferous sands, situated either immediately above the primitive deposits, or transported to and re-arranged at some distance from the point of origin. Platinum is only found in secondary or alluvial deposits. The primary gold deposits of the Ural are very numerous, four groups of them being actually worked—namely, those of Berezowsk and Goroblagodask, of the district of Miask, of the Baschkir territory, and of the Orenburg Cossacks.

The Berezowsk deposits, which are the only ones that have been systematically developed to any extent, are included in an area of about 22 square miles, in which the prevailing rocks are schists penetrated by numerous veins or dykes of a fine-grained granitic rock containing pyrites known as beresite, varying in thickness from 12 ft. to 120 ft. and upward, many of which extend beyond the limits of the mining region. The beresite dykes are traversed by numerous fissures filled with quartz, forming veins varying in thickness from about 10 mm. to 70 mm., or, on an average, 30 mm., having a general east and west course, often uniting into groups but never becoming parallel to the enclosing dyke. Sometimes, but rarely, they pass from the beresites into the neighbouring schistose rocks. The

vein-stuff, as well as the rock, where most auriferous, is rusted from the decomposition of pyrites; the best mines yield from 1 to 1½ oz. per ton, 10 grms. (about 7 dwts.) being considered as the lowest workable limit. The pyrites is often much richer than the quartz, in some instances averaging up to 6 or 7 oz. per ton. Below the level of decomposition of the pyrites into gossan, or as it is locally called, *krassiks*, the gold appears to be entirely contained as sulphide.

The secondary auriferous deposits, although called sands, are almost entirely clays, pure or somewhat sandy, and enclosing rolled masses and blocks of many different rocks. They are found throughout the whole Ural region over a length of more than 500 miles, having filled the valleys and forming marshy plains on both slopes of the chain, the larger development being, however, on the eastern side.

Gold is found in the alluvium in particles of all sizes up to large nuggets, accompanied by many other minerals, such as palladium, platinum, osmiridium, native copper, diamond, cinnabar, iron pyrites, magnetite, chromite, specular iron ore, rutile, brookite, anatase, corundum, garnet, and quartz. Speaking generally, the deposits associated with rocks containing hornblende and augite are richer than those in which granite and gneissic rocks prevail.

The auriferous beds vary in thickness from about 1½ ft. to 3½ ft., in breadth from 60 ft. to 150 ft., and exceptionally to about 300 ft., and in length from 60 ft. or 80 ft. to 1,500 ft., the direction being generally parallel to that of the chain. The most extensive deposits are those of Balbuk, 2½ miles, and Stolbuk, 3½ miles long. The sterile covering or over-burden is usually less than 13 ft., although exceptional deposits have been found at 60 ft. and even 130 ft. below the surface. The cover very frequently forms peat bogs. The amount of gold varies from 12 to 39 grs. per ton of sand, although occasionally it is double or even four times the latter amount.

Platinum has not up to the present time been found except in alluvial deposits, in which it is always associated with gold; sometimes the latter predominates, and the platinum may not exceed 1 per cent. of the product. On the other hand, gold may at times be almost absent, and the deposits in which this condition prevails, although less abundant, are those of most value. They are confined to districts of Nischne, Tagil, Goroblagodask, and Biseik. In the first of these localities they extend for about 25 miles to the south of the village, and from the associated minerals, such as olivine and chromite, they appear to be derived from the waste of a mass of serpentine known as Mount Solvaïska or the White Mountain. The platinum is found in grains and nuggets, the largest of the latter weighing about 320 oz. The yield varies from 39 to 195 grs. per ton. The richest deposits, those of the Martiane River, are from 13 ft. to 16 ft. thick, and are covered by 60 ft. or 70 ft. of overburden, chiefly consisting of clay. The conditions of occurrence in the other localities are similar to those described above, except at Goroblagodask, where the bed rock of the alluvia is limestone, but outcrops of porphyry and serpentine are found in the vicinity.

The gold deposits are partly the property of the Crown or its lessees, and partly of private individuals, but in the latter case there is often a reservation of minerals which are subjected to special royalty rents. The rate paid by the Crown lessees is from 8½ per cent. to 20 per cent., in addition to which a 3 per cent. tax is levied on all gold produced in any of the mines, the product being compulsorily saleable to the State. Platinum working, on the contrary, is free from all taxation, and the government monopoly of refining, which was kept up for a time, having been abandoned, the product is mostly placed in the London and Paris markets.

In working the alluvial deposits two methods are followed. In the first the plant and apparatus are provided by the ground owner, who hires labour and directs the operations, either personally or by deputy; while in the second a system of tribute is followed, the ground being let to free workmen or *starateli*, who provide everything necessary for working, and deliver the produce at a fixed rate to the proprietor. This price may vary with the difficulty of working, from 9 dols. to 10·50 dols. per oz.; but in all cases

the prime cost in the proprietary workings is higher than in those of the free labourers, who are able to handle, to a profit, stuff with from 8 to 10 grs. of gold per ton. Platinum sands are considered poor when containing less than 45 grs., and rich when above 180 grs. per ton. The lowest profitable limit seems to be about 39 grs.

The platinum workings of Avrorinski are at present the most important operations of their class. The deposits, from 13 ft. to 16 ft. thick, lie upon a conglomerate of serpentine, are covered by nearly 80 ft. of dead ground, and extend for about $1\frac{1}{2}$ miles, with a breadth varying between 70 ft. and 250 ft. The average yield is about 87 grs. of platinum minerals per ton, but in places it goes up to 20, 30, or even 50 times as much. The working is entirely subterranean, small pits 70 ft. to 80 ft. apart being sunk to the deposit, and the material, being drawn to the surface by windlasses, is washed in the ordinary Siberian frame at the mouth of the pit. About 400 hands are employed, the work going on night and day.

The crude platinum contains about 1 part in 4,000 of gold, which is separated by amalgamation and washing with water in large capsules. The final product contains 90 per cent. of platinum. The whole of the gold produced in the Ural and Siberia is sent to the Government assay office at Ekaterineborg, where it is melted and cast into bars, the assay of which forms the basis of final settlement between the Government and the miners.—W. S.

Determination of the Value of Commercial Aluminium.
Chem. Zeit. Rep. 1892, 16, 4.

See under XXIII., page 548.

The Action of certain Liquids on Aluminium. G. Lunge.
Eng. and Mining J. February 13, 1892, 296.

See under XVIII., page 543.

PATENTS.

Improvements in the Extraction of Precious Metals from Ores. W. T. Rickard, London. Eng. Pat. 6479, April 15, 1891.

THE finely pulverised ore, either raw or roasted, as the case may be, is charged into an iron tank with a semicircular bottom, and is mixed with water to a thin pulp by means of a revolving horizontal shaft carrying iron discs, set at an angle. The temperature is then advantageously raised by steam to about 180° F. and, while the discs are revolving a solution of acid mercury sulphate and a small quantity of the metal are added to the pulp. After half an hour the rate of rotation is diminished so as to allow the amalgam to settle, whilst the tailings are washed away by a stream of water; or the mass is run into a settling tank of similar construction to the above but furnished with amalgamated copper discs instead of iron ones; or the usual course of running over amalgamated copper plates with the ordinary mercury traps may be pursued.

Wooden tanks and scrap iron may be used instead of iron tanks for the amalgamation. The evolution of hydrogen is regarded as an important auxiliary. It is claimed, owing to the precipitation of metallic mercury within the mass, that even the finest particles of gold and silver are amalgamated by the atom treatment. The precious metals are recovered in the ordinary way from the amalgam.

Refractory ores are first roasted in a furnace constructed with a number of superposed hearths, with a fire-grate at one end of the lowest hearth, whilst the space above the uppermost hearth communicates with the first of a series of settling chambers, having the inlets and outlets alternately at the top and the bottom; hence hot gases in traversing them have to assume a zig-zag course, which facilitates the deposition of suspended matters. In the side of the furnace doors are provided for each chamber and hearth, and the latter have also an opening in the middle of the bed,

through which ore settling on them can be discharged into a truck placed beneath the lowest hearth. The pulverised ore is fed from a hopper fitted with a screw or other regulating appliance, through an elongated horizontal pipe, into the throat of the furnace, where it encounters a blast of hot air, and is projected on to the end edge of one of the hearths. By this means the ore is scattered, kept in motion, and carried along by the gaseous current, and a suitable temperature being maintained the desired oxidation ensues.—D. A. L.

New or Improved Metallic Alloys. S. Pearson and J. H. Pratt, Birmingham. Eng. Pat. 8137, May 12, 1891.

PATENTEES make various alloys by any means, but ordinarily by first melting either copper and nickel together or previously prepared copper-nickel alloys and then mixing in the zinc. The proportions are varied according to the character of the product required, but the following are the proportions preferred:—

Nickel.	Copper.	Zinc.	Nickel.	Copper.	Zinc.
Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
$\frac{1}{2}$	59 $\frac{1}{2}$	40	6	46	48
1	58	41	7	43	50
2	56	42	8	42	50
3	54	43	9	41	50
4	51	45	10	40	50
5	49	46			

The first three yield superior brass or bronze, giving a smoother surface than ordinary brass when cut, filed, or turned; the fourth, fifth, and sixth are similar but harder, whilst the subsequent mixtures exhibit a progressive hardness and are sufficiently white to replace German silver.

To give the alloys a fine close grain and to render them more malleable and ductile they are vigorously stirred when in a molten state with a mixture of 100 parts of manganese dioxide, or carbonate, 50 parts of borax, and 25 parts of potassium or sodium nitrate, or an equal weight of carbon, using $\frac{1}{2}$ to 3 oz. of this mixture for each pound of alloy. Whereas an addition of $\frac{1}{4}$ to 1 per cent. of aluminium to the alloys is made when greater tensile strength is required.

All these alloys may be rolled and drawn hot.—D. A. L.

A Process for Extraction of Antimony from its Ores, and Separation of other Metals therefrom. A. W. Warwick, London. Eng. Pat. 8415, May 15, 1891.

By this process the finely pulverised ore is agitated and heated with a solution of an alkaline sulphide or hydroxide, and the filtered liquid is either acidified, to precipitate the antimony as sulphide from which the metal is recovered in the ordinary way, or the liquid may be treated electrolytically and the antimony deposited from it directly as metal.

—D. A. L.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

The Siemens Electrolytic Process for the Extraction of Copper from the Ores. Eng. and Mining J. **53**, 1892, 327 and 329.

COPPER has hitherto been extracted from its ores in the electrolytic way by using as anodes either plates of impure copper or copper matte. The copper was then dissolved from the anode and precipitated galvanically at the cathode. Only a part of the electric current was utilised, however, for dissolving the copper, the solution soon became poor in copper, and had to be replaced by a new solution, the formation of which from the ores was attended with expense and difficulty. Moreover, the use of copper matte for the anodes required a previous smelting of the roasted ore, which forms one of the costly parts of winning copper in the ordinary manner. Finally, the casting of the anode plates is difficult and uncertain, and the electrolytic process itself is interfered with by the falling to pieces of the anodes before their complete solution.

Soluble anodes are, however, necessary in the ordinary electrolytic process, because the use of insoluble anodes leads to strong polarisation whereby the useful work of the electric current is reduced in very great measure. In the Siemens method this evil is overcome by adding to the decomposing copper-carrying solution another solution which takes up the oxygen set free at an insoluble anode, and thereby lessens the polarisation. For such a depolarising solution ferrous sulphate is used, which is changed, by the oxygen set free at the anode, into ferric sulphate. A lixiviant for the copper in the ore is thus obtained, at the same time, as ferric sulphate is capable of dissolving metallic copper, as well as the sulphides of copper.

Instead of the iron sulphates the chlorides, ferrous and ferric, were formerly used with similar results. In this method, however, there were insuperable practical difficulties, so that it was abandoned. The method of Dr. Hopfner differs essentially from that of Siemens, only in that no iron salts are used, but cuprous and cupric chlorides instead; besides the construction of the apparatus is different. The electrolyte used in the Siemens method consists of a solution of ferrous and cupric sulphates, with the addition of some free sulphuric acid to increase its conductivity. This liquid is continually added to the cathode chamber, where a portion of the copper is deposited by the electric current, after which the liquor passes down into the anode chamber, and is finally drawn off at the bottom of the latter.

During this passage downward the ferrous sulphate is changed into basic ferric sulphate; then by the action of the free sulphuric acid, coming from the decomposition of the cupric sulphate it is changed into neutral ferric sulphate, which by its greater specific gravity sinks down to the carbon rods or plates of which the anode is composed. The liquor drawn off has thus become poor in copper and consists of a solution of neutral ferric sulphate. This solution has the property of converting cuprous and cupric sulphides, as well as metallic copper, into cupric sulphate. The ferric sulphate is thereby reconverted into ferrous sulphate, while the oxygen set free oxidises the copper. This oxidation and solution of the copper can be completely carried out with many finely pulverised sulphide ores, even in an unroasted condition, by use of a solution moderately heated. With other ores, however, a moderate roasting of the pulp, by which the copper compounds are converted essentially into cuprous sulphide, must precede the solution of the copper.

The lixiviation of the pulverised ore by means of the decopperised and oxidised liquor is performed in long, narrow, shallow wooden troughs, in which the pulp is kept suspended by means of stirrers. The liquor coming from the electric cells is continually fed at the head of the trough, mixed with the necessary amount of pulp, and leaves the trough with the decopperised pulp at the other end. The solution is hastened, if necessary, by heating the lixiviant by means of a steam-pipe lying in the trough. The leached pulp is separated from the solution either by settling or by a filtra-

tion apparatus. The solution has now become rich in copper and deoxidised, and is fed anew to the electric apparatus. Thus is constituted a continuous process between the leaching of the ore and the electrolysis of the solution, the lixiviant being produced electrically in the decomposition cells and the electrolyte regenerated chemically by the solution of the copper in the ores.

For the successful operation of this process it is necessary that it be carried on continuously night and day. The dynamo should be driven by its own motor in order to secure the most even possible running.

The cost of a plant for the production of 1,000 kilos. of pure copper per 24 hours, for ores containing from 4 per cent. to $4\frac{1}{2}$ per cent. copper, not including buildings, motive power, or foundations, is estimated as follows:—Electrolytic plant, 115,308 marks; ore crushing plant, 31,152·50 marks; leaching plant, 61,140 marks; total, 209,600·50 marks. With ores rich in copper the cost of the crushing and leaching plants is less inversely, as the grade of the ore. The size and number of the electrolytic vats, &c., is the same, whether the ore is rich or poor.

In the above estimate the electrolytic plant includes dynamos capable of precipitating 1,040 kilos. of copper per day, measuring instruments, conductors, 1,200 anodes, and the fittings for 100 baths. Also the following apparatus constructed at the proposed works: 100 wooden boxes (baths), 4,970 mm. long, 1,620 mm. wide, and 370 mm. deep, inside measurement, lined with asphalt; 5 wooden boxes (leaching vats), of 2 cb. m. contents, lined with asphalt; about 500 m. of wooden launders, lined with asphalt, 100 mm. wide and 100 mm. deep; 1,200 wooden slabs (cathodes), 1,520 mm. long, 400 mm. wide, and 25 mm. thick, without the copper plates; 600 wooden gratings (filters), 1·6 m. long, 0·815 m. wide, and 15 mm. thick, made of staves 25 mm. wide, together with 900 square metres of linen; 100 wooden gratings (stirring apparatus for the baths), 4,700 mm. long, 1,560 mm. wide, 20 mm. thick, made of staves 25 mm. wide.

The leaching plant consists of 16 wooden vats, with the stirring apparatus, 4,500 mm. long, 750 mm. wide, and 1,000 mm. deep; one wooden vat, lined with asphalt, for fresh liquor, nine iron vacuum chambers of 3 cb. in. contents, lined with lead, for half-regenerated lixiviant, and three of the same size for regenerated lixiviant; 10 wooden settling basins, lined with asphalt, $2 \times 2 \times 2$ metres; 100 wooden launders, 100 mm. \times 200 mm.; vacuum pumps, stirring apparatus, pipe fittings, filters, &c. The power required for the leaching plant is estimated at 10 h.p.

The crushing machinery, figured in this estimate, consists of three patented ball mills, with a capacity of comminuting 25 tons of ore to the necessary size per 24 hours. The estimate also includes the conveyors, elevators, and other appurtenances. For this part of the plant 45 h.p. is required.

The cost of producing 1,000 kilos. of fine copper per 24 hours, from 4 per cent. to $4\frac{1}{2}$ per cent. ores, is estimated as follows:—Interest on the capital invested in the plant (209,600 marks), at 5 per cent. per annum, 28·75 marks; amortisation of plant, at 10 per cent., 57·50 marks; motive power (130 h.p.), 62·40 marks; labour, 15 men, at 2 marks per man per day, 30 marks; interest on the copper in the baths, 10 marks; fuel for warming the lixiviant, 10 marks; general expense, superintendence, &c., 40 marks; total, 238·65 marks, exclusive of the cost of ore.

The cost of producing 1,000 kilos. of fine copper from ores rich in copper, copper matte, with 35 per cent. Cu for example, is estimated as follows:—Interest on the capital invested in the plant (160,000 marks), at 5 per cent., 22 marks; amortisation, at 10 per cent., 44 marks; motive power (85 h.p.), 40·80 marks; labour, 12 men at 2 marks, 24 marks; interest on copper in the baths, 10 marks; fuel for heating the lixiviant, 10 marks; general expenses, superintendence, &c., 35 marks; total, 185·80 marks.

—W. S.

PATENTS.

Improvements in Ozone Apparatus. Siemens Bros., London. From Siemens and Halske, Berlin. Eng. Pat. 8929, May 26, 1891.

THIS invention relates to improvements in tubes or apparatus for ozonising air. The electrical arrangement of such apparatus has hitherto consisted in interposing between two conducting coatings charged with electricity of opposite sign, one or two dielectric layers and the layer of gas to be ozonised, but according to this invention both the electric coatings are situated on the same side of the dielectric layer and separated by a shield of insulating material; while at a small distance from the other side of the dielectric layer is situated an insulated conducting plate. Thus currents will pass from the part of the dielectric layer below the one electric coating, through the narrow space in which the gas to be treated is situated, to the insulated plate, and from this back again through the gas to the part of the dielectric layer beneath the second coating.—G. H. R.

Improvements relating to the Electrolytic Extraction of Metals and to the Electrolysis of other Substances. C. Hoepfner, Giessen, Germany. Eng. Pat. 9079, May 28, 1891.

THIS invention consists in the use of ferro-silicon for anodes in electrolysis wherever expensive carbon or platinum plates have hitherto been employed. It is well known that this material has already been used by Uelsmann for the cathodes in Bunsen batteries, but this use is restricted to batteries having nitric acid as an exciting liquid, in circumstances where a preserving effect of the electric current is presumed.—G. H. R.

Improvements in or Appertaining to Accumulators for the Storage of Electric Currents. W. P. Thompson, Liverpool. From E. Correns, Berlin. Eng. Pat. 16,270, September 24, 1891.

THIS invention consists in the production of electrodes for secondary batteries by mixing with the active material the silicate of a metallic earth in order to cause the whole to set to a stone-hard mass, with the object of effectively preventing the crumbling and breaking away of the plates. To render the adherent mass porous, so as to afford access for the current to the interior, some substance such as zinc, which will subsequently dissolve out, is added to the mixture of lead salts and the alkaline silicate. Antimony, or tin also, may be employed, since they dissolve under the action of the current.—G. H. R.

Improvements in the Manufacture or Production of Chlorine and Alkaline Carbonates. C. Kellner, Vienna, Austria. Eng. Pat. 20,713, November 27, 1891.

See under VII., page 523.

Improvements in the Method of Purifying Electrolytes containing Zinc, relating to or connected with the Electro-metallurgic Production of Zinc. Nahnson, Cologne, Prussia. Eng. Pat. 2225, February 5, 1892.

ZINC has been employed in the form of chips or grains with the object of purifying electrolytes containing zinc, but this treatment is insufficient, and the present invention relates to its employment in the form of powder. When rough zinc, or alloys of zinc, have to be refined and are used as anodes in the baths, the resulting lye is always neutral or slightly basic, and is at once passed into the purifying apparatus where it is treated with zinc powder to free it from impurities, after which it is again ready for use in the baths. When the anode is insoluble, however, and the electrolyte consequently acid, it must first be neutralised by the addition of an ore containing the oxide or carbonate

of zinc, or any other raw material containing zinc in a readily soluble form, before it is passed into the purifiers, which consist of flat vats kept constantly stirred. When the impurities consist of copper only and amount to 1 per cent. of the entire quantity of zinc 10 lb. of copper must be precipitated by means of zinc powder in the daily production of 1,000 lb. of zinc, which will necessitate a daily addition of 11 lb. of zinc. It is preferable to introduce at the beginning of the operation a larger quantity of zinc powder into each vat, say 100 lb., and subsequently add the amount required daily to the first of the series. 1 per cent. of silver will require a daily addition of 5½ oz. of zinc for the same output of zinc.—G. H. R.

Improvements in Process and Apparatus for Bleaching by Electrolysis. O. Imray, London. From T. Y. Montgomery, New York, U.S.A. Eng. Pat. 2329, February 6, 1892.

THE invention consists in using sea water, or a solution of rock salt or sea salt of the same density, as the electrolyte, and providing means whereby air may be driven through the bath, thereby aiding the process of oxidation and bringing the products of electrolysis into better contact with the fibre or fabric to be bleached. The electrodes, which are perforated, are arranged horizontally in the bath, and the conductors and connections are coated with paraffin or other similar substance to protect them.—G. H. R.

Improvements in the Electro-Metallurgic Extraction of Zinc. G. Nahnson, Cologne, Prussia. Eng. Pat. 2913, February 15, 1892.

THE improvement consists in using an electrolyte composed of a mixture of the sulphate of zinc with a sulphate of the alkalis, but preferably not magnesia, and heating the bath to a temperature of about 130° F. The solution contains from 1½ to 2½ ounces of crystallised sulphate of zinc, and 10½ to 5½ ounces of a sulphate of an alkali per litre according to the density of the current. The following advantages are claimed for this process: that the conductivity is 300 to 400 per cent. higher than that of the sulphate of zinc electrolyte at the degree of concentration yielding the best conductivity, that any density of current from 8 to 125 ampères per square yard can be employed, and that using condensing engines it is possible to extract a ton of zinc from the ore with a consumption of only 3 to 3·5 tons of coal.—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Occurrence of Octylic Alcohol in Distilled Wool Fat. C. Hannau. Pubbl. del. laborat. chimico centrale delle Gabelle. Roma, 1891; Chem. Zeit. Rep. 1892, 16, 2.

THE author thought Guetta's statement that octylic alcohol occurred in distilled wool fat, as a special characteristic thereof, might lead to a method of discovering adulterations practised with wool fat upon other fats. He was, however, unable to prove the presence of any such alcohol in distilled grease, and so cannot support Hannau's observation and statement (this Journal, 1892, 138).—J. L.

Testing Lard for Fatty Oils. P. Welhans. Pharm. Zeit. 36, 798; Chem. Zeit. Rep. 16, 4.

See under XXIII., page 548.

Adulteration of Linseed Oil with Rosin Oils. F. Coreil. Chem. Zeit. Rep. 1892, 16, 90.

See under XXIII., page 550.

An Apparatus for Determining the Liability of Oils to Spontaneous Combustion. E. H. Richards. Technol. Quarterly, 1891, 346.

See under XXIII., page 547.

PATENTS.

Improvements in the Manufacture of Detergent Powder. R. Armstrong, Preston. Eng. Pat. 8827, May 25, 1891.

THE invention consists in adding to a mixture of sodium carbonate and soap or grease certain quantities of ammonia salts in crystals, or if the mixture of the materials in a hydrated condition, is to be made, the ammonia salts are to be protected by a coating of fat, stearin, or paraffin wax, so as to "prevent chemical contact with the alkali of the detergent powder." There are no less than eight claims, one of which protects the perfuming of such detergent powder.

—J. L.

Improvements relating to the Purification of Fatty Substances. H. H. Lake. From "La Société anonyme des Parfums naturels de Cannes," Paris, France. Eng. Pat. 9431, June 3, 1891.

IN previous specifications (Eng. Pats. 10,280, 1889, and 5940, 1890; this Journal, 1890, 325; 1891, 159), the use of steam and of a vacuum had been patented for purifying fatty substances extracted by volatile solvents, but these two methods have the drawback that a small quantity of water was retained by the fatty mass, whereby the latter acquired a dim appearance. This is avoided by the new patented method, according to which the fatty substance is heated—by means of a coil or a double bottom—up to a temperature higher than the boiling point of water under the pressure existing in the vessel.—J. L.

An Improved Filtering Apparatus for Oil and the Like. H. Berk, Chemnitz, Germany. Eng. Pat. 3052, February 16, 1892.

THE novelty claimed by the inventor consists in fixing two concentric casings in such a manner that a space is left between the outer casing and the inner one, which forms the filter proper; in this space all heavier impurities settle out before they can get on the filter. There is one sheet of drawings illustrating the apparatus.—J. L.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Experiments to Determine the Effect of the Substances usually added to Caoutchouc and Gutta-Percha. C. Heinzerling and W. Pahl. Verhandl. d. Vereins zur Beförd. d. Gewerbe. 1891, 415, and 1892, 25.

NUMEROUS experiments on the hard and soft rubbers made from caoutchouc have given the following results. (By hard rubber is meant ebonite, vulcanite, &c.):—

1. All mineral and organic admixtures diminish the elasticity of soft rubber, the rubber mixture containing 10 per cent. of sulphur, used for vulcanising, yielded the most elastic product. The elasticity of hard rubber goods is, on the contrary, increased in certain cases by the addition

of organic substances, such as rosin oil and rosin, asphaltum, and such inorganic substances as vermilion, and lime.

2. The resistance to stretching of soft rubber is more or less increased by the addition of pitch, chalk, heavy spar, zinc oxide, and particularly magnesia. The addition of vermilion and magnesia has the same effect on hard rubber, as also has a longer vulcanisation with more considerable quantities of sulphur. All other mineral admixtures, such as litharge, hydrate of lime, and any organic mixtures (with the exception of a considerable addition of asphaltum), diminish the resistance of stretching in the cases both of soft rubber- and hard rubber-goods.

3. Mineral admixtures, as zinc oxide, lead oxide, chalk, magnesia, lime, and organic substances like asphaltum and glycerin, increase the solidity of soft rubber. The solidity of hard rubber is increased by the addition of large quantities of asphaltum, lime, or magnesia. Rosin oil and rosin in quantity diminish this quality. The solidity of soft rubber is diminished by the addition of linoleum, oil substitute, rosin oil, and paraffin.

4. Although pure rubber with sulphur has long been considered the best insulator, yet this is not so, as mixtures with a number of other substances answer better. These bodies are zinc oxide, lime, chalk, magnesia (in small quantities), antimony sulphide, also linoleum, oil substitute (in small quantities), rosin oil, rosin, and paraffin. The mixture of rubber and paraffin is the best. The addition of vermilion, lead oxide, and magnesia (in large quantities) diminishes the insulating power. The cold vulcanised rubber (so-called patent india-rubber) is the worst insulator.

5. All the mixtures of caoutchouc and organic substances give off vapours when exposed to heat (130°—150° C.). Rubber so prepared is badly adapted for standing exposure to heat. The other mixtures are not affected at these temperatures.

6. Most of the mixtures containing metallic oxides are attacked by acids, in many cases with the formation of insoluble metallic salts, which increase their weight. The mixtures of rubber and the already-named organic bodies resist acids well.

The power of resisting oil is increased by the presence of the already specified inorganic substances and especially of lead and zinc oxides. The action of alkalis and coal-gas is so slight that it may be ignored.

7. Most of the mixtures of caoutchouc and mineral substances become in time hard and brittle. Their insulating power does not, however, appear to become affected.

The experiments with various samples of gutta-percha have given the following results:—

1. The following bodies do not appreciably affect the action of chemicals on gutta-percha:—Vermilion, 50 per cent.; rosin and rosin oil, 15 per cent. each; lime (hydrate), 50 per cent.; asphaltum, 30 per cent.

2. Pure gutta-percha and pure "Ballata" (the dried juice of *Sapota Millerie Bleek*, gutta-percha substitute) without any addition whatever, form the best insulators.

3. The addition of other substances, as vermilion, lime, rosin oil, and rosin, diminishes the insulating power.

4. Asphaltum up to 30 per cent. has very little effect on the insulating power.

5. The resistance to stretching is somewhat increased by the addition of vermilion, 50 per cent., or lime (hydrate), 50 per cent. The limit of elasticity is diminished by these additions. The solidity is increased by vermilion and diminished by lime.

6. Rosin oil and rosin, 30 per cent., and asphaltum, 30 per cent., diminish the elasticity and hardness. These slightly increase the resistance to stretching.—A. L. S.

Note on the Spontaneous Conversion of Isoprene into Caoutchouc. W. A. Tilden. Chem. News, 65, 1892, 265.

ISOPRENE is a hydrocarbon which was discovered by Greville Williams many years ago among the products of the destructive distillation of india-rubber. Later, in 1884, (Trans. Chem. Soc. 45, 410) it was observed by the author

among the more volatile compounds obtained by the action of a moderate heat upon oil of turpentine and other terpenes. It is a very volatile liquid, boiling at about 36° . Its molecular formula is C_5H_8 , and it forms a tetrabromide, $C_5H_8Br_4$, but no metallic derivatives, like the true homologues of acetylene.

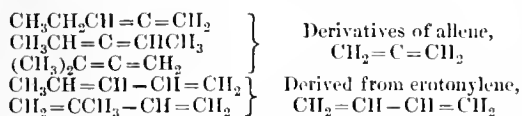
Bouchard (Compt. Rend. 87, 654, and 89, 361 and 1117), observed that when isoprene is heated to a temperature near 300° , it gradually polymerises into a terpene which he called di-isoprene, but which is now usually called *dipentene*. This compound boils at 176° . A quantity of eolophene similar to that which is produced by the action of heat upon turpentine is formed at the same time.

When isoprene is brought into contact with strong acids, aqueous hydrochloric acid, for example, it is converted into a tough elastic solid, which has been examined by G. Bouchardat and the author; it appears to be true india-rubber.

Specimens of isoprene were made from several terpenes in the course of the author's work on those compounds, and some of them were preserved. He was surprised a few weeks ago at finding the contents of the bottles containing isoprene from turpentine entirely changed in appearance. In place of a limpid colourless liquid the bottle contained a dense syrup, in which was floating several large masses of solid of a yellowish colour. Upon examination this turned out to be india-rubber. The change of isoprene by spontaneous polymerisation had not to his knowledge been observed before. The author can only account for it by the hypothesis that a small quantity of acetic or formic acid had been produced by the oxidising action of the air, and that the presence of this compound had been the means of transforming the rest. The liquid was acid to test paper, and yielded a small portion of unchanged isoprene.

The artificial india-rubber, like natural rubber, appears to consist of two substances, one of which is more soluble in benzene or in carbon bisulphide than the other. A solution of the artificial rubber in benzene leaves on evaporation a residue which agrees in all characters with a similar preparation from Para rubber. The artificial rubber unites with sulphur in the same way as ordinary rubber, forming a tough elastic compound.

The constitutional formula of isoprene is not known with certainty, but it must be selected from the five following formulae:—



It is obvious that compounds such as these containing doubly-linked carbon may polymerise in a variety of ways, but which way would lead to caoutchouc cannot be at present defined.—W. S.

Analysis of Linoleum Floorcloth. J. Pinette. Chem. Zeit. 16, 1892, 281.

See under XXIII., page 550.

Colour Testing. W. C. Wilson. Paper read before the Association of Master Painters and Decorators of Pennsylvania, U.S.A., per Chem. Trade J. 10, 130, 163, 274, 290.

The following points must be made the special features of colour testing:—

1. Purity of the material.
2. Purity of the tone; brilliancy, richness, which indicate the amount of care in selection.
3. Fineness of grinding or preparation; this signifies the degree of the division of the particles, and upon the completeness of such division will depend—
4. Its spreading capacity (covering power).
5. Its body. This of course applies to opaque or semi-opaque colours only. "Body" means capacity to conceal the surface to which the paint is applied and must not be confused with spreading capacity (covering power). It is an inherent quality.

6. Its staining power or tinting strength with white or other colours.

7. The quality or purity of the tint with white.

8. If a paste colour the consistency of the paste.

9. Transparency of transparent colours and the quality of transparency.

Sulphate of lime or silica are only adulterants when added surreptitiously to those articles in which they have no recognised place as components, as for instance, sulphate of lime in Venetian red and silica in ochre. White clay, or kaolin, is quite frequently used as an adulterant. Clay is a silicate of alumina and would occur naturally to a greater or lesser degree in ochre, sienna, amber, Vandyke brown, and earths generally. Carbonate of lime is found naturally in some of the earth pigments, but generally in very small quantities, and when found in quantities exceeding 5 or 10 per cent. must be considered an adulterant. Exceptions to this rule would be colours like rose pink, or all those lakes in which carbonate of lime is used as the medium for carrying the organic colouring matter. The same applies to the presence of barytes in pigments. Barytes, when mixed as oil paint, is absolutely devoid of opacity and covering power. When mixed with pigments that are specifically lighter, it will separate when painted, permitting the real pigment to come to the surface. Whiting and terra alba (sulphate of lime) are decidedly better oil absorbents than barytes. Zinc white, owing to its certainty to seal, will never replace white lead, though it may be desirable to use it in admixture with white lead.

GREEN PIGMENTS.—The green most used is that known as chrome green. It is prepared by mixing Prussian blue and chrome yellow, or by making the two together simultaneously. The commercial chrome greens consist of about one part of colour and three parts of mineral base, chiefly barytes. They may be divided into two classes, one inclining distinctly to yellow in tone and the other to blue. The difference is due almost entirely to the character of the chrome yellow in the green. For testing these greens three standards in three different shades of perfectly pure greens are used. By mixing two of them the shade of any chrome green sample can be perfectly matched. The sample to be tested is then reduced to one-tenth by mixing it with white lead. Next, 150 parts of white lead are weighed out and mixed in portions with the standard shade until the same depth of shade is obtained as that made with one-tenth of sample. The remaining part of the white lead is then weighed and found amounting to, say 30 parts, showing that 120 parts have been used to one part of the standard shade. This would show that the sample has but one-twelfth the colouring strength of the standard, or is approximately 8 per cent. strong.

To test the fineness of the greens, the colour is rubbed out on a piece of smooth glass with a palette knife; coarse particles show their presence by scratches. Chrome greens being a mixture of two colours are liable to show a separation of their elements when mixed very thin with oil of turpentine. The green showing this separation in the least degree is best in that respect. Body tests are made by equally thinning two samples with oil and painting them on well-primed boards of equal size.

Paris Green is distinctly crystalline in its character and its richness of colour depends entirely on this. In grinding, a Paris green must be selected of very fine crystal. Purity and quality must be determined comparatively. A ready test for purity is to dissolve out the oil with benzine and when the dry powder is obtained treat it with strong ammonia, in which it should be entirely soluble.

Verdigris is entirely a transparent colour. Like Paris green it is a copper compound and should be entirely soluble in ammonia.

REDS.—Venetian red, Indian red, Turkey red, rose pink, and red oxide, owe their colour wholly or in part to iron oxide, with the exception of rose pink and rose lake.

Indian Reds cannot be classed as pure, unless they contain from 95 to 99 per cent. of oxide of iron. The paler the Indian red, the greater the tinting strength and the rosier the tint; the deep coloured gives a purplish tint in comparison.

Tuscan Red is essentially a mixture of Indian red with some sort of lake colour, the cheapest article being made from a reduced Indian red and rose pink. The first quality of Tuscan red to be noticed is its brilliancy, next its opacity or body. Its tinting strength is of far less importance than the quality of the tint. Fineness of grinding must be insisted on. The best product of this class of pigments is the "new" Tuscan red, which contains the most permanent red lake colour known.

Venetian Red.—The best Venetian red is that one consisting of ferric oxide and sulphate of lime only. For a standard a red with 20 per cent oxide is best used. Its comparative brightness ought to be examined as well as fineness of grinding.

Vermilion.—This is a crystalline pigment. The deeper the shade the larger the crystal, hence the paler shade will have the more body. Although not brilliant it is the most reliable of all reds for permanency. The imitations are primarily orange lead coloured with eosine. Crimson tones are obtained by the introduction of white lead, zinc white, sulphate of lead, &c.; they are comparatively fugitive. Cheap grades are made with red lead and barytes.

Red Lead is quite an important pigment now. It is the very best preservative that can be applied in the shape of paint. It should never be mixed with whiting or similar bodies; where a mixture is desired equal parts of red lead and iron oxide will be found to give an excellent paint.

Yellow and Orange Chromes.—These colours are particularly susceptible to adulteration. In the pure state they are compounds of chromic acid and oxide of lead, or of chromic acid, sulphuric acid, and oxide of lead.

Pale Chromes.—The great desideratum is to get the minimum paleness of shade with the minimum of sulphuric acid, or with the maximum of chromic acid: that is, to obtain the minimum of paleness with the maximum of staining power. As the shade deepens, the strength lessens. This applies particularly to the orange chromes, which contain frequently orange lead. The presence of the latter is very objectionable, but is easily detected by the nitric acid test.

Medium Chromes ought to form clear golden tones with white lead and not a buff. A fourth or a third of zinc white mixed with the white lead used for these tints, has the property of holding the colour better. Adulterations of the medium chromes are found out by testing tinting strength in comparison with recognised pure standards. The pale shades ought not to incline to greenness, as such yellows will blacken very quickly. The grinding should be perfectly fine, without the faintest trace of grit.

Ochres.—The French ochres, which are the finest yet discovered, are regarded as the standard of quality.

Yellow Ochres.—These pigments owe their colour to hydrated oxide of iron. The other constituents are principally silicate of alumina, or clay and free silica. The value of an ochre does not depend on the percentage of ferric hydroxide. Gold ochre is invariably a mixture of ochre and chrome yellow. The standard of this should be a mixture of good French ochre with pure chrome yellow.

Blacks.—Bone blacks have generally some blue added, to intensify the colour. They vary greatly in colour and opacity, hence careful selection must originally be made. Lamp black improves the opacity of bone blacks, but is very injurious to their intensity. There is only about 10 per cent. of carbon in bone black, the rest being chiefly calcium phosphate.—C. O. W.

The Application of Certain Rare Metals for Ceramic Colours. Sprechsaal, 1892, 25, 85.

See under VIII., page 523.

Vulcanisation of Waterproof Fabrics. Industries, 12, 1892, 498.

See under V., page 517.

PATENTS.

A Process for the Manufacture of White Lead. J. H. Noad, East Ham, Essex. Eng. Pat. 3832, March 3, 1891.

This invention relates to the production of white lead by electrolysis of a solution of acetate of ammonia, lead being used as anodes and any other conducting metal or carbon as cathodes.

An electrolytic bath is charged with a 10 per cent. solution of acetate of ammonia and in it are suspended as anodes, slabs, bars, or plates of lead. The cathodes, which may consist of any other conducting metal or carbon, are enclosed within porous cells or partitions, prepared of Willesden waterproof paper. These cells, as well as the bath itself, are provided with overflow pipes, which communicate with a pipe supplying carbonic acid gas and with a filter-press.

The bath is worked with an electric current of a density of about 4 ampères to the square foot and a pressure of about 1 volt to each tank. After a time the liquid in the porous cells is mostly ammonia, that of the bath being mostly acetate of lead. Through the mixed liquid overflowing from both, carbonic acid gas is blown, and the whole sent through the filter-press; the filtered liquid, containing the regenerated acetate of ammonia, is returned to the bath.—C. O. W.

Improvements in the Waterproofing of Textile Materials. J. G. Smith, Liverpool. Eng. Pat. 6698, April 18, 1891.

See under V., page 518.

A New or Improved Composition for Coating Ships' Plates and the Like. R. Jacks, South Shields, Durham. Eng. Pat. 9193, June 1, 1891.

A hot mixture of tar, pitch, and cement. The tendency of this mixture to set or harden is further secured by the admixture of litharge or other suitable dryer.—C. O. W.

Improvements in Paints or Protective Coverings for Ships' Bottoms and other Structures. C. H. Bigland, Liverpool. Eng. Pat. 2253, February 5, 1892.

In this invention a paint is proposed consisting of a boiled mixture of—

- 1 part of encre poison,
- 3 parts of Venice turpentine,
- 3 parts of sulphate of manganese,
- 6 parts of carbonate of lime,
- 6 parts of belladonna,
- 24 parts of ordinary pigment,

and sufficient oil or varnish to render the mass liquid.

—C. O. W.

Improvements in Spreading Machines for Spreading India-Rubber or other Plastic Material on Textile Fabrics and the Like. W. Coulter, Greenheys, and T. Rowley, Manchester. Eng. Pat. 3155, February 18, 1892.

The improvement relates to the gauges used on spreading machines and consists in three gauges swinging on the same pivots. The edges of these three gauges possess various degrees of sharpness, and being arranged as it were in the form of an equilateral triangle, the angles of which form the edges of the gauges, either of the latter is available for immediate use by turning the whole gauge round through an angle of 60°. Drawing attached to specification.—C. O. W.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Contribution to our Knowledge of Sumac. W. Eitner.
Der Gerber, 1892, 18, 51.

THE author confirms Macagno's statement that the percentage of tannin in sumac leaves reaches a maximum and decreases afterwards. Macagno had shown that Virginia sumac contained in June, 21 per cent. tanning matter, whilst in August, 15 per cent. only were found. Eitner gives the following values for samac from Bosnia which was collected on the following dates: June 23rd, 18·97 per cent. tanning matter; July 7th, 22·97 per cent.; July 21st, 18·89 per cent.; August 4th, 17·17 per cent.; August 18th, 17·30 per cent.; September 2nd, 16·83 per cent.

The period at which the maximum of tanning matter appears in the sample from Bosnia is that before flowering, when all the leaves are completely developed. In Sicily the leaves are gathered at three periods: the lowest leaves are collected in May and gradually the upper leaves, when they have reached full development, are taken. Thus a product containing large quantities of tanning material (sometimes up to 26 per cent.) is obtained. American sumac reaches its maximum of tanning material (27 per cent.) in July; but as the leaves are gathered much later, namely before they become withered, the commercial product contains a considerably smaller quantity of tannin.

There is another advantage attending the gathering of the sumac leaves at the time of the tannin-maximum, since they tan a bright colour, while the over-ripe leaves contain a yellow-brownish colouring substance which makes its appearance only when the period of vegetation reaches its end. The same colouring matter also occurs in leaves gathered early, when they are exposed in a moist state to the action of sunlight, or if they are stored when moist. In the former case they lose at the same time some tannin; in the latter case, however, this does not occur, except when they grow mouldy. The Sicilians only have due regard for these properties of sumac, while in other countries, through the irrational methods attending the gathering, large sums are wasted. The government of Bosnia, assisted by the author, has started a rational system of culture of sumac.

—J. L.

So-called "Decolourised" Tannin Extracts. V. H. Soxhlet, Chem. Zeit. 1892, 16, 15—16.

See under VI., page 519.

Weighting of Leather. B. Kohlmann. Chem. Zeit. 1892, 16, 16—17.

See under XXIII., page 549.

PATENTS.

Improvements in Drying Leather or Hides, and in Appliances therefor. E. Pim, Maghull, Lancaster. Eng. Pat. 6603, April 17, 1891.

LEATHER and hides have heretofore been dried by currents of air travelling in a more or less horizontal or upward direction, and in contact with both sides of the leather or hide. By this method damage has frequently occurred, especially to the grain, owing to the "variable and too energetic action of the air." By this invention the leather or hides are folded lengthwise, with the outer surface or grain within the fold, and suspended, belly edges upwards, in a closed chamber provided with holes disposed evenly through the ceiling and floor. Heated or dried air is drawn through the chamber downwards by means of fans or a chimney at the rate of a few feet a minute. Thermometers indicate the temperature of the air, and hygrometers its humidity. Valves serve to regulate the current of air, which is dried by quicklime. The drying of the leather or hides is thus effected from the flesh surface, and the grain protected.—A. G. B.

An Improved Process of Decolourising and Clarifying Tanning Liquors or Tannic Extracts. A. Huillard, Paris. Eng. Pat. 7106, April 24, 1891.

THE liquors (which mark on an average from 2° to 3° B.) from the tubs or vats of the exhausting batteries are treated "by a certain quantity of a derivative of strontium, such as strontium hydrate, anhydrous strontia, strontium carbonate, or other strontium salt." The effect of this treatment is claimed to be the precipitation of the colouring matters in the liquor. Filtration and the addition of a little sulphuric acid to precipitate the excess of strontia follow. A further filtration and concentration in a vacuum to 20° or 30° B. complete the process.—A. G. B.

Improvements in the Manufacture of Artificial Manure. A. Knorre, Wandsbek-Marienthal, Schleswig-Holstein, Germany. Eng. Pat. 8402, May 15, 1891.

See under XV., page 541.

An Improved Compound Fabric. F. I. Bugg, Ipswich. Eng. Pat. 18,003, October 20, 1891.

See under V., page 518.

Improvements in the Process of Dyeing, Tanning, and Mordanting Leather, Teazled Fabrics, or other Porous Materials, and in Apparatus employed therefor. I. Goldschmidt, Fürth, Bavaria, Germany. Eng. Pat. 19,397, November 10, 1891.

See under VI., page 521.

XV.—MANURES, Etc.

The Phosphate Beds of Florida. A. Keller. Chem. Zeit. 1892, 16, 65, 78—79, 110—113.

THE first portion of the paper deals with the climatic, geographic, and economic conditions which subsist in Florida, and influence the production and exportation of phosphates: this part may be dismissed as of commercial interest rather than chemical. The detailed consideration of the various kinds of phosphate follows and is here abstracted.

River-pebble is found in many of the rivers of West Florida, especially the Peace and the Alafia, and where it is abundant it is the most easily obtained phosphate. The sand and pebbles are raised by a dredging machine with a powerful centrifugal pump and thrown on to a revolving sieve made of iron bars and turning in an inclined plane. The pebble, sandstone, and sticks are retained by the sieve, the sand falling back into the river, and are immediately transferred to the drying apparatus. The quantity thus raised in a day varies with the locality; 100 tons may be pumped one day and only 20 the next, some parts of the river containing much phosphate, others containing little else than sand. The drying systems are three:—(1.) The brick-dryer, which is very similar to a pyrites burner; this does the work best, but is the most costly. (2.) The revolving dryer, an iron cylinder which is kept in rotation and through which the furnace gases pass. (3.) The screw dryer, which continuously passes the phosphate through the furnace. The cost of raising river-pebble averages 1 dollar per ton; during the current year this has been added to by the imposition of an *ad valorem* tax ranging from 50 cents to 1 dollar per ton. In certain parts of the Peace there is a greater tendency for phosphates to deposit than in others, and when such a spot has been dredged it may frequently pay to return to it sooner or later; in some

places the phosphate bank will leave the spot entirely during a flood and be deposited elsewhere. The exhaustion of the phosphate in the river Pease may be expected at no distant date; between April 1890 and September 1891 42,000 tons left by ship and 19,000 tons by rail.

Land-pebble.—Pebble phosphate consists of stones varying in size from the barely visible to that of a nut; in shape they resemble peas and beans; the angles are rounded and the surfaces polished. The river-pebbles are dark grey, bluish or black, a colour which they owe to tannin washed from the plants in the rivers; the land-pebbles differ from the river-pebbles only in that they have not been recently washed and are lighter in colour, being frequently white. In composition there is no difference between land- and river pebble; their average contents of calcium phosphate and iron and aluminium oxides are 65–70 per cent. and 3 per cent. respectively. River-pebble in the market does not contain more than 60–65 per cent. of calcium phosphate, as a rule, owing to the admixture of sandstone and sticks.

All the land between the Pease and Alafia creeks is more or less phosphatic. The richest district is an area of some 160 square miles between Bartow, Fort Meade, Chicora, and Callsville; the soil of this portion is sandy and covers a phosphatic clay. The following analyses of three borings are instructive:—

I. Cypress marsh on Chiloechatchee: Black mud, decaying wood, &c., 3 ft.; sand, 4 ft.; blue clay, with $2\frac{1}{2}$ lb. of white pebbles, 4 ft.; sand free from phosphate, 1 ft.; sand with $1\frac{1}{2}$ lb. of gray pebbles, 3 ft.; sandstone.

II. Cowbridge on Horsecreek: Humus, $\frac{1}{2}$ ft.; sand, 1 ft.; sand, with $4\frac{1}{2}$ lb. pebbles, 4 ft.; clay without phosphates, 10 ft.

III. 14 miles west of Bartow: Sand, 2 ft.; sandstone, 2 ft.; sandstone containing pebble, 1 ft.; white and green clay, with 25 lb. of white and green pebbles, 20 ft.; clay without phosphates, 5 ft.

Prospecting a pebble bed is easily accomplished with an ordinary clay-borer, but very erroneous estimates as to the quantity of phosphates are frequently made because of the necessity for passing through the ground-water which is nearly always near the surface; the clay gets churned up with the water, and if the phosphates be reckoned as a percentage on the bored-out clay the estimate for the bed will be too high. The author quotes a case in which his estimate for a bed was 15–20 per cent. of phosphate, while that of the American engineers, unaware of this pitfall, was 50 per cent. The use of 4-in. iron tube-borers, which are kept pumped out and not worked more than is necessary, is recommended.

An analysis of a section of the core of boring III., mentioned above, gave the following percentages on the dry substance:—Loss on ignition, 0.79; P_2O_5 , 33.61; CaO, 48.04; Fe_2O_3 , 1.20; Al_2O_3 , 1.38; MgO, &c., 5.54; CO_2 , 2.29; SiO_2 , 7.15. The top pebbles are frequently mixed with, or imbedded in, sandstone; but beyond a certain depth they are nearly always free from sandstone, and the deeper they are the better they seem to be; the white nodules containing much alumina seem to be for the most part at the top.

The land-pebble industry is still in its infancy, being but two years old. Improved machinery is wanted; the present washing machines perform their work very perfunctorily and leave too much alumina in the form of clay, rendering the phosphate practically useless. Failing a better method, some works dry the whole material and then sift out the sand and powdered clay; the phosphate obtained, however, is too aluminiferous for the European market. It has been found that many of the pebbles have been lost by the use of too coarse a sieve: one of 22 meshes to the inch gave in several experiments 25 per cent. more phosphate than one of 12 meshes. Although this particular kind of phosphate has not yielded much return as yet, great things are expected of it, mainly because it can be won entirely independently of manual labour. It may be noted that recent experiments to apply the dredging method used for river-pebbles proved abortive.

Hard-rock is as geographically distinct from pebble phosphate as it is mineralogically. South of Alafia Creek

pebble has the monopoly, while northwards hard-rock is almost the sole representative. The best of it occurs in "boulders," varying from several tons to several pounds in weight; these are embedded together with "gravel" in sand, clay, or the "soft-phosphate," described below. The depth of the beds varies from 40–50 ft. to 5–10 ft.; experimental boring has shown their extension at 60–65 ft., but, except where they outcrop, beds which are deeper than 10 ft. or 15 ft. have not been generally worked. The market phrase "land containing so much per cent. of phosphate" means that under 100 acres of such land there are so many acres in which the phosphate is covered by not more than 15 ft. of sand; on this scale of valuation 3 per cent. land is good and 5 per cent. very good. Prospectors' rules, such as "Where hammock—no phosphate" or "Where saw-grass—phosphate" are rare, but have only local significance, if any at all. The distinction between solid and laminated rock has reference to the greater homogeneity of the former, which is either white, grey, yellow, or, less frequently, dark blue or black; most frequently it is marbled and not all of one colour.

Good hard rock contains from 77 to 82 per cent. of calcium phosphate and 3 per cent. of ferric oxide and alumina. A detailed analysis gave, per cent.:—

H_2O 0.92; CaF_2 4.40; $Ca_3(PO_4)_2$ 85.14; $CaCO_3$ 3.63; Al_2O_3 1.52; Fe_2O_3 0.45; SiO_2 4.13.

Formerly hard rock only was exported, and the gravel was voted to contain too much alumina to be of use; but the latter is now washed, after which it contains 30–35 per cent. of phosphoric acid and seldom more than 3 per cent. of ferric oxide and alumina. This also applies to the laminated rock which contains pockets of clay amounting to some 5–8 per cent.; it is now burnt to make it brittle, broken, and sifted; this reduces the ferric oxide and alumina to 3–4 per cent. and renders the phosphate fit for export. In America phosphate can be marketed with much higher contents of ferric oxide and alumina than the European purchaser will tolerate. The burning of the rock is carried out by piling 100–200 tons to a height of 3–4 feet on a layer of wood one foot high and igniting; the method is cheap but otherwise unsatisfactory, and in the author's opinion practically useless.

Some details as to the methods of raising the rock, and a discussion concerning the respective merits of various cranes and scrapers here follow.

Plate-rock or **sheet-rock** is the most interesting of the Florida phosphates. It occurs in irregularly shaped tables of varying area, but most frequently about the size of a man's hand; they are one or more centimetres thick, and vary in colour from brownish yellow to white. The heavier and more brittle pieces are the richer in phosphoric acid, the lighter and softer contain more clay. The average contents of calcium phosphate is 74–78 per cent., and that of ferric oxide and alumina 3–4 per cent. and more; the latter however is due to the admixed gravel. Plate-rock always rests on the irregular surface of a stratum of limestone which is frequently dolomitic and contains remarkable "wells." These wells are nearly circular and 10, 12, or 15 metres deep; they are sometimes as much as one metre in diameter, and are filled with the same plate-rock, embedded in sand or clay, which forms the whole bed. In good places the phosphatic bed will contain 50–80 per cent. of plate-rock and is covered by 6–10 feet of sand. The mining is considerably easier than in the case of hard rock but the yield per acre is much less.

Plate-rock has been mined for some year and a half, but very little has found its way into the market; washing has proved difficult and capital has not been plentiful.

Soft phosphate is a phosphatic clay or clayey phosphate which is friable and easily worked; it is white, reddish or yellow, and contains varying quantities of water. The following analyses are put in:—

(1.) Soft phosphate from Polk county contained, per cent.,— H_2O , 8.35; total P_2O_5 , 29.80; water soluble, P_2O_5 , 0.81; citrate soluble P_2O_5 (after Wagner), 2.05; ditto (after Petermann), 2.83; Fe_2O_3 and Al_2O_3 , 8.86.

(2.) *Soft phosphate* from Alafia creek contained per cent., H_2O , 5.8; total P_2O_5 , 19.94; water soluble, P_2O_5 , 0.62; Fe_2O_3 , 7.50; Al_2O_3 , 10.26.

Much swindling is done in Florida with this soft phosphate. Certified by jerry analysts to contain 10 per cent. and more of water-soluble phosphoric acid, it is offered and purchased as a "complete fertiliser" at 30—35 dols. per ton, and as "raw soft phosphate" at 5 dols. In reality it is dear at any price, and what value it has as a manure can only be reaped by the farmer who can dig it for himself; it is not worth transport.

Pebble land in Florida will fetch 15—50 dols. per acre; for hard rock land 25.50, and 100 dols. are paid; the value of unphosphatic land is 3—5 dols.

The production of phosphate in Florida will not compare with that of South Carolina. The cost of winning should be reduced by improved machinery; lower rates of transport and wages are badly wanted. The author estimates the cost of mining at 4 dols. for good hard rock, 3—5 dols. for plate rock, and 1—2 dols. for river pebble (this Journal, 1891, 393 and 737; also 1890, 565).—A. G. B.

Sulphuric Acid Manufacture in 1891. R. Hasenclever. Chem. Ind. 1892, 15, 69.

See under VII., page 521.

PATENTS.

Means of Colouring Liquid Weed Destroyers, Sheep Dips, Insect Destroyers, and other Poisonous Liquids. T. Reade, Wolverhampton. Eng. Pat. 7569, May 1, 1891.

THE object of colouring such liquids as are detailed in the title is the prevention of accidents and crime; it is attained "by the introduction of a chromium compound, or compound of which chromium forms a part, to such preparations when of an alkaline character, or, when such preparations are not alkaline, but are compatible with an alkali, by the introduction of such compound and of an alkali."—A. G. B.

Improvements in the Manufacture of Artificial Manure. A. Knorre, Wandsbek-Marienthal, Schleswig-Holstein, Germany. Eng. Pat. 8402, May 15, 1891.

THE invention relates to the mucous refuse of tanneries, particularly from the fleshing and unhairing shops. This refuse is stated not to have been successfully employed heretofore for agricultural purposes when received direct from the tanneries, partly "on account of its great beating properties," and partly because it is liable "to form an impermeable felted cover on the land," in consequence of its constituents being principally hairs and "mucous parts."

The refuse is dried, first by draining or in a centrifugal machine, and then in a kiln. When dried it is ground in a "mill course," crushing mill, or other disintegrator. The hair having been made brittle by the action of the lime during unhairing and the subsequent drying, will readily grind up together with the other matter to a fine powder. If this powder is to be used directly after grinding, it is better to add a mineral acid (preferably sulphuric) to the refuse before drying and grinding, for the lime is thus converted into gypsum, which hardens during drying and renders the grinding more easy. Moreover, as sulphate, the "lime will be more effective and appropriate for numerous soils than the carbonate of lime." The powder is easily distributed over the land, and will not felt.—A. G. B.

An Improved Insecticide and Fertiliser. H. H. Lake, Middlesex. From the Biolytic Gypse Company, New York, U.S.A. Eng. Pat. 3023, February 16, 1892.

THE "lime-mud" obtained during the manufacture of caustic soda by boiling soda ash or black ash of 48 per cent. strength (100 parts) with unslaked lime (40—60 parts) in a "suitable quantity of water," is dried and powdered. This constitutes the new insecticide and fertiliser; in the former capacity it acts by virtue of the caustic soda which it retains. It is sown broadcast, or "dissolved in water" and sprayed on to the trees or other plants infected.—A. G. B.

XVI.—SUGAR, STARCH, GUM, Etc.

Recent Inventions in the Beetroot Sugar Industry. E. O. von Lippmann. Chem. Zeit. 1892, 16, 500—502.

AMONG the most important points touched upon in this review are the following:—The use of animal charcoal in the manufacture of raw beetroot sugar is growing quite exceptional, being by degrees entirely replaced by the improved mechanical filters. Even in the refining industry the use of animal charcoal is falling off. The Steffen Systematic washing process for the direct production of white sugar in the beetroot sugar factory has been employed to some extent, but has not given the results which were anticipated. Some factories in Austria and Belgium have worked successfully in this direction with Drost and Schultz's process, but detailed and exact proof is wanting. The recovery of sugar from molasses is almost abandoned at present in raw sugar factories. In the refining industry the chief claims of Steffen have been declared invalid in Germany. Very ingenious and effective forms of apparatus have been constructed for drying "crystals" and "granulated." The production of after-products in refineries is reduced to a minimum, or altogether avoided, and the recovery of sugar from molasses has been given up in almost all German refineries.—A. R. L.

The Best Means of Valuing Raw Sugar. A. Herzfeld. Zeits. d. Ver. f. Rübenzuckerind. Chem. Zeit. 16 (Chem. Rep.), 114—115.

THIS lengthy paper (112 pages), which deals with the question from historical as well as technological and chemical aspects, contains several important and careful investigations, the following being the salient points:—

1. *Production of Raffinose in Beetroot Sugar Products, and its Influence on the Form of Sugar Crystals.*—Raffinose originates in the root without doubt, but the opinions hitherto broached as to the causes of its origin are by no means certain, and in some cases incorrect. It is present in stromtia after-products (rarely in first products) and molasses to the extent of 8—16 per cent.; in osmose-molasses to 8 per cent., and in many ordinary beetroot molasses and refuse products of the industry. Small quantities of raffinose may occur in first products of polarisation, 94—97, as well as in clean after-products, but its amount is usually below the limit (0.33 per cent.) which can be estimated by the inversion method. The raffinose formula: $S = \frac{0.5124 P - 1}{0.839}$; $R = \frac{P - S}{1.85}$, ought only to be applied to those products in which the presence of this substance is probable, since many products contain compounds which would be reckoned as raffinose, and which are produced either from the sucrose or invert sugar by overheating in the manufacture, and also by exposure to the weather; among these are saccharic acid and its salts; high polarising substances (dextran?) are often present, and fermentation derivatives of the organic constituents other than sugars frequently occur in molasses. To control the optical test, the copper method of Preuss is recommended. The mucic acid method serves as a qualitative

test for raffinose, but is frequently inadmissible (in the presence of calcium salts for example) for quantitative purposes, as is also Gunning's methyl alcohol method, because in this case invert sugar saccharates, &c., are also dissolved. The occurrence of elongated crystals is not a specific indication of the presence of raffinose.

2. *The Solubility of Sugar in Water; the Formation of Molasses; and the Melassigenic Effect of Raffinose.*—By very accurate experiments made in an apparatus capable

of maintaining the temperature to 0.1°C ., it was found that 100 parts of water dissolve 65.17 parts of sugar at 5.2°C .; 66.63 parts at 19.15°C .; 68.31 parts at 28.8°C .; 72.23 parts at 49.53°C .; 74.33 parts at 59.4°C .; and 82.76 parts at 99.45°C . From these the percentage solubility of sugar is calculated by the method of least squares, thus:—

$$y \text{ to } x^{\circ}\text{C} : y = 64.1835 + 0.13477x + 0.0005307x^2,$$

whence the following table is constructed:—

Temperature C.	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°
Percentage of sugar...	64.18	64.87	65.58	66.33	67.09	67.89	68.70	69.55	70.42	71.32	72.25

Temperature C.	55°	60°	65°	70°	75°	80°	85°	90°	95°	100°
Percentage of sugar...	73.20	74.18	75.18	76.22	77.27	78.36	79.46	80.61	81.77	82.97

The old tables of Scheibler and Flourens are, therefore, only partially accurate, and show differences amounting to 10 per cent. in certain places. The solubility of sugar is decreased by the presence of small quantities of salts (organic and inorganic), but increased by that of large quantities; whilst salts containing water of crystallisation decrease the solubility, easily soluble salts such as potassium acetate increase it. The same is true of mixtures of salts, but each salt appears to act as if it were alone, therefore, relatively small quantities of mixtures of easily soluble salts raise the solubility of sugar largely in concentrated solutions. Normal molasses is not a supersaturated solution of sugar, but a saturated solution of sugar in that of the other ("nichtzucker") constituents. When sufficient water is added to molasses to form a saturated solution of sugar if it were present, *per se*, this diluted molasses will dissolve fresh quantities of sugar. When small quantities of potassium acetate, potassium chlorate, &c. are added to saturated sugar solution, the sugar is partially precipitated but redissolves on addition of an excess of the salts; albumin, pectin, dextrin, and dextran behave in the same manner. Raffinose follows the same rule as the other "nichtzucker" constituents, but has much weaker melassigenic properties than all the other substances examined, even than potassium chlorate.

3. *Proposed Alteration in Calculating the Rendement (Estimated Yield) of Raw Sugar, with regard to the Organic "Nichtzucker," especially Raffinose.*—In France it has long been the custom, instead of multiplying the ash by five and deducting this from the polarisation in calculating the "rendement," to deduct four times the ash, twice the invert sugar, and 1.5 per cent. for loss in manufacturing, or for the money value, to deduct twice the organic "nichtzucker" constituents reckoned at 60 centimes for each per cent. The author considers it more accurate, instead of merely deducting five times the ash, to take into account all the non-sucrose constituents, for not only are all these substances melassigenic, but certain of them are produced by the over-heating and decomposition of the sugar, and not being in combination with the ash, their action is at present entirely ignored. It is proposed, since the effect of raffinose has not been accurately ascertained, to deduct twice the total non-sucrose constituents from the polarisation in the case of first products. The chief objection to this is that the amount of organic "nichtzucker" which being obtained by difference is dependent on the accuracy of the estimation of all the constituents, the most inexact estimation being that of the water. This is, however, overcome by employing a drying-oven with double walls of asbestos or inlaid glass, and salt water, or toluene (boiling point, 109° – 110°) as heating material. A new basis for the calculation of after-products is to be desired.—A. R. L.

PATENTS.

Improvements in the Manufacture of Candy. H. H. Lake, London. From W. P. Kirchhoff and J. W. Kirchhoff, New Orleans, U.S.A. Eng. Pat. 13,566, August 11, 1891.

WHEN a solution of cane-sugar and glucose is concentrated *in vacuo* to the consistence necessary to form "hard crack," the candy produced is hygroscopic; whilst when the evaporation is performed in an open vessel, much caramel is produced. The patentee claims to have remedied these objections by the following process:—The solution is evaporated *in vacuo* to a consistency below that necessary to form "hard crack," and finished in an open vessel heated either by steam or direct fire.

—A. R. L.

Improvements in and relating to the Production of Adhesive Substances Soluble in Water from the Gum exuded from Almond, Cherry, Peach, and other Trees. L. Kern. Hamburg, Germany. Eng. Pat. 21,370, December 7, 1891.

THE patentee claims a process for purifying and preparing the gums from the above-mentioned sources, prior to their application and use as adhesive substances.

The crude gum is ground, separated by boiling from earth and other impurities, and the meal steeped in water for 12–24 hours. The gelatinous mass is run into an autoclave, where it is exposed to the action of steam at a pressure of 15–90 lb. per square inch for $\frac{1}{4}$ –1 hour, and then filtered under diminished pressure through narrow woven cloths. The filtrate is evaporated at a moderate but uniform temperature, and the viscid product dried on galvanised or enamelled iron sheets previously greased; the finished product is hard and brittle, and possesses all the properties of genuine gum arabic.—A. R. L.

An Improved Coil for Feeding Syrup or Molasses into Vacuum Pans. H. Basanta, San Juan, Porto Rico. Eng. Pat. 3236, February 19, 1892.

THE coil is somewhat smaller in diameter than the vacuum pan, and is placed within it, preferably over the steam coil, to which latter it may be secured. It is perforated on its lower portion, and on that part outside the pan there is a pipe for steaming the coil, and another for introducing chemicals, such as "bloomer" or sulphuric acid, &c., into the pan. It is claimed that the feed is more regularly distributed over the pan by this coil, and is, in fact, so gentle and well divided in the masseuite that each crystal continues to develop and the formation of small grains of dust is avoided.—A. R. L.

Improvements in the Crystallisation of Saccharine and other Solutions. J. C. Mewburn, London. From "The Maschinenfabrik Grevenbroich," Grevenbroich, Germany. Eng. Pat. 8345, May 19, 1892.

WELL developed crystals are placed in a tank (or series of tanks connected by pipes), having a perforated bottom, a tube or channel below it, and a second tube above the layer of crystals. The tank is heated by a jacket, and a saturated solution, at the same temperature as that of the crystals, is introduced through the lower tube; the solution circulates through the crystals and passes off through the upper tube, the process going on continuously; during its progress cooling air or water is caused to pass through the jacket. By this means the solution is kept in constant agitation during the cooling, and the patentee claims that the invention provides a process whereby well developed crystals are obtained even from solutions of low value, and the secondary formation of fine grains avoided.—A. R. L.

XVII.—BREWING, WINES, SPIRITS, Etc.

On the Presence of Invertase in Wine and Beer. E. Donath. Chem. Zeit. 16, 1892, 459.

THE nitrogenous constituents of wine and beer are not definitely known, and it appeared probable to the author that one of them might be invertase. Quite recently A. Bau (Chem. Zeit. 1892, 16, 143; Chem. Rep. 1892, 16, 86), has determined the cupric reducing power of beer both before and after digestion with cane sugar. His results indicate the presence of invertase.

The author took 1 litre of white wine and concentrated it to $\frac{1}{4}$ litre, taking care to keep the temperature below 35° C.; the residue on treatment with ether yielded a colourless jelly in the ethereal layer; this should contain the ferment if present. The jelly was poured into strong alcohol, and the floccular precipitate separated on the filter, subsequently dissolved in water, and re-precipitated with alcohol. The purified substance in aqueous solution did not reduce Fehling's solution, but on digestion with cane-sugar solution it did; thus proving the presence of invertase. Two litres of beer were treated in the same way and with the same results.—A. L. S.

Softening Brewing Water and the Treatment of Hard Water containing Soda. T. Langer. Allgem. Ztschr. f. Bierbr. u. Malzfabr. 1892, 20, 4.

A BREWING water of 34.6° hardness, which yielded a beer of unpleasant colour, was softened according to Clarke's method with lime until it possessed a hardness of 18°. It was then found to be quite satisfactory.

In another case a water which, besides being very hard, contained sodium carbonate, was treated in the same way and the sodium carbonate rendered harmless by the addition of gypsum.—A. L. S.

Report on the Deplastering of Wine. Berthelot, Gautier, and Duclaux. Compt. Rend. 114, 152–155.

FOR many years plaster of Paris has been added to wines, not, however, without objections having been raised to its use. A recent French statute has fixed 2 grms. per litre as the maximum amount of potassium sulphate that shall be present in a wine.

In order to reduce the amount of sulphate to this, after the operation of plastering has been performed, a mixture of strontium tartrate and tartaric acid has been used, strontium sulphate and potassium acid tartrate being produced.

After this process it is unfortunately found that quite appreciable quantities of strontium tartrate remain in solution, even when the deplastering has only been partially performed.

Although the salts of strontium in such quantities are not known to be in any way harmful, yet it is quite possible that when taken in daily doses they might in time have some ill effect. Also as commercial strontium salts are almost invariably contaminated with barium salts, of which the poisonous properties are well known, the employment of any compound of strontium for the above purpose must be attended with not a little risk.

Taking everything into consideration, the committee appointed recommends that the French Academy of Sciences expresses its disapproval of the practice referred to.

—A. L. S.

PATENT.

Improvements in or Applicable to the Manufacture of Unfermented Wine. J. F. Henderson, Aberdeen, N.B. Eng. Pat. 1044, January 19, 1892.

ABOUT 84 lb. each of bruised Muscatel and Valencia raisins, the rind of 28 lemons, and 24 lb. ginger are extracted with 5 to 6 gallons of spirits of wine 10 overproof. After drawing off the spirituous extract the residue is extracted with water containing 2 oz. salicylic acid, the aqueous extract is boiled with 3½ cwt. cane sugar and lemon juice. When cool there is added to it the spirituous extract and about 12 oz. of caramel. It is diluted with boiled water until the gravity is reduced to 45° Tw. and clarified either by subsidence or finings. To make an unfermented sparkling wine, 4 oz. of the extract are taken for each reputed quart bottle, the bottle filled up with water and the mixture carbonated in the usual manner.—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOODS.

The Action of Certain Liquids on Aluminium. G. Lunge. Eng. and Mining J. February 13, 1892, 206.

EXPERIMENTS were all made with commercial rolled sheet aluminium, 1 mm. thick, from the Neuhausen works, of the following composition:—0.44 per cent. combined silicon, 0.11 per cent. crystallised silicon, 0.25 per cent. iron; traces of copper; 99.20 per cent. aluminium (by difference). The sheet was cut up into strips of such a size that they could be conveniently introduced into the flasks serving for experiment. Each strip was freed from sharp edges by a file, and was thoroughly cleaned in order to lay bare a real metallic surface and remove the excessively compact surface produced by the rolling process. They were for this purpose treated, first with concentrated solution of caustic soda, then with water, then with dilute sulphuric acid, again with water, scrubbed with a brush and distilled water, rinsed with alcohol and dried in an oven. Three such strips were accurately weighed, hung by means of small holes, upon a glass hook, in such manner as not to touch one another, and introduced into the flasks containing the liquids to be tested. Each flask held about 400 cc. of liquid, and was closed by a cork through which passed the stem of the glass hook. After leaving the whole for six days at the ordinary temperature of the room, the strips were taken out, rinsed with distilled water, freed from any adhering alumina, by means of a soft brush, rinsed with alcohol, dried and weighed. The loss of weight was referred to the aggregate surface of the three strips (about 130 sq. cm.), and is in the following table reduced to 100 sq. cm. Each liquid was tested at least twice in order to guard against accidental mistake. In a few cases, where the nature of the liquids presented no special difficulties, the alumina was, moreover, determined gravimetrically in the liquid after the experiments, with results closely approximating those found by ascer-

taining the loss of weight of the aluminium. The following table gives the results of the experiments :—

Liquids Experimented upon.	Loss in Weight.			
	A.	B.	Average.	Reduced to a Surface of 100 sq. ct.
Ordinary claret	Mg. 4.1	Mg. 3.3	Mg. 3.7	Mg. 2.84
Ordinary hock	4.0	4.5	4.3	3.27
Brandy	1.6	1.2	1.4	1.08
Pure 50 per cent. alcohol.....	0.8	0.8	0.8	0.61
5 per cent. solution of tartaric acid	1.9	2.4	2.2	1.69
1 per cent. solution of tartaric acid	3.6	3.1	3.4	2.58
5 per cent. acetic acid	4.3	5.7	5.0	3.85
1 per cent. acetic acid	6.2	5.2	5.7	4.38
5 per cent. solution of citric acid ..	2.8	2.8	2.8	2.15
1 per cent. solution of citric acid ..	2.3	2.6	2.5	1.90
5 per cent. lactic acid	6.1	6.3	6.2	4.77
5 per cent. butyric acid	1.7	1.7	1.7	1.31
Coffee.....	0.6	0.7	0.7	0.50
Tea .....	..	..	..	..
Beer.....	..	..	..	..
4 per cent. boric acid solution	2.3	2.3	2.3	1.77
5 per cent. carbolic acid	0.1	0.5	0.3	0.23
1 per cent. carbolic acid	0.8	0.5	0.7	0.49
$\frac{1}{2}$ per cent. salicylic acid.....	7.3	9.2	8.3	6.35

In very few of the cases was any action outwardly visible. In the case of brandy and alcohol, where the quantitative action was extremely slight, the surface of the aluminium showed a few fungus-like excreescences, probably formed by alumina, and caused by accidental flaws in the sheet. Lübbert and Roscher found that alcohol, ether, and all similar liquids had no action at all on aluminium foils, so that the observation made by the author would appear to be due to an accidental cause. Only in the last case, that of a solution of salicylic acid, did the aluminium lose its bright surface and become dull.

The following are the conclusions :—The action of coffee, tea (both of which had been poured in hot), and beer is zero, or practically so; that of brandy is also extremely slight; the action of acids and acid liquids (wine, sour milk, fruit-juices, &c.) is more pronounced, but even in this case far too slight to cause any alarm whatever. Taking the worst case found, that of acetic acid, a maximum attack of less than 5 mgrms. per 100 sq. cm. in six days was found. Now, a canteen holding a litre (or nearly a quart), has an inner surface of about 600 sq. cm. and an aluminium weight of about 200 grms. Such a canteen would in the very worst case lose 5 mgrms. in a day, even if it were always full, or 1 gram. in 200 days, and only in 55 years would it be reduced to half its weight. This action is certainly too trifling to be practically considered.

Aluminium may, therefore, without any fear, be employed for canteens or any other vessels serving for holding articles of food, at least at the ordinary temperature.—W. S.

PATENT.

A Process for the Manufacture of Artificial Human Milk, and other easily Digestible Foods. R. Reith and O. Dahm, Berlin, Germany. Eng. Pat. 7345, April 28, 1891.

The patentee proposes that albuminous substances such as "white of eggs, blood albumen, fibrin, casein, legumin,

gluten, and the like," shall be heated in solution at 120°—150° C. in a closed vessel by steam or a jacket of superheated steam. Such substances are thus coagulated and subsequently redissolve, giving rise to a solution closely resembling one of albuminose. When 1—2 parts of this albuminose-like substance are added to 100 parts of cows' or other milk, it is rendered as digestible as human milk, may be used as a substitute for the latter, and may be boiled, sterilised, or desiccated without suffering the detrimental change which coagulable albuminous bodies would produce therein. The new substance possesses the advantage over peptone in being devoid of bitter taste. $\frac{1}{2}$ — $\frac{3}{4}$ parts may be added to 100 parts of beef tea, cocoa, coffee, or tea, for the use of children, invalids, &c., and these rendered nourishing to any extent without affecting either their taste or smell.—A. R. L.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Ephedrine. P. Spehr. Pharm. Zeits. Russ. 1892, 31, 84.

THE alkaloid of the *Ephedra monostachia* forms on oxidation with potassium permanganate, benzoic acid. It is very easily soluble in water and alcohol, and these solutions can be kept for days at a temperature of 80° without decomposition of the alkaloid ensuing. It is soluble in chloroform 1:11, in ether 1:109, in benzene 1:1180, and in petroleum spirit 1:13,570.—B. B.

Ephedrine. P. Spehr. Pharm. Zeits. Russ. 1892, 16, 101.

EPHEDRINE, prepared by the author from *Ephedra monostachia*, has the composition $C_{13}H_{19}NO$, whereas the alkaloid prepared by Nagai from *Ephedra helvetica* has the formula $C_{10}H_{15}NO$. A pseudo-ephedrine of the same formula as the last named substance has been prepared from the same plant by E. Merck. A comparison of the three alkaloids gave the following results :—

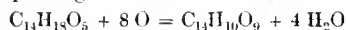
	Nagai's Ephedrine.	Pseudo-Ephedrine.	Spehr's Ephedrine.
Formula.....	$C_{10}H_{15}NO$	$C_{10}H_{15}NO$	$C_{13}H_{19}NO$
Melting point : Free base.....	216° C.	115° C.	112° C.
Hydrochloride	216° C.	174° C.	207° C.
Solubility in :			
Water	Slight	1:454	Very great
Alcohol	Great	Very great	"
Absolute ether	"	1:15	1:98
Official ether	"	1:24	1:109
Benzene.....	"	1:26	1:1180
Chloroform	"	1:8	1:11
Light petroleum	Very slight	Almost insoluble	1:13750

Taste	Bitter, astringent	Burning, anæsthetic
Action	Strongly poisonous and mydriatic.	Very feeble
Crystalline form : Free base.....	Rhombic prisms	Monoclinic
Hydrochloride	Rhombic prisms	Hexagonal prisms

Kobert has investigated the physiological action of Nagai's ephedrine on dogs and cats, and finds that they show strong symptoms of poisoning upon internal administration. The alkaloid prepared by the author, on the other hand, has no such effect.—B. B.

Chemistry of the Kola Nut. E. Knebel. Apoth. Zeit. 1892, 7, 112.

THE kola nut was first investigated by Liebig, who detected caffeine in it, and ascribed its action to that substance. Heckel showed that, even after the removal of caffeine from the kola nut, it had a distinct physiological action, which he ascribed to the presence in it of kola-red. The author has, however, recognised a glucoside, which splits up on heating with water or dilute acids into caffeine, glucose, and kola-red, and to which he has assigned the name *Kolauin*. This substance is split up on the ripening or drying of the nut by the action upon it of a diastatic ferment, so that the red colouring matter contains varying proportions of kola-red and kolauin. Kola red corresponds in composition to the formula $C_{14}H_{18}O_5$, and, according to the results of its acetylation, contains five hydroxyl groups. It is a very unstable body. The percentage of tannin in the kola nut (which is 1 to 2 per cent.) appears to correspond with the equation expressing the oxidation of kola-red—



whence it appears that the fusion of kola-red with alkalis would give the same decomposition products as tannin.

—B. B.

Hydrastinine Hydrochloride. E. Merck. Zeits. Österreich Apoth. Ver. 1892, 30, 107.

AN absolutely white preparation cannot be obtained as the salt, even when pure, has a light lemon colour. A sample passing the following test is found to satisfy all requirements:—

0.2 of a gm. is dissolved in 6 cc. of water and six drops of caustic soda solution (1:5) added. Each drop produces a white precipitate, which disappears on shaking. On shaking and stirring the clear solution, the free base crystallises out, the separation being completed by allowing to stand, and subsequently adding a little more caustic soda. The precipitate must be pure white, and the supernatant liquor clear and colourless. On acidifying with hydrochloric acid the hydrastinine redissolves, and the liquid takes a yellow colour. Samples which when thus tested give a precipitate that does not wholly dissolve and gives a turbid solution, or which form a turbid or coloured mother-liquor after the base has crystallised out, are contaminated with foreign matter.—B. B.

American Oil of Turpentine. J. H. Long. Chem. Trade Journ. 10, 261.

VARIOUS kinds of turpentine oil differ from each other in marked degree in their action on polarised light, French oil being laevo-rotatory, while the American and Russian oils are dextro-rotatory. The degree of rotation is not constant, especially great variations being found in the American oil.

The Distillation of Turpentine.—The largest proportion of American turpentine is obtained from the "longleaf" pine (*pinus Australis*). The "loblolly" or "oldfield" pine (*pinus taeda*), "pitch" pine (*p. rigida*), and the "swamp" or Cuban pine (*p. cubensis*) supply comparatively small quantities. The crude turpentine is collected by cutting in the tree a few feet from the ground, "pockets," or "boxes," capable of holding about half a gallon. To facilitate the collection of the "gum" in the boxes, grooves called "streaks" are cut in the tree above each box. The exudation runs down these streaks and is collected in the boxes. Boxes cut in new trees are "virgin" boxes and the "gum" found in them, which is white and of the consistence of honey, is called "virgin dip." Gum which, running down the tree and has, by exposure to air and light,

become hard, is removed in the autumn and is called "scrape." After four or five years working, the trees are abandoned.

The process of distillation is carried out in copper stills, holding from eight to 50 barrels of the gum. Water is added so that the oil may pass over in a current of steam. The vapour leaving the still is condensed in a worm surrounded by cold water, and the distillate flows into a receiving tank, where the oil collects on the surface. A bowl of "gum" weighs about 280 lb. (127 ko.) and yields from 7 to 9 gallons (26.5 to 34.3 litres) of the oil. The weight of rosin left in the still is about four times as great as that of the oil obtained. The American production is about 300,000 barrels per annum, of which over one-half is exported, chiefly from Savannah and Wilmington.—C. O. W.

Percentage of Guaiacol in Wood Creosote. J. Bongartz. Chem. Zeit. Rep. 16, 6.

See under III., page 511.

Manufacture of Nitro- and Amidomethylphenylpyrazolone and a Derivative of the latter. O. Imray, London.

From the "Farbwerke vormals Meister, Lucius, und Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 7963, May 8, 1891.

METHYLPHENYLPIYRAZOLONE when dissolved in five times its weight of sulphuric acid (monohydrate), and nitrated with nitrating acid of 33 per cent. is converted into a yellow nitro body, which separates out when the melt is poured into iced water. After recrystallisation from alcohol, in which it is sparingly soluble, the nitro-methylphenylpyrazolone forms an orange yellow crystalline powder having the composition $C_{10}H_9N_3O_3$, and melting at $218^\circ C$. It is insoluble in water, but dissolves in a soda solution. On reduction with tin and hydrochloric acid the nitro-compound is reduced to the corresponding amido body, and after removal of the tin by sulphuretted hydrogen and partial evaporation the hydrochloride separates out in fine needles. It is purified by dissolving in water and reprecipitation with concentrated hydrochloric acid, and has the composition $C_{10}H_{11}N_3O \cdot 2 HCl$. By diazotising and boiling a solution of the salt a precipitate is obtained scarcely soluble in alcohol or glacial acetic acid. It dissolves in soda and is reprecipitated by acids.—T. A. L.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Aluminium Light. A. M. Villon. Bull. Soc. franc. Phot. 1892, 8, 134.

POWDERED aluminium can be used for a flash light for photographic purposes instead of magnesium. It is considerably cheaper than magnesium, and burns without smoke. The light given by it is almost as actinic as that obtained from magnesium. Powdered aluminium cannot be satisfactorily burnt in an ordinary spirit lamp, and the best result was obtained by using a spirit lamp, in the middle of the flame of which the end of a tube conveying oxygen was introduced, and into which the powdered aluminium was projected by means of a compressible india-rubber ball. The best light was obtained by the use of a mixture of 100 parts of powdered aluminium, 25 parts of lycopodium, and 5 parts of ammonium nitrate.—B. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

The Annual Report (Sixteenth) of Her Majesty's Inspectors of Explosives for 1889.

In their annual report recently published, Her Majesty's Inspectors of Explosives are fortunately able to state that only one death occurred from accident during manufacture. Thirty-four persons, however, lost their lives during the year owing to accidents in the use of explosives, and in most cases carelessness was the cause of the accident. There were only two fatal accidents owing to improper thawing of nitroglycerin explosives; hitherto this has been a fruitful source of accident. There have been several outrages and malicious attempts made with explosives, but happily no lives were lost. The chief explosions of this character were at Dublin Castle and Dawsholm Gas Works, Glasgow, and were in both cases clearly the result of deliberate planning. Particulars are given of a fire which took place on board S.S. "Delecomyn," en route for India with 56½ tons of safety cartridges on board. About 18 tons were jettisoned, and the remainder were destroyed by the fire without giving rise to a general or violent explosion.

In regard to the great explosion of the Vigna Pia Magazine near Rome, the committee appointed to inquire into the explosion "came to the conclusion that it originated in a fire initiated by the spontaneous ignition of parachute or signal rockets, and the committee laid special stress on the danger of storing with gunpowder combustible stores such as fireworks, liable to spontaneous ignition." A serious explosion took place at the Schlebusch Dynamite Factory near Cologne during a thunderstorm; a heavy discharge of electricity struck the gelatin and washing houses, causing both buildings to explode simultaneously. The lightning conductors had been examined during the previous month and were found to be in perfect order.

A considerable addition has been made to the list of authorised explosives during the year, but no striking new departure is exhibited as nearly all those added are modifications or slight variations on previously existing explosives. It is pointed out that there is at present a vast variety of smokeless or quasi-smokeless powders on the market at home and abroad, but practically all may be classed under two heads, viz., those consisting essentially of nitrocellulose and those consisting of the same material in conjunction with nitroglycerin.

Owing to the considerable extent to which electric lighting is adopted or proposed to be adopted in factories for explosives, a series of rules have been drawn up to indicate the minimum of precautions which should be observed in all electric light installations for factories and magazines for explosives. These rules have been largely based on those issued by the Phoenix Fire Office with special modifications or additions in some cases. Are lamps are not to be used, and in the case of danger buildings the light is to be placed outside of the building.

Where there is any liability to the formation of dust the lamps are to be immersed in water or otherwise protected from dust falling on them. Experiments made at Waltham Abbey showed that if the globe of an incandescent lamp be broken in gunpowder dust, the carbon filament retained its heat long enough to fire the dust. Dr. Duprè calls attention to the fact that gelatin dynamite has gradually advanced to the first position among the various explosives employed, judging by the number of samples received. He examined two samples of gun-cotton which are of considerable interest, and reports: "One of them was taken in 1887 from the river which passes the gun-cotton works at Stowmarket, having been in the water since 11th August 1871, or for a period of 16 years. The other was dug up in February 1891, on the place of the old exploded magazine at the same factory, having been buried in the earth for a period of 19½ years. Both samples were in perfect condition, not having undergone the least deterioration. This, though not quite unprecedented, is nevertheless highly interesting as tending to confirm, most strongly, previous conclusions, viz., that well made gun-cotton is an extremely stable compound." Some experiments were made as to the ignition of gunpowder by means of an electric spark. It was found that dry

gunpowder could not readily be exploded by a series of sparks from a small induction coil, while moist gunpowder readily took fire. Notices are also given of the more important accidents with petroleum and similar substances, one of the most serious being the explosion on board S.S. "Tancerville," which "was due to the ignition and explosion of a quantity of petroleum vapour in admixture with air accumulated in and about the ballast tank."

From a special report made by Her Majesty's Inspector of Explosives, Lieut.-Colonel Cundill, on the ignition and partial explosion of gelatin dynamite which took place at Nantymwyn lead mine, Carmarthenshire, on March 28, 1892, it appears that a miner was lowering a case containing 50 lb. of gelatin dynamite down a shaft when it slipped from the rope and fell. A report was heard, and smoke and flames issued from the spot. Another miner, who was waiting to receive the case, as well as the man lowering it, died from the poisonous fumes, neither having received any external injury beyond a few scratches. The case fell, at most, 48 ft. This is the first instance in this country of a simple fall exploding a nitroglycerin compound. The actual cause of the accident is obscure, but Lieut.-Colonel Cundill considers that "from the evidence afforded by the facts it is most reasonable to conclude that the ignition and quasi-explosion were produced simply by shock acting on the gelatin dynamite when in an abnormally sensitive state" (owing to its having been frozen and partially thawed on the outside), "and perhaps brought violently in contact with the hard rock, or that they were produced by actual contact with the flame of one of the men's candles."—W. M.

Nitrojute, an Explosive. O. Mülhäuser. Chem. Zeit.
16, 163.

AFTER purifying the jute fibre by boiling with a 1 per cent. solution of sodium carbonate and washing with water, the author treats 1 part of the purified jute with 15 parts of nitrosulphuric acid. With different proportions of nitric and sulphuric acids he obtained the following results:—

Exp.	HNO ₃ :H ₂ SO ₄	Yield.	Ignition Point.	Nitrogen.
		Per Cent.	° C.	Per Cent.
I.	1 : 1	129.5	179	11.96
II.	1 : 2	132.2	167	12.15
III.	1 : 3	135.8	169	11.91

Another trial made with fine carded jute and an acid mixture similar to that in experiment II. gave 145.4 per cent. yield of nitrojute, which ignited at 162° C. and contained 12 per cent. of nitrogen (this Journal, 1892, 214).—W. M.

PATENTS.

An Improved Method of Charging Explosive Shells.
F. W. Dodd, London. Eng. Pat. 5608, April 1, 1891.

A CASE is constructed of wood, compressed paper, or india-rubber of such form and size that when inserted into the shell there is a small space left in all directions between the outer surface of the case and the inner surface of the shell. The case is filled with the explosive and inserted into the shell, the space between case and shell being then filled with any suitable plaster which will set hard, the cap is screwed on, and the charge becomes securely fixed in the shell.

—W. M.

Improved Machinery for Compressing Gunpowder or other Material into Pellets. H. Greenwood, Leeds. Eng. Pat. 7948, May 8, 1891.

THIS invention is for arrangements of machinery for "compressing gunpowder and other material in measured quantities into pellets and discharging the same automatically from the machine, such pellets being formed either solid or hollow, and compressed between oppositely moving plungers."—W. M.

Improvements in Machinery for the Manufacture of Explosives. E. W. Anderson, Erith. Eng. Pat. 12,303, July 20, 1891.

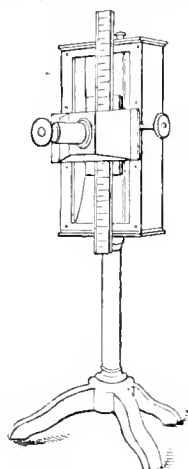
THIS invention relates to improvements in machines described in Specification No. 11,667, 1889* (this Journal, 1890, 893), for the manufacture of cordite. The original specification must be consulted for details of the mechanical arrangements adopted, which are illustrated by numerous drawings.—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

A New Colorimeter. Chem. Zeit. Rep. 1891, 15, 324.

GALLENKAMP'S colorimeter consists of two equally wide adjacent troughs constructed of plate-glass and encased together in metal. The one into which the liquid under examination is placed has the form of a parallelepiped, whereas the other, which serves to contain the normal solution, is circular. The colour of the normal solution in the latter gradually decreases down to a colourless



A NEW COLORIMETER.

liquid. By means of the observation apparatus, which can be moved in front of the troughs, a point of the scale may be found at which both liquids show the same colour. The scale is divided into 100 parts, so that it gives the percentage relation of colour between the liquid under examination and the normal solution. When the telescope attached to the observation apparatus is replaced by a small direct vision spectroscope, the instrument forms a spectro-colorimeter. Besides its accuracy and delicacy, the instrument has the advantage that the heights of the liquids remain unaltered during the measurement. After some practice single readings do not differ more than 0.5 per cent. It is best illuminated by projecting diffused daylight by means of a white screen from behind.—A. R. L.

An Apparatus for determining the Liability of Oils to Spontaneous Combustion. E. H. Richards. Technol. Quarterly, 1891, 346.

THE author describes the following laboratory apparatus for the experimental determination of the facility with which oils oxidise under favourable conditions. At the instigation of the New England Cotton Manufacturers' Association and of the Boston Manufacturers' Mutual Fire Insurance Company, Professor Ordway undertook the

investigation of this subject, the outcome of which is this apparatus in the form given it by W. B. Allbright and F. W. Clark.

The apparatus consists of an outer shell formed by a six-inch wrought-iron tube which can be closed at each end by discs of wood. Inserted into this tube is an inner four-inch tube of sheet-iron with overlapping metal covers at each end. Thus there is left an air-space of one inch around the inner tube and of three inches at each end. The whole apparatus is conveniently placed on a tripod and heated by a Bunsen burner. Three thermometers which are inserted into the inner shell through the outer one allow of the reading of the temperature.

For purposes of testing an oil 50 grms. of the oil are evenly distributed over, say, 50 grms. of cotton waste, and the waste carefully pushed into one end of the inner tube and one thermometer inserted into the middle of the ball. A second ball of unsoiled waste is placed at the other end of the tube. On heating, the thermometer inserted into this blank waste should not rise above 100°–101° C., which can be easily controlled by the readings of the middle thermometer. The latter should be kept at about 125° C.

The results obtained by means of this apparatus have been of the greatest use for determining the cause of fires and for gauging the degree of safety of oils. For instance, the percentage of fatty oil which may be safely mixed with mineral oils can be easily determined. Thus neat-foot oil and best lard oil may be added to the extent of 50–60 per cent., while cotton oil should not be allowed beyond 25 per cent.

Shavings, leather, skeins of dyed yarn, or rolls of dyed cloth may be tested in the same way in this apparatus. Paper pulp, boards, and other combustible substances, when heated to a higher temperature, would indicate the temperature at which inflammation sets in.—J. L.

INORGANIC CHEMISTRY.— QUALITATIVE.

Colour Testing. W. C. Wilson. Chem. Trade J. 10, 130, 163, 274, 290.

See under XIII., page 537.

INORGANIC CHEMISTRY.— QUANTITATIVE.

Dry Method of Analysis of Galena. P. Jannasch and T. Bickes. J. Prakt. Chem. 1892, 45, 113–114.

BROMINE attacks the mineral at ordinary temperatures to a certain extent; complete transformation into bromide may be brought about by first heating with a small flame and finally heating to fusion point, a current of bromine passing all the while. So soon as the conversion is complete the boat containing the material is allowed to cool in a current of bromine, and subsequently weighed. The contents of the boat are then treated with chlorine water, warmed, and the lead chloride formed is dissolved by hot water, aided with a little nitric acid. The liquid is filtered from the gangue and the lead precipitated as sulphate in the filtrate.

On the Electrolytic Determination of Metals as Amalgams. W. Gibbs. Amer. Chem. Journ. 13, 570–571.

THE author in 1883 read a paper before the National Academy of Sciences on a method of electrolysis for the separation of metals from their solutions by the use of mercury as the negative electrode, the positive electrode being platinum. Iron, cobalt, nickel, zinc, cadmium, and copper can be completely separated as amalgams from a solution of their sulphates in this way.

Drown (Trans. Institute of Mining Engineers, Vol. 20, not yet published) has shown that iron may thus be separated from even very small quantities of alumina, and

it is to be expected that iron and some other metals may also be separated from titanium, zirconium, niobium, and tantalum, and that the electro-negative portion of certain metallic salts may be estimated in the same way.

Lückow (Zeits. Anal. Chem. **25**, 113) has estimated zinc, and Vortmann (Ber. **24**, 2749) has estimated mercury, zinc, cadmium, lead, bismuth, and antimony by the author's process.

E. F. Smith, in his "Electrolytic Analysis," erroneously states that the author applied this method to tin and mercury.—P. J. H.

Determination of the Value of Commercial Aluminium.

Schweiz. Wochenschr. Pharm. 1891, **29**, 471; Chem. Zeit. Rep. 1892, **16**, 4.

THE impurities occurring in aluminium and depreciating greatly its value are chiefly silicon and iron. After discussing the various methods in vogue the author proposes the following:—The aluminium is dissolved in caustic potash of 30–40 per cent. (free from SiO_2), and silicon and iron are determined separately. He dissolves 3–4 grms. in 35 cc. warm caustic potash ley. Without filtering off the black flocculent residue, the liquor is treated with an excess of pure hydrochloric acid and evaporated to dryness. The silica is then determined in the usual way.

For the determination of iron the author dissolves in the same way 3–4 grms. aluminium, acidulates with dilute sulphuric acid, and titrates with potassium permanganate.

—J. L.

On the Volumetric Estimation of Sulphuric Acid.

K. Farnsteiner. Chem. Zeit. **16**, 182.

THE sulphuric acid is precipitated in a nearly boiling solution, slightly acid with hydrochloric acid, by a measured but excessive quantity of barium chloride solution of known strength. The solution is again heated for some time and ammonia free from carbonate is added until the neutral point is just passed, and then ammonium chromate (which is preferable to potassium chromate) in slight excess. When the liquid is cold it is introduced into a suitable measuring flask, filled up to the mark. When the precipitate has settled, half the liquid is filtered off into a beaker, or better a wide mouthed flask provided with a ground stopper. The excess of chromate is then estimated by Volhard's method, i.e. potassium iodide and hydrochloric acid are added, and the iodine liberated is titrated with sodium thiosulphate.

Owing to the fact that barium sulphate carries down the chromate with it, the results are too low except in solutions containing small quantities of sulphuric acid. Thus, a solution containing about 0.8 per cent. of potassium sulphate gave 45.11 and 44.83 per cent. of SO_4 instead of 45.91. But with very dilute solutions (containing 0.04 to 0.08 per cent. of potassium sulphate), the results are sufficiently exact. Thus, in a solution of potassium sulphate containing 0.0744 of the salt in 100 cc., the SO_3 found was 0.0340 gm.; SO_4 calculated was 0.0342 gm. The method is recommended for the estimation of sulphuric acid in soda, rock salt, and table salt, potash, and potassium chloride. In estimating the sulphuric acid in natural waters 100–200 cc. are taken; the carbonates are first decomposed by heating with dilute hydrochloric acid, and the method given above is then followed. 200 cc. of Hamburg tap water gave 0.0079 SO_3 by gravimetric, 0.0077 by volumetric analysis.

The only bodies which interfere with the determinations in water are ferric oxide, which is precipitated by the ammonia, and nitrous acid, which can be decomposed by adding a few crystals of pure urea to the water while the carbonic acid is being driven off. A single determination can easily be made in an hour.—P. J. H.

Notes upon the Estimation of Chlorine in Electrolysed Solutions. L. M. Norton. Technol. Quarterly, 1891, 361.

ON electrolysing aqueous solutions of sodium chloride, solutions are obtained which contain chlorine in several forms of combination. The author describes his methods of estimating the chlorine.

It may be premised that by the electrolysis of a sodium chloride solution at ordinary temperature the liquor will contain sodium chloride, sodium hypochlorite, and sodium chlorate, whilst sodium chlorite could not be found. At a temperature of 50° – 55° C. mainly sodium chloride and sodium chlorate are obtained.

(a.) *Estimation of Chlorine combined as Hypochlorite.*—25 cc. of the solution are titrated with a standardised sodium arsenite solution and the chlorine present as hypochlorite calculated. The solution must be preserved for the determination of the chloride present.

(b.) *Estimation of Chlorine combined as Chloride.*—The solution from the preceding operation is made up to a known volume and an aliquot part of it is titrated with standardised silver nitrate solution, potassium chromate being used as indicator. The presence of arsenic does not interfere with the correctness of the result; in fact, sodium arsenite itself may be used as indicator in place of the potassium chromate.

Thus the chlorine present as hypochlorite plus chloride is estimated; by subtracting the amount found *sub a*, the quantity of chlorine present as chloride is obtained.

(c.) *Estimation of the Total Chlorine.*—It is, of course, evident that the total chlorine could not be obtained by the titration of the original solution *before* being electrolysed. The simplest way of determining the total chlorine is to reduce the hypochlorite and the chlorate to chlorides and to titrate with silver nitrate. To effect the reduction the author uses sulphurous acid, which has been recommended for this purpose by Rose and Engel. Free acid being formed during the reduction potassium chromate cannot be used as indicator for the subsequent titration with silver nitrate; the author adds, therefore, an excess of silver nitrate and titrates back with ammonium sulphocyanide.

From the total chlorine thus found the chlorine present as chlorate can be easily calculated.

The method of determining the hypochlorite plus the chlorate by allowing them to act on potassium iodide in the well known way has not been found as convenient as the one described above.

A less rapid method would be to determine the total oxidising power of the solution, i.e., the hypochlorite plus chlorate, by means of an excess of standardised ferrous sulphate.

In testing the efficiency of electrolytic chlorine generators the chlorine produced is most conveniently absorbed in sodium hydrate, the amount of chlorine, which the latter contained, having been determined previously. The chlorine in its different combinations may be estimated as above.

The author recommends these methods for the analysis of bleaching powder if the determination of total chlorine and chlorate is desired.—J. L.

ORGANIC CHEMISTRY.— QUALITATIVE.

Testing Lard for Fatty Oils. P. Welmaus. Pharm. Zeit. 1891, **36**, 798; Chem. Zeit. Rep. 1892, **16**, 5.

THE author proposes a new reaction by means of which he is able to detect the presence of any fatty oil in lard. If one gm. of a fatty oil be dissolved in 5 cc. chloroform in a test-tube, and 2 cc. phosphomolybdic acid or sodium phosphomolybdate and a few drops of nitric acid are added, on violent agitation the reagent is reduced and the mixture becomes emerald green. On standing a few minutes the lower layer of chloroform becomes colourless whilst the upper layer shows a green colour; on adding ammonia or alkalis, the green colour is changed into a blue one.

Lard (tallow, goose fat, butter fat), treated in the same way does not show any change of colour; on saturating with ammonia or alkali the mixture becomes colourless.

The only oil of animal origin which reduces the above mentioned reagent is cod-liver oil, which contains besides amines of the fatty series, several bases of an alkaloid character, viz., Morrhaine, Gadoline, &c.—J. L.

Adulteration of Turpentine. J. H. Long. Chem. Trade J. 10, 261.

TURPENTINE oil is not largely adulterated at the present time. Light petroleum oils, gasoline, benzine, or light rosin oils have occasionally been employed as adulterants. The various sophistications can be detected by the following tests:—

1. *Specific Gravity*.—The specific gravity of American turpentine varies within the narrow limits of from 0.864 to 0.870, according to Allen. Thirteen samples examined by the author showed results varying between 0.8622 and 0.8655 at 15° C. With pure commercial samples, the density was found to range from 0.8656 to 0.8748.

The petroleum products, which could be used for the sophistication of turpentine have all a density much lower than this.

Gasoline, 88° B.	Sp. gr. 0.6508 at 15° C.
" 74° B.	" 0.7001 "
Benzine, 63° B.	" 0.7306 "
"Standard white," 110 fire test	" 0.7959 "
"Water white," 150 "	" 0.7918 "
"Head light," 175 "	" 0.7952 "
Mineral seal	" 0.8293 "
Paraffin oil	" 0.8906 "

A mixture of 95 vols. of a turpentine, sp. gr. 0.8680, with 5 vols. of each one of these oils, gave the following results:—

With 5 vols. gasoline, 88° B.	Sp. gr. 0.8568
" gasoline, 74° B.	" 0.8595
" benzine, 63° B.	" 0.8605
" "standard white," 110 fire test.	" 0.8637
" "water white," 150 fire test....	" 0.8632
" "head light," 175 fire test....	" 0.8630
" mineral seal	" 0.8656
" paraffin oil.....	" 0.8688

For the detection of ordinary rosin spirit the specific gravity is not of much use, some grades having a lower, and some a higher density than turpentine. Fatty oils can readily be detected by this test.

2. *Boiling Point*.—In the examination of a large number of pure commercial samples of turpentine, the boiling point was uniformly found at 155° to 156° C., 85 per cent., distilling between 155° and 163° C. The distillation is practically complete below 185° C. The initial and final boiling points of the eight mineral oils referred to were as follows:—

	Initial.	Final.
	° C.	° C.
Gasoline, 88°	About 40	About 110
Gasoline, 74°	" 55	" 125
Benzine, 63°	" 95	" 165
"Standard white," 110°.....	" 130	Above 360
"Water white," 150°	" 140	About 310
"Head light," 175°	" 160	" 315
Mineral seal	" 230	Above 360
Paraffin oil.....	" 300	" 360

The initial temperature means the point when about 1 cc. out of 100 has passed over. The presence of 5 per cent. of either of these oils in turpentine would readily show itself.

3. *Flashing Point*.—Much importance is attached to the flashing-point test, which according to Redwood is at 33° C. By the presence of volatile petroleum products it is much lowered. Mixtures of 95 vols. of turpentine and 5 vols. of the above mineral oils show the following flashing points:—

With gasoline, 88°	Flashing point below 15° C.
" " 74°	" " " 19° C.
" benzine, 63°	" " " about 22° C.
" "Standard White," 110° ..	" " " 32° C.
" "Water White," 150° ..	" " " 33° C.
" "Head Light," 175°	" " " 34° C.
" Mineral seal	" " " 35° C.
" Paraffin oil	" " " 36.5° C.

This table requires no comment.

4. *Vapour Density*.—This was determined in a Victor and Carl Meyer's apparatus with ethyl benzoate as heating liquid. Thus fractionated fresh turpentine was found in two tests to possess a molecular weight of 135.11 and 134.53 respectively. Ordinary commercial turpentine, not fractionated, gave results varying between 136.6 and 147.7, average of 15 samples 142.0. The light petroleum products have molecular weights considerably lower than that of turpentine. A small addition of benzene can be detected by fractionating the sample and determining the vapour density of the first 10 cc. This method of course fails with heavier petroleum products.

5. *Distillation with Steam*.—The results obtained in this way fully agree with Armstrong's experience. The method is valuable for the detection of vegetable oils, or heavier petroleum products.

6. *Nitric Acid Oxidation*.—Wm. Burton (Amer. Chem. Jour. 12, 102) has shown that a fairly quantitative measure of the petroleum products present in a turpentine may be made by slowly dropping 100 cc. of it into about 300 cc. of fuming nitric acid which is kept in a flask immersed in cold water. At the end of the reaction it is simply necessary to wash the oxidation compounds with hot water, in which they dissolve, while the practically unattacked petroleum is left behind. This method gives very satisfactory results.

—C. O. W.

ORGANIC CHEMISTRY.— QUANTITATIVE.

Weighting of Leather. B. Kohlmann. Chem. Zeit. 1892, 16, 16—17.

INASMUCH as such substances as may be used for this purpose can only be introduced by making the leather absorb solutions of them, it is obvious that insoluble materials are inapplicable, and it would appear that sugar, barium salts, and cheap vegetable extractive matter are the only weighting materials actually used. The detection of the fraud resolves itself into the determination of soluble organic matter, ash, sugar, and barium; the two former should be compared with the average quantity to be found in genuine leather; the two latter will serve as qualitative indications, since properly tanned leather is free from them.

The samples must be dried at 105° before they are weighed, for the water in genuine leather varies from 12 to 20 per cent.; they are then cut into the thinnest possible strips and extracted with cold water, hot water being inadmissible because leather speedily goes slimy in it, and is thus imperfectly extracted. In testing for sugar in this extract it must be remembered that any excess of tannin which may exist in the leather will be dissolved, and will yield sugar when boiled with alkalis or alkaline liquids, like Fehling's solution. To avoid errors from this source the aqueous extract should be precipitated with lead acetate and

the excess of lead removed by sodium carbonate before the sugar is determined by Fehling's solution or by the polarimeter. The other estimations need no comment.

The examination of pure leather showed that cold water extracts 10–12 per cent. of the weight of the dry leather,

and that the ash varies between 0.5 and 1 per cent. It will thus be seen that samples II. and VI. in the subjoined table are the only pure specimens, IV. is adulterated with soluble organic matter other than sugar, and the rest contain both sugar and barium.

	Samples.							
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
100 of Leather Dried at 105° contain								
Organic matter insoluble in water	79.9	89.2	79.8	78.0	73.6	87.7	80.0	77.6
Organic matter soluble in water	15.9	10.2	15.8	20.9	22.6	11.8	17.1	19.3
Ash	4.2	0.6	4.4	1.1	3.8	0.5	2.9	3.1
Sugar	Found	Nil	Found	Nil	Found	Nil	Found	Found
Barium.....	Found	Nil	Found	Nil	Found	Nil	Found	Found

—A. G. B.

Analysis of Linoleum Floorcloth. J. Pinette. Chem. Zeit. 1892, 16, 281.

LINOLEUM floor cloth is manufactured from ground cork and oxidised linseed oil, with admixture of various pigments and mineral weighting materials. In the analysis of this material the first step is to remove from its under-part a sort of very coarse cloth, which generally carries a thick coat of paint. The linoleum is then ground or cut into small pieces, and extracted with ether in a Soxhlet apparatus. The mineral constituents of the linoleum are estimated by analysing the ash obtained after ignition. The loss on ignition, oil and cork, supplies the analytical figure for the latter constituent. The following analyses were made in the above manner:—

—	1	2	3
Moisture.....	3.39	3.01	3.41
Linseed oil.....	11.43	10.60	19.58
Cork.....	77.24	73.63	54.16
{ Silica	2.94	3.99	4.31
{ Alumina	1.91	4.94	0.61
{ Ferric oxide.	1.78	1.79	8.86
{ Lime	1.31	2.04	6.17
{ Alkalies, &c., }			2.90
	100.00	100.00	100.00

As the quality of linoleum floorcloth depends chiefly upon the percentage of linseed oil contained in it, the interpretation of these analyses offers no difficulty.

—C. O. W.

Estimation of Glycerol in Wine. M. T. Lecco. Chem. Zeit. 1892, 16, 504.

In the determination of glycerol in wine by the method proposed by the Commission on wine analysis methods, Berlin 1848, it is more accurate to employ a large relative proportion of sand, the extraction of the glycerol being more complete:—10 cc. of the wine are mixed with dry pulverised calcium hydroxide (0.1 gm.) and quartz-sand (10 grms.) evaporated on the water-bath almost to dryness, and the residue extracted 4–5 times with hot absolute alcohol, the alcoholic solution filtered, and the filtrate (40–50 cc.) evaporated on the water-bath to a syrup. The latter is mixed with alcohol (5 cc.) and ether (7–5 cc.) and allowed to remain for some hours in a corked flask, when it is decanted into a tared weighing flask, evaporated,

placed for an hour in a water oven, and weighed. The following amounts of glycerol were obtained in three samples of the same wine, by the methods stated.

No. I.—The same method as above described. Glycerol = 0.0873 gm.

No. II.—The same, but mixture of wine, sand, and calcium hydroxide more completely evaporated, moistened with water, and extracted with absolute alcohol. Glycerol = 0.0889 gm.

No. III.—The same, but still more completely evaporated, without stirring, and the residue extracted direct with absolute alcohol. Glycerol = 0.0971 gm.

It therefore appears that the highest results are obtained when the evaporation is most complete and the residue extracted, without addition of water, with absolute alcohol. The author is still continuing his experiments, especially in the direction of ascertaining whether the glycerol isolated in this method is pure.—A. R. L.

The Best Means of Valuing Raw Sugar. A. Herzfeld. Chem. Zeit. 16 (Chem. Rep.), 114–115.

See under XVI., page 541.

Adulteration of Linseed Oil by Rosin Oil. F. Coreil. Journ. Pharm. Chim. 1892, 5 sér., 25, 185; Chem. Zeit. Rep. 1892, 16, 90.

THE author proposes a new method for recognising the presence in linseed oil of rosin oil. The principle of this new method is that rosin oils, just like oils of animal origin, are blackened by gaseous chlorine. The author passed for three minutes a current of chlorine through samples of pure linseed oil and of such oil containing 5, 10, and 20 per cent. of white rosin oil. The pure oil, likewise the oil containing 5 per cent. of rosin oil, were but slightly coloured, whilst the other two samples were slightly darkened. Pure rosin oil became reddish brown. After three hours' standing the pure linseed oil had remained unchanged; the oil containing 5 per cent. rosin oil was slightly brown, that with 10 per cent. distinctly brown, that with 20 per cent. dark brown; the pure rosin oil by this time had become black.

The author criticises the methods proposed by Rémont (Bull. Soc. Chim. 33, 401–466; 525–532) and Aignan (this Journal, 1890, 330) for the estimation of rosin oils and replaces them by the following method: 2 grms. of the oil, previously dried at 105° C., are heated with 40 cc. of standardised alcoholic potash on the water-bath for two hours. If pure linseed oil be treated in this way the saponification will be found complete after 1–1½ hours; in the presence of more than 15 per cent. of rosin oil the saponification never becomes completed, which can be recognised by the appearance of oily drops on shaking or by an opalescence on adding water.

After two hours' boiling, allow to cool, add phenolphthaleïn, and titrate back the excess of alkali with half-normal hydrochloric acid.

Pure linseed oil requires per grm. of oil 201—221 mgrms. potash, whilst white rosin oils, which are used mostly for adulterating linseed oil, only require 20—41 mgrms. caustic potash. Taking 211 as the mean value for linseed oil and 31 for rosin oils, the formula $\frac{100(211-n)}{211-31}$ n being the amount of potash required by the grm. of oil under examination, gives the percentage of rosin oil used as an adulterant.—J. L.

ANALYTICAL AND SCIENTIFIC NOTES.

The Determination of the Temperature of Steam arising from Boiling Salt Solutions. J. Sakurai. Proc. Chem. Soc. 1892 (111), 92—94.

The evidence now on record as to the temperature of the steam arising from boiling salt solutions is exceedingly unsatisfactory. Rudberg has maintained that the temperature of such steam is always the same as that of water boiling under the same pressure, but, under the conditions observed in his experiments, the temperature indicated was evidently not that of the steam, but of a film of liquid water condensed upon his thermometer bulb. Müller came to the conclusion that steam at the moment of its formation within a boiling salt solution has only the temperature of 100°, though it is more or less superheated by rising through the hot solution. Not only is this conclusion difficult to accept on theoretical grounds, but the observations on which it is based are by no means of a convincing character, and are not peculiar to salt solutions.

On the other hand, Faraday and Magnus thought they had proved that the temperature of steam escaping from a boiling salt solution is the same, or nearly the same, as that of the solution, but from the manner in which their experiments were conducted, it is not clear that the temperature they observed was really that of the natural steam escaping from a boiling solution. On the contrary, it would appear that what they determined was essentially the temperature of the wall of the vessel around the thermometer and of the steam superheated thereby.

Such being the case, the author has studied the conditions under which the true temperature of steam escaping from a boiling salt solution may be ascertained, and he has devised a method by which this can be readily effected. The result of his observations is, that *the temperature of steam escaping from a boiling salt solution is the same as that of the solution.* The most essential conditions for success are:—

1. The thermometer used in ascertaining the temperature of the steam must be kept from contact with the solution—even the smallest drops thrown up by ebullition.

2. The effect of the cooling of the thermometer by radiation must be rendered insignificant in proportion to the heating up by the steam. This condition is readily fulfilled by rapid renewal of the vapour in contact with the thermometer by the expedient of combining the introduction of steam from without with the boiling of the solution by the lamp. Ebullition alone should suffice, but the practical difficulties in the way prevent such being the case; the boiling would have to be tumultuous to generate much vapour, and in a short time the solution would become too concentrated for the experiment to be continued with convenience. On the other hand, by duly regulating the amount of steam entering from without, and the height of the flame, an abundant supply of steam can be secured, and the temperature of the boiling solution may be maintained constant within a few thousandths of a degree for any length of time.

3. The walls of that part of the vessel which serves as the steam chamber for the thermometer must be sufficiently protected from external cooling, and yet, at the same time must not be heated to the temperature of the steam.

Through the non-observance of the former condition as in Rudberg's experiments, so much of the steam is condensed in keeping the walls at 100° that it is hardly possible to keep enough passing over the thermometer bulb, while if the latter condition is ignored, as in Magnus's experiments, the indications of the thermometer may be illusory.

In the apparatus employed this last condition was secured by protecting the steam chamber with a jacket, through which passed a slow stream of the vapour generated by gentle distillation of somewhat dilute acetic acid. By modifying the degree of dilution any desired temperature, changing only slowly as distillation proceeded, was obtained in the jacket; in this manner condensation of steam upon the thermometer bulb, as well as upon the surrounding walls, was prevented.

A salt solution whose boiling point had been approximately determined and known to be higher than that of the dilute acetic acid was boiled, and a rapid current of steam introduced into the boiling solution from without. The thermometer for ascertaining the temperature of the steam now rose above that in the jacket, and ultimately attained the same temperature as the boiling solution. The following are an example of the results obtained with a solution of calcium chloride:—

Temperature of the			Difference.	
Steam.	Solution.	Acetic Acid Vapour.	(II.)—(I.)	(I.)—(III.)
111.2	112.5	110.8	1.3	0.4
111.7	112.5	110.9	0.8	0.8
112.2	112.6	111.1	0.4	1.1
112.5	112.7	111.3	0.2	1.2
112.7	112.9	111.5	0.2	1.2
113.0	113.0	111.6	0.0	1.4
113.1	113.2	111.8	0.1	1.3
113.3	113.3	111.9	0.0	1.4

—W. S.

Note on an Observation by Gerlach of the Boiling Point of a Solution of Glauber's Salt. J. Sakurai.

A FEW years ago G. T. Gerlach (Zeit. Anal. Chem. 26, 413) published a paper in which he mentions that steam escaping from a boiling solution of Glauber's salt containing a crystalline magma of the anhydrous salt indicated a temperature of 100°, whilst the liquid is boiling at 82°, or even at 72°. This observation appeared so curious and so anomalous that the author was induced to repeat his experiments: the results, on the whole, confirmed his observations as to temperatures, but, at the same time, deprived them of all exceptional character, in fact showed them to be erroneous in so far as they imply that a substance can evolve a vapour hotter than itself.—W. S.

Ammonia in Rain Water and in the Atmosphere.
A. Muntz. Compt. Rend. 114, 184—186.

MUNTZ and Marcato (Compt. Rend. 113, 779) found that the mean of a number of estimations of the ammonia in the rain of the tropics was 1.55 mgrms. per litre. Taking the mean amount of ammonia present in the rain of temperate countries to be 0.50 mgrms. per litre, their experiments show that the rain of the tropics is richer in ammonia than that of temperate climates.

Albert Levy (Compt. Rend. 113, 804) considers the number 0.50 mgrms. per litre as too little, since he has

found that rain collected at the Montsouris Observatory, Paris, contained a mean amount of 2.2 mgrms. ammonia per litre. The author quotes the results of experiments made by several chemists, which show that the rain-fall of towns always contain considerably more ammonia than that of the country, and so considers that Albert Levy's numbers, which were obtained from rain collected near Paris, are not fairly comparable with the author's numbers.

He quotes numbers obtained from the analysis of a large number of rain waters collected at Rothamstead, the mean of which do not differ greatly from 0.5 mgrms. per litre.—A. L. S.

ERRATUM.

This Journal, May issue, page 458, col. 1, line 27, for "sulphuric acid" read "hydrochloric acid." Also line 45, for the words "like the molybdenum precipitate," substitute the words "in a slow current of oxygen."

New Book.

WATTS' DICTIONARY OF CHEMISTRY. Revised and entirely re-written by H. FOSTER MORLEY, M.A., D.Sc., Professor of Chemistry at Queen's College, London, and M. M. PATTISON MUIR, M.A., Prelector in Chemistry, of Gonville and Caius College, Cambridge. Assisted by Eminent Contributors. In Four Volumes. Vol. III. London: Longmans, Green and Co., and New York (15, East 16th Street). 1892.

OCTAVO volume, strongly and handsomely bound, price 50s. The work is to be completed in four volumes, and the present issue is the third volume. It contains Introduction to the Articles relating to Organic Chemistry, by Dr. H. F. Morley. Then follow a list of Special Contributors, list of Abbreviations and of Terms and Quantities, &c., frequently used. The subject-matter covers 853 pages, commencing with I (Indigo-carboxylic acid) and ending with P (Phenyl-tetrazole carboxylic acid). The condensed and abbreviated style followed in the text is nevertheless easily interpreted, and the method of dividing the paragraphs and giving each its function and title greatly facilitates reference.

Thus, under the principal heading with the name of any substance under consideration, one generally uniform method of treatment is observed, which is easily classified by means of the spaced-off sub-headings. After some general remarks, a paragraph may commence headed "*Formation*," and this is necessarily followed by other paragraphs respectively headed "*Preparation*," "*Properties*," "*Reactions*," and "*Salts*," so far as is admissible. In the volume are to be found important but concise treatises on the following subjects:—Isomerism, Isomorphism, Metallurgical Chemistry, Rare Metals, Mineralogical Chemistry, Molecular Constitution of Bodies, Molecular Weights, Molybdenum, Nitric Acid, Nitrogen, Nitrogen Group of Elements, Oxygen, Oxides, The Periodic Law, and Petroleum.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

UNITED STATES.

Customs Decisions.

The following decisions respecting the construction to be given to Acts of Congress relating to the classification of articles in the Customs tariff and the application of the Customs Laws of the United States, have recently been given by the Customs authority in that country:—

"Eikonogen," a chemical salt, the distinguishing characteristic element of which is derived from coal-tar, not a colour or dye, and not an aniline salt, is dutiable as a coal-tar preparation, not a colour or dye, at 20 per cent. *ad valorem* under paragraph 19, N. T.

"Duresco," a paint containing zinc but not containing lead, neither dry nor ground in oil, but ground or mixed with water, is dutiable at 25 per cent. under paragraph 61.

An extract or paste of indigo, commonly known as white indigo not earned, is dutiable at three-quarters of one cent per pound under paragraph 29, N. T.

Liquid composed of water, acetic acid, and gelatin, not liquid albumen, is dutiable at 25 per cent., as a chemical compound, under paragraph 76, N. T.—*Board of Trade Journal*.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

INDUSTRIAL ENTERPRISE IN JAPAN.

Paper Mills.—The manufacture of foreign paper in mills is an industry of earlier date than cotton spinning, if the single cotton mill established in Kagoshima be excepted. It has not, however, developed of late years in the same rapid manner. There are at present, exclusive of the large Government paper mill at Oji, a suburb of Tokio, and the Kobé paper mill, a foreign enterprise, only six paper mills in Japan, distributed as follows:—

In Tokio, two, namely, the Seishi mill, established in 1876 with a capital of 79,166*l.*, owned by a company, and employing 400 workpeople; and the Yukosha mill, established in 1874 with a capital of 17,483*l.*, owned by a company, and employing, on an average, only 24 workpeople.

In Osaka, two, namely, the Shimogo mill, established in 1876 with a capital of 19,000*l.*, and owned by a private individual; and a large mill owned by a Mr. Abe, now in course of erection, the capital invested being 190,000*l.*

In Kioto, one, the Umedzu mill, established in 1875.

In Kokura (province of Buzen), one, the Senjin mill, established in 1891.

The paper made in these mills is intended for home consumption. It consists of printing paper and writing paper of various kinds, wrapping and packing paper, and paper of a coarse kind used in the match-box trade. The machinery used is in some cases English, in others American. The materials used are rags, rice-straw, and the bark of the "*Abies firma*."

With regard to the future of the Japanese paper-making industry, Mr. Lay says:—

"Things do not augur well for the future of this industry. At present there are eight mills engaged in the foreign paper manufacture, but, owing to excessive competition amongst themselves, only two of them, the Oji paper mill and the Kobé paper mill, are quite able to hold their own. For some years past the amount of paper produced has gradually grown, a specially large increase taking place last year (1890), when the total output reached to about 22,400,000 lb. The demand in Japan is only for 16,000,000

lb., which leaves a surplus of 6,400,000 lb. This over-production is telling heavily upon the trade, and it is thought that some of the smaller mills with limited capital will be compelled to stop work before long. The price per 100 lb. of paper is less than half of that of 1881. In 1881 it was 2*l.* 4*s.* 4*d.*; in 1883, 1*l.* 14*s.* 4*d.*; in 1885, 1*l.* 6*s.*; in 1887, 1*l.* 1*s.* 2*d.*; in 1889, 1*l.* 1*s.* 3*d.*; and in 1890, 19*s.* 7*d.*

"Japanese paper manufacturers have not only to compete against each other, but have also to struggle against foreign competition. Over 5,000,000 lb. of foreign paper are annually imported. The desire of those engaged in the industry is to have the import duty raised, so as to keep out importations from abroad."

mixed and churned together with a large quantity of water by apparatus working in tanks for the purpose; the fluid "slip," from which after being strained is passed into settling-ponds or "backs" of the ordinary kind. The "slurry" there deposited is cut into lumps and dried on drying-floors heated by means of flues. Calcining is carried out in kilns of the intermittent type, the fuel generally used being anthracite coal. The "clinker" after sorting is ground under pairs of revolving grindstones, usually about 6 ft. in diameter and a foot thick; and the ground cement is then sifted through rotating gauze-covered sifters, after which it is exposed to cool, and finally packed for sale in casks or bags. The mixing,

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Cement Company, Company, Company, Company, Atsuta, near Nagoya; the Osaka Cement Company, Osaka; the Onoda Cement Company, Yamaguchi, near Shimonoeki; the Nippon Cement Company, Yatsushiro, on the Hiogo coast.

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all cases quite so satisfactory, though there has been a marked improvement of late in the latter respect.

"Japanese manufacturers have now realised the importance not only of technical knowledge and suitable appliances, but also of ceaseless care, and of aiming especially at uniformity of quality, the lack of which gave the earlier-made Japan cements the doubtful reputation from which they are only now emerging. Engineers and chemists have been sent to the factories of England and Germany to master the secrets of the craft; and the knowledge thus gained, together with the incentives created by a steadily-growing demand, and a fair amount of competition have already had a beneficial effect on the manufacture generally. Grinding and sifting in particular have been very greatly improved; but in burning there is doubtless

found that rain collected at the Montsouris Observatory, Paris, contained a mean amount of 2.2 mgrms. ammonia per litre. The author quotes the results of experiments made by several chemists, which show that the rain-fall of towns always contain considerably more ammonia than that of the country, and so considers that Albert Levy's numbers, which were obtained from rain collected near Paris, are not fairly comparable with the author's numbers.

He quotes numbers obtained from the analysis of a large number of rain waters collected at Rothamstead, the mean of which do not differ greatly from 0.5 mgrms. per litre—A. L. S.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

UNITED STATES.

Customs Decisions.

The following decisions respecting the construction of the

INVERSION-CONSTANTS AT 20° C. FOR THE QUOTIENTS.

Quotients.	95	90	85	80	75	70	65	60	55	50	45	40
Percentages of Ash in Dry Substance.												
1	32.68	32.66	..	..	..	..	..	..	..	..	..	..
2
3	32.65	32.62	..	..	..	..	..	..	..	..
4
5	32.62	32.58
6
7	32.55	32.47
8
9	32.56	32.56	32.52	32.49
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
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Bodies, Molecular Weights, Molybdenum, Nitric Acid, Nitrogen, Nitrogen Group of Elements, Oxygen, Oxides, The Periodic Law, and Petroleum.

of a coarse kind used in the match-box trade. The machinery used is in some cases English, in others American. The materials used are rags, rice-straw, and the bark of the "Abies firma."

With regard to the future of the Japanese paper-making industry, Mr. Lay says:—

"Things do not augur well for the future of this industry. At present there are eight mills engaged in the foreign paper manufacture, but, owing to excessive competition amongst themselves, only two of them, the Oji paper mill and the Kōbē paper mill, are quite able to hold their own. For some years past the amount of paper produced has gradually grown, a specially large increase taking place last year (1890), when the total output reached to about 22,400,000 lb. The demand in Japan is only for 16,000,000

lb., which leaves a surplus of 6,400,000 lb. This over-production is telling heavily upon the trade, and it is thought that some of the smaller mills with limited capital will be compelled to stop work before long. The price per 100 lb. of paper is less than half of that of 1881. In 1881 it was 2*l.* 4*s.* 4*d.*; in 1883, 1*l.* 14*s.* 4*d.*; in 1885, 1*l.* 6*s.*; in 1887, 1*l.* 1*s.* 2*d.*; in 1889, 1*l.* 1*s.* 3*d.*; and in 1890, 19*s.* 7*d.*

"Japanese paper manufacturers have not only to compete against each other, but have also to struggle against foreign competition. Over 5,000,000 lb. of foreign paper are annually imported. The desire of those engaged in the industry is to have the import duty raised, so as to keep out importations from abroad."

Miscellaneous.—Of all the industries instituted in Japan in imitation of those existing abroad, the match industry has been the most successful. The first match factory was established in 1876, and four years later the demand for foreign matches decreased considerably and Japanese matches were exported to the value of 58,532*l.* Carelessness on the part of the manufacturers led during the next few years to a sudden decline in the demand; but in 1886 the industry recovered itself, the export of matches in that year amounting in value to 63,000*l.* Since then the production of Japanese matches has increased every year, and although prices have fallen considerably, the industry is in a flourishing condition, the export of matches during the year 1890 amounting in value to 235,761*l.*; the total quantity manufactured in the same year was 4,101,000 gross, being an increase of 688,640 gross over the production of the year preceding.

The chief seats of the match industry are the towns of Tokio, Osaka, and Hiogo, more especially the two latter, which contain nearly 60 of the 70 odd factories now in existence.

These factories are all carried on as private undertakings, and not as companies, and they enjoy no official support.

The operatives engaged in this industry belong, as a rule, to a very poor class. The wages of male workers range from 7*d.* per diem to 2*d.* per diem; those of the females employed from 4½*d.* per diem to 1½*d.* per diem.

There are, it appears from Mr. Lay's report, 17 soap factories in Osaka and one in Hiogo. The amount of soap produced in the Hiogo factory in the year 1890 was 77,160 boxes; of this amount only 14,249 boxes were consumed in the country, the remainder being exported to China. The value of the soap manufactured in the Osaka factories in the same year amounted to 15,000*l.*, half of the quantity made being exported also to China. Most of the factories in question are small establishments conducting operations on a very limited scale.

In Yokohama, however, there is a large soap factory.

The cost of labour is very moderate, unskilled men being paid at the rate of 10½*d.* a day to 1*s.* 0½*d.* a day, and women 4*d.* a day to 6½*d.* a day.

The manufacture of Portland cement in Japan is an industry of comparatively recent growth, but it may be regarded as one of the most successful of the foreign industries established in this country.

The following notes on this subject have been kindly supplied by Major-General Palmer, R.E., the Engineer-in-Chief of the Yokohama Harbour Works:—

The chief Portland cement works in Japan are:—

Asano's Cement Works, Fukagawa, Tokio; the Suzuki Cement Company, Onagigawa, Tokio; the Atsuta Cement Company, Atsuta, near Nagoya; the Osaka Cement Company, Osaka; the Onoda Cement Company, Yamaguchi, near Shimonoseki; the Nippon Cement Company, Yatsushiro, on the Hiogo coast.

There are some minor works, such as the Mikawa Cement Company in the province of Mikawa, another in Jōshin; and I understand that the Kawaguchi (Osaka) Works, which have been suspended for a time, are likely to be soon started again. All of these, however, are of small capacity.

There is no chalk formation in the country, and the general practice is to use ordinary slaked lime (hydrate of lime), mostly prepared at works in Nimo, Yashin, Iyo, and Tosa. To this is added the necessary proportion of clay, usually in the form of river mud. The materials are

mixed and churned together with a large quantity of water by apparatus working in tanks for the purpose; the fluid "slip," from which after being strained is passed into settling-ponds or "backs" of the ordinary kind. The "slurry" there deposited is cut into lumps and dried on drying-floors heated by means of flues. Calcining is carried out in kilns of the intermittent type, the fuel generally used being anthracite coal. The "clinker" after sorting is ground under pairs of revolving grindstones, usually about 6 ft. in diameter and a foot thick; and the ground cement is then sifted through rotating gauze-covered sifters, after which it is exposed to cool, and finally packed for sale in casks or bags. The mixing, grinding, and sifting apparatus are driven by steam machinery. One day per month is usually given to cleaning and repairs. At the Osaka Cement Company's works the simple methods above outlined have been somewhat improved upon lately in certain respects. The clay in a dry state (from beds near Akashi) is pounded in steam-driven stamping mills; and both the lime and the powdered clay are well sifted before being mixed together (without water) in rotating iron vessels fitted with distributors. The powder mixture is then passed into brick tanks, where it is wetted with only a moderate quantity of water, and left 24 hours to settle, after which the slurry is beaten by hand into iron moulds, and turned out in the form of bricks of about 240 lb. in., which are partly dried in air before being passed to the heated drying floors.

At the Onoda works, in addition to six kilns and accessories for manufacture by the process indicated above, an extensive imported German plant designed to make about 600 tons of cement per month by a more modern process was brought into work some three years ago (1889). In this process limestone and clay, both supplied from beds in convenient proximity to the works, are crushed and finely ground by steam-driven machinery, and after mixture are wetted with enough water for moulding into large bricks, which are dried in air and then calcined in a "Hofmann modified" kiln. The machinery throughout is of good class, and sifting is here done on a better system than at any of the other factories. I understand that a good cement is now being turned out by this new plant, but I do not know whether the full capacity has yet been developed.

At Yatsushiro the lime is prepared on the premises from excellent limestone, an almost boundless supply of which exists in a group of islets, the property of the company, only two or three miles from the works. The clay is alluvial, taken from the foreshore near at hand, which is the estuary of the Kumagawa.

General Palmer further observes:—

"The ordinary working capacity of the several factories may be stated approximately as follows:—

Asano's Works (Tokio), 12,000 tons; Suzuki Cement Company (Tokio), 6,000 tons; Atsuta Cement Company (Nagoya), 7,000 tons; Osaka Cement Company (Waka), 4,000 tons; Onoda Cement Company (Yamaguchi), 3,600 tons; Nippon Cement Company (Yatsushiro), 13,400 tons.

"The quality of the product turned out at the different works is various. Analysis has established that the ingredients and the proportions in which they are used are generally satisfactory; but the details of manufacture and the experience and care bestowed upon it are not yet in all cases quite so satisfactory, though there has certainly been a marked improvement of late in the latter respect.

"Japanese manufacturers have now realised the importance not only of technical knowledge and suitable appliances, but also of ceaseless care, and of aiming especially at uniformity of quality, the lack of which gave the earlier-made Japan cements the doubtful reputation from which they are only now emerging. Engineers and chemists have been sent to the factories of England and Germany to master the secrets of the craft; and the knowledge thus gained, together with the incentives created by a steadily-growing demand, and a fair amount of competition have already had a beneficial effect on the manufacture generally. Grinding and sifting in particular have been very greatly improved; but in burning there is doubtless

something yet to be learned, which only long experience can bring. On the whole there is good warrant for believing that the best Japan-made cements, if not quite equal in quality to the best European products, may be trusted, under proper safeguards, for all engineering purposes."

The manufacture of glass is one of the oldest of the foreign industries in Japan, and has been carried on on a comparatively extensive scale. Mr. Lay's report enumerates nine glass factories in Osaka alone, which represent a total capital of 35,167*l.*, and employ 287 workmen. Glass produced in these works was exported in 1890 to the value of 11,000*l.*; of this 80 per cent. went to China proper, 15 per cent. to Hong-Kong, and a small quantity to Vladivostock and San Francisco.

Glass is also manufactured in Nagasaki.

By far the largest glass factory in Japan is that in Tokio, owned by the Shinagawa Glass Company.

Mr. Playfair, in his report, gives the following details regarding this establishment:—

"These works were originally started by the late Prince Sanjo as far back as 1872, when he employed an Englishman as instructor. It then passed into the hands of the Government, and subsequently became the property of two Japanese merchants, who sold it to the present company in 1888.

"The capital of the company is 95,000*l.*, and it receives no support from Government.

"The articles manufactured are chiefly bottles for beer and wine, medicine bottles, and table glass of cheap quality. A small quantity is exported to China and Hong-Kong, but the greater part of the production is for home use. The material used is obtained from the province of Mikawa for goods of a superior class, and from the province of Boshu for beer bottles.

"The total number of workpeople employed is 143, of whom eight are women, the daily averages of a man being about 11½*d.*

"The average monthly output is:—Table glass, 41,128 pieces; beer, wine, and medicine bottles, 97,424 pieces; other glass ware, 726 pieces.

"Last year the company paid no dividend."

The glass produced in all Japanese factories is, on the whole, of a coarse description. This is probably in part due to the fact that the demand is principally, if not entirely, for a low-priced article. It may be doubted, however, whether the Japanese glass-blowers have yet attained the skill necessary to produce the finer kinds of glassware. In any case, so far as the manufacture of window glass is concerned, the industry has not been a success. It has been found that the foreign article is cheaper and of a quality superior to that made in Japan, and the Customs returns show that the value of the importations of glassware in 1890—and this item is made up chiefly of window-glass—was double that of the importations of the same commodity in 1884.

The best known breweries in Japan, beside the one in Yokohama, which is a foreign enterprise, are the Sakurada brewery in Tokio, established in 1879, and the Yebisu brewery, situated in the neighbourhood of the city, which was established in 1890.

Both the Sakurada and Yebisu breweries are the property of joint-stock companies, and receive no official support.

The beer is made chiefly for home consumption, but it is also exported to China, Hong-Kong, and the Straits Settlements.

The system followed is German, each brewery having an instructor of that nationality. Hops are imported from Germany, but while the Sakurada brewery uses Japanese barley, the Yebisu Company imports German malt.

In 1890 the Sakurada brewery paid a dividend of 15 per cent. The Yebisu Company also paid a dividend at the rate of 10 per cent. for the first half of the same year, but owing to losses sustained during the subsequent six months, a call was made upon the shareholders at the end of the year.

The importation of beer into Japan during 1890 was only 102,227 dozen as compared with 139,084 dozen in 1889, and it is probable that its importation will gradually decrease.

The manufacture of leather in Japan according to foreign methods dates from the year 1886, when the first factory was established.

So far the home manufacture does not appear to have seriously affected the importation of leather from abroad, the increased production in Japan being met by an increase in demand.

The various industries described above do not by any means exhaust the list of foreign industries carried on in this country.

Japan now supplies herself with sulphuric acid, caustic soda, and bleaching powder, commodities for which she formerly depended upon Europe. The manufacture of boots and shoes, as well as that of foreign clothing and hats, is spreading extensively, though the latter, owing to the growing demand for foreign wearing apparel, has not yet affected the quantity imported from abroad; and, other industries, such as brush-making, saddlery, and coach-making, and the manufacture of paints, lubricating oils, millboard, upholstery, umbrellas, cigarettes, artificial fertilisers, iron safes, gunny bags, and straw-plait—in which last commodity a large export trade is conducted—are gradually obtaining a foothold in the country.

In the case of some of the industries introduced into Japan, the country is now self-supporting, foreign competition being no longer possible, in others so much has been accomplished, as to render it certain that the time is not far off when importation will altogether cease. The future of other industries again—such as that of cotton spinning—though not so assured, is still hopeful: while even in those branches in which the least results have been obtained she possesses a constant advantage in the great cheapness of labour. Nor, so far at least, has this progress been made at the sacrifice of any of the various artistic industries which are more peculiarly her own. And although there is truth in the criticism that would disparage her progress for the reason that it is imitative and not constructive, the fact that Japan, an Oriental country, has been able to dissociate herself from her sister countries of the East and profit by Western inventions to the extent that is in evidence augurs well for the years to come. On the other hand, it must be remembered that the concluding remarks made in this report on the subject of cotton spinning apply equally to all extensive industrial operations conducted by the Japanese people. The need of foreign co-operation for the successful development of all such undertakings—co-operation, that is to say, in the shape of capital, financial experience, organisation, and expert knowledge—is admitted by all competent observers; and without it foreign manufacturers for many years to come will have no reason to fear Japanese competition.—(No. 231, *Foreign Office Miscellaneous Series*.)

GENERAL TRADE NOTES.

CANADIAN TANNERIES.

The following article appears in the *Toronto Monetary Times* for the 6th May:—

A subject which is well worthy some attention at this time is the development of the leather industry of late years in Canada. It is not so very long ago since the tanneries of the Dominion confined their output practically to hemlock sole, harness, upper (cowhide) buff, pebble, splits, and patent leathers. Then came the making of domestic calf—up to this time calf had been usually imported from France—and very creditable it was. Sheepskin linings were turned out, and a few factories made glazed calf and kid in 1870 to 1880, but the great bulk of such stock for ladies' fine footwear came from Paris, some of it from the United States. Gradually, within the last dozen years, the relative share of upper, calf, buff, and pebble in the stock of

a Canadian shoe manufacturer have been changing. People in these later days want a finer material. This is the case in the United States, and there we find an enormous increase in the production and use for both women's and men's shoes of what is known as dongola leather. This is made from goat-skins which are procured from South America, from Algeria, and from other parts of the world. What is known as the chromo process is used in producing it.

The products of Canadian tanneries in the year 1892 are much more varied. This arises in part from the increased demand for fine goods such as ladies wear, and for fine goods for men. Nor must it be forgotten that the country-folk are wearing fewer of the "east-iron" sort of rough stogy boots once so numerous. More kips and splits are used. There is now in Canada a very considerable manufacture of dongola leather, both dull and bright, which article is made from imported goat skins by tanners in Montreal and Toronto. The quality and finish of this leather is very creditable, and resembles what had in previous years been obtained from the old country. To learn how to produce it rapidly and economically has been an expensive process, however. Another recent product is the glove-grain, a soft finish cow skin made in Ontario as well as in Quebec, especially of late years. The use of this has increased. It is used for foxing uppers, &c.

MINING IN MANCHURIA.

The *London and China Telegraph* of the 9th May last says that if the *Pekin Gazette* is to be believed, the rich deposits of silver ore in the neighbourhood of Kirin are shortly to be worked after the Western method, and the governor of the province reports that the foreign apparatus and chemicals necessary for reducing the silver from the galena ore have arrived. The Kirin mine will be the first in Manchuria worked on the foreign method, though the mountain ranges in the north of the province are, according to popular belief amongst the Chinese settlers and Manchu inhabitants, exceedingly rich in the precious minerals. On the Russian side mining is carried on with great activity, and in a most systematic and elaborate manner; but hitherto, except at one or two places, the Chinese Government has strenuously opposed any exploitation of the mineral wealth of the northern part of Manchuria. Perhaps they were not altogether unwise in this, and the terrible story of the massacre by Manchu troops of the adventurous Chinese miners at Shol-to-ga, or Mopo, some seven years ago, will ever be remembered by people in Manchuria as a warning to those who would attempt to work the mineral riches of Manchuria against the wishes of the Government. The remembrance of the terrible fate which overtook the large number of the Chinese miners who were engaged at the washings (from which over three million pounds worth of gold is said to have been obtained in 10 months) will, we imagine, prevent any irregular exploitation on a large scale of the mineral wealth of Manchuria for many years to come. As in every part of the Chinese Empire, the provincial governors jealously keep all mining enterprises under their own control, with the inevitable results of corruption, speculation, and utter failure to make the mines pay. As an instance we may refer to the mines at Shol-to-ga, which have been taken in hand by the Government since 1880, when they were placed under the direction of a General Li, who brought up an American miner to assist him. Elaborate and expensive machinery was obtained and carried at an enormous outlay to the place, but the actual cost of working has been found so great that there is little or nothing gained by the operations. It is a capital offence, at least in theory, for Chinese to have anything to do with this illicit gold traffic, but their own officials wink at it and regularly buy the gold from the dealers, and the metal eventually finds its way to Moukden and Peking, where it is currently believed to be the product of the Government gold mines at Mopo and at another place about 200 li to the south-west of Aigun. No doubt much of the opposition of the Chinese Government and officials to gold and silver mining is due to their desire to keep such enterprises exclusively in their own hands. In the memorial under

notice the governor of Kirin mentions a curious point, namely, that an expectant *chehsien*, who had qualified himself as a professor of chemistry at the Peking university (Tung-wen Kwan), could not be employed in the mining department without losing his rank in the mandarinat, and the governor very sensibly petitioned that this accomplished official should be allowed to teach his countrymen how to separate silver from the lead ore without involving any loss of dignity—"rather to reward this official for his superior attainments, and thus encourage him to exert himself still more." It may be accepted as a sign of the times and of the change of ideas in Peking that the rescript to the memorial was "sanctioned," and what with mandarins who are professors of chemistry, and European machinery for the extraction of the silver, we may shortly expect to hear more of the mines near Kirin, where lead has been extensively worked for many years.

WINE ADULTERATION IN GERMANY.

The *Moniteur Officiel du Commerce* says that the German Government has submitted to the Reichstag a Bill with the object of regulating the production of wines.

From a hygienic point of view it is forbidden to use in this manufacture compounds of barium, boracic acid, salicylic acid, salts of strontium, &c.; the maximum quantity of sulphuric acid will also be fixed.

On the other hand, the Bill recognises the legality of blending and, within certain limits, that of the addition of water and sugar to wine, on condition that the merchants make known to the buyers the composition of the products so manufactured.

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

	Month ending 31st May	
	1891.	1892.
	£	£
Metals.....	1,818,667	1,606,253
Chemicals and dyestuffs.....	678,759	802,685
Oils.....	556,912	579,224
Raw materials for non-textile industries.	2,899,859	3,351,827
Total value of all imports	31,377,698	31,935,738

SUMMARY OF EXPORTS.

	Month ending 31st May	
	1891.	1892.
	£	£
Metals (other than machinery)	3,770,025	2,775,746
Chemicals and medicines	742,054	723,690
Miscellaneous articles.....	2,616,065	2,427,203
Total value of all exports.....	19,744,473	17,783,969

IMPORTS OF METALS FOR MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Copper:—			£	£
Ore..... Tons	8,855	4,709	76,200	29,593
Regulus..... "	11,453	12,436	319,802	330,337
Unwrought.... "	2,428	2,967	130,877	142,159
Iron:—				
Ore..... "	263,676	211,391	202,806	153,346
Bolt, bar, &c.... "	5,539	8,820	54,221	84,079
Steel, unwrought.. "	576	931	7,422	8,681
Lead, pig and sheet.. "	14,913	13,561	187,647	149,468
Pyrites..... "	59,927	59,891	110,549	91,513
Quicksilver..... Lib.	547,600	417,070	58,577	49,353
Tin..... Cwt.	39,768	36,351	141,135	169,932
Zinc..... Tons	5,959	3,905	137,562	86,255
Other articles... Value £	..	..	391,869	440,627
Total value of metals	..	..	1,818,667	1,696,283

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Bark, Peruvian.. Cwt.	8,801	10,945	17,923	22,715
Bristles..... Lib.	242,637	315,687	84,770	40,720
Caoutchouc..... Cwt.	22,471	16,617	290,312	165,375
Gum:—				
Arabic..... "	4,879	4,279	15,479	11,412
Lac, &c..... "	8,038	13,781	31,911	50,976
Gutta-percha.... "	6,684	8,207	85,924	105,498
Hides, raw:—				
Dry..... "	48,671	57,770	116,611	101,632
Wet..... "	39,152	43,965	87,445	88,522
Ivory..... "	541	806	29,975	40,525
Manure:—				
Guano..... Tons	4,908	2,103	25,705	8,973
Bones..... "	6,913	4,081	33,856	20,585
Paraffin..... Cwt.	36,941	48,079	56,915	73,180
Linen rags..... Tons	2,269	2,661	19,899	26,978
Esparto..... "	17,313	14,673	82,611	67,487
Palp of wood.... "	11,899	15,121	61,035	88,410
Rosin..... Cwt.	38,695	193,683	8,207	48,987
Tallow and stearin.. "	139,493	169,177	169,041	203,939
Tar..... Barrels	5,140	3,407	3,470	2,519
Wood:—				
Hewn..... Loads	184,221	221,177	361,992	426,835
Sawn..... "	298,185	315,371	481,388	744,836
Staves..... "	5,751	6,239	31,289	32,042
Mahogany..... Tons	3,213	3,623	50,826	32,218
Other articles.... Value £	..	..	826,715	948,603
Total value .....	..	..	2,899,859	3,351,827

Besides the above, drugs to the value of 64,635*l.* were imported as against 67,114*l.* in May 1891.

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Alkali..... Cwt.	12,322	4,329	£ 5,781	£ 3,992
Bark (tanners, &c.).. "	46,656	39,145	18,967	18,714
Brimstone..... "	17,276	54,184	7,640	14,318
Chemicals..... Value £	..	..	106,053	129,197
Cochineal..... Cwt.	281	228	1,693	1,338
Cutch and gambier Tons	1,258	1,594	32,294	37,507
Dyes:—				
Aniline..... Value £	..	..	19,936	15,846
Alizarine..... "	..	..	23,645	24,828
Other..... "	..	..	1,956	438
Indigo..... Cwt.	2,127	2,404	35,683	46,236
Nitrate of soda.... "	487,575	637,154	209,684	257,902
Nitrate of potash.. "	25,266	28,191	22,041	54,153
Valonia..... Tons	1,154	3,458	24,219	46,624
Other articles... Value £	..	..	179,167	199,562
Total value of chemicals	..	..	678,759	802,685

IMPORTS OF OILS FOR MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Cocoa-nut..... Cwt.	2,990	20,970	£ 4,485	£ 24,410
Olive..... Tons	1,956	2,277	69,115	83,111
Palm..... Cwt.	78,003	96,537	94,443	100,083
Petroleum..... Gall.	11,021,929	7,976,650	219,974	162,559
Seed..... Tons	1,536	1,501	39,499	35,681
Train, &c..... Tons	1,568	1,698	34,963	38,585
Turpentine..... Cwt.	717	32,056	568	39,742
Other articles.. Value £	..	..	93,895	86,032
Total value of oils...	..	..	556,942	579,224

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Alkali..... Cwt.	429,864	540,974	£ 194,211	£ 194,782
Bleaching materials.. "	151,619	145,309	51,367	58,158
Chemical manures. Tons	50,971	20,212	179,649	155,149
Medicines..... Value £	..	..	82,749	83,772
Other articles.... "	..	..	234,048	231,229
Total value .....	..	..	742,054	723,090

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR
MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Brass..... Cwt.	9,712	10,730	£ 42,708	£ 43,258
Copper:—				
Unwrought..... "	60,006	65,459	170,282	159,803
Wrought..... "	24,479	22,393	82,190	68,507
Mixed metal.... "	25,708	12,498	70,448	32,196
Hardware..... Value £	..	..	196,111	172,231
Implements..... "	..	..	102,517	107,498
Iron and steel.... Tons	321,152	238,968	2,706,138	1,803,289
Lead..... "	6,278	9,971	85,760	117,087
Plated wares... Value £	..	..	28,046	21,139
Telegraph wires, &c. "	..	..	51,238	107,026
Tin..... Cwt.	9,559	8,040	45,181	58,679
Zinc..... "	14,161	16,813	14,783	15,483
Other articles .. Value £	..	..	84,314	88,490
Total value .....	..	..	3,770,025	2,775,716

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH
ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Gunpowder..... Lb.	1,287,800	934,700	£ 29,731	£ 29,808
Military stores.. Value £	..	..	93,363	99,023
Candles..... Lb.	1,285,900	1,555,700	25,335	28,943
Caoutchouc..... Value £	..	..	101,608	85,842
Cement..... Tons	46,007	51,120	92,967	95,432
Products of coal Value £	..	..	146,808	115,985
Earthenware ... "	..	..	157,048	153,566
Stoneware..... "	..	..	13,595	14,934
Glass:—				
Plate..... Sq. Ft.	198,768	158,524	14,282	8,260
Flint..... Cwt.	8,384	8,185	17,878	16,615
Bottles..... "	73,821	69,553	34,188	32,463
Other kinds.... "	13,391	16,077	11,890	13,513
Leather:—				
Unwrought..... "	12,376	9,179	110,593	87,803
Wrought..... Value £	..	..	25,017	18,450
Seed oil..... Tons	5,778	5,811	133,030	114,957
Floorcloth..... Sq. Yds.	1,495,300	1,313,000	63,202	58,812
Painters' materials Val. £	..	..	137,323	112,686
Paper..... Cwt.	79,276	82,394	136,095	141,581
Rags..... Tons	3,814	4,739	23,760	33,303
Soap..... Cwt.	43,347	47,406	44,679	45,732
Total value .....	..	..	2,616,065	2,427,203

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND
MACHINERY.

APPLICATIONS.

9234. J. A. Mays. Process of and apparatus for effecting the concentration and separation of solids. May 16.

9419. H. Williams. Improvements in apparatus for exhausting or drawing away, and washing or purifying gas or gases, or products of combustion. May 18.

9499. W. J. Mirrlees and D. Ballingall. Improvements in apparatus for evaporating, concentrating, and distilling liquids. May 19.

9538. H. Hirzel. Improvements in still columns. Complete Specification. May 19.

10,126. D. Wiekham. Improvements connected with apparatus for aerating malt and other liquors and liquids. May 27.

10,298. F. W. Scott, E. G. Scott, and F. W. Scott, jun. Improvements in evaporating apparatus. May 30.

10,595. A. Chapman. Improvements in apparatus for evaporating or concentrating alkaline or other solutions. June 3.

10,836. R. G. Ross, J. B. Hilliard, and W. Paterson. A new or improved apparatus and process for directing the passage and controlling the speed of gases, air, or fluids ascending through other fluids or liquids for the purpose of causing absorption of said gases, or for sterilising or otherwise treating the liquids through which the gases ascend, for treating water for brewing purposes or aerating malt worts, but is also applicable for other purposes. June 8.

11,019. G. Inglis. A shield or protector for use during the charging and drawing of gas retorts and other furnaces. June 11.

11,078. E. Schellerrer. Improvements in couplings for pipes for conveying heating liquids and for similar uses. June 13.

11,125. A. G. Berry. Improvements in and relating to triple-effect evaporators for treating sugar and other liquids. June 14.

11,249. O. Hamilton. A new or improved method of mixing and dissolving solids and liquids, and apparatus therefor. June 15.

11,296. W. J. Mirrlees and D. Ballingall. Improvements in apparatus for evaporating, concentrating, and distilling liquids. Complete Specification. June 16.

COMPLETE SPECIFICATIONS ACCEPTED.*

1891.

7636. T. A. A. Pile and W. A. Pile. Machines for moulding and pressing clay or other plastic materials. May 4.

8475. W. P. Thompson. — From P. Marix. Improvements in and relating to the method of effecting by means of centrifugal force the reaction of bodies of different densities on one another. May 18.

9434. J. Menzies. A new composition, and process for manufacturing the same. June 1.

9922. W. Luzzi. Treatment or purification of graphite to render it suitable for industrial purposes. May 25.

10,299. E. Theisen. Method and apparatus for effecting the condensation and purification of steam and other condensible vapours. June 15.

10,616. E. Theisen. Apparatus for condensing steam and other condensible vapours. June 22.

12,174. C. Gautsch. Apparatus for use in the preparation of chemical solutions or liquids for the extinguishing of fire. May 25.

12,401. L. Gye. Apparatus for drying or extracting moisture. June 1.

12,998. G. Rodger. Apparatus for heating metals by liquid or gaseous fuel. June 8.

13,323. J. H. Minto. Apparatus for charging liquids with gases. June 1.

14,986. P. Borgarelli. Apparatus for drying grain and other granular or pulverulent materials. June 22.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

9265. F. B. Hill and R. D. Brett. Improvements relating to the utilisation of liquid hydrocarbons for lighting and heating purposes, and to apparatus therefor. May 16.

9419. H. Williams. See Class I.

9444. J. Bowing. Improvements in coking processes. May 18.

9455. G. de Velna. Manufacture of an emulsion of petroleum or analogous hydrocarbons and of compounds thereof with carbonaceous material suitable for fuel, and for the manufacture of gas. May 18.

9459. W. Fonlis. Improvements in obtaining cyanides from illuminating and heating gas. May 18.

9474. W. Fonlis. Improved means for obtaining cyanides from illuminating and heating gas. May 18.

9614. W. Lowrie. Improvements in the method of treating peat for fuel and other purposes. May 20.

9618. T. W. Lee. Improvements in the manufacture of blocks or briquettes of fuel. May 20.

9619. J. Bowing. Improvements in the manufacture of briquettes and similar artificial fuels and in the recovery of tar products. May 20.

9620. J. Bowing. Improvements in the manufacture of coke and in the recovery of tar products. May 20.

9757. E. Bracewell. Improvements in the treatment of peat moss to adapt it for fire-lighters. May 23.

9854. H. Birkbeck.—From E. B. Müller, Germany. Process for manufacturing compact pit coal out of pit coal-dust, slack, or small pieces of pit coal. Complete Specification. May 24.

9938. W. Baeker. Process for treating coal-tar to render the same suitable for the production of light gas. May 26.

10,112. E. Wall and G. H. Frecknall. Improved condenser for use in the manufacture of gas.

10,150. F. Thomas and J. Murray. Antiseptic sanitary peat fuel. May 27.

10,486. H. Williams. Improvements in the manufacture of illuminating gas. June 2.

10,745. The Manchester Oxygen (Briu's Patent) Co., Limited, and W. M. Jackson. Improvements in the manufacture of oxygen. June 7.

10,933. W. J. Birnie. Improvements in the manufacture of hydrogen gas for illuminating and heating purposes. June 9.

10,954. W. J. Hague. Improvements connected with the manufacture of producer-gas and its application to marine and other boilers and furnaces, and the apparatus connected therewith. June 10.

11,102. R. B. Anderson. Furnaces for heating gas-retorts. June 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

5468. W. H. Wilson. Improvements in or connected with the manufacture of illuminating gas. May 4.

9781. L. Labois. Treatment of sulphur ores, crude sulphur, ozokerites, heavy oils of petroleum, and other materials for extracting, purifying, or refining purposes, and apparatus for use therein. June 15.

10,452. E. Rischgitz and the Patent Mining and Financial Trust, Lim. Treatment of peat. June 22.

10,667. F. Fanta. A new self-acting apparatus for the automatic production of oxygen. June 15.

13,036. G. Webb, jun., and G. H. Rayner. Manufacture of oxygen gas. June 15.

13,431. J. H. Fergusson. Manufacture of illuminating gas. June 22.

13,550. W. L. Wise.—From Solvay and Co., Belgium. Purification of gas. June 22.

14,030. B. Redwood, R. Redwood, and H. Barringer. Method and apparatus for measuring depth of water in oil tanks. June 1.

1892.

7243. C. Fink. Method and apparatus for purifying smoke and precipitating the products of combustion thereof. May 25.

8159. R. Marshall. Combustion of fuel and apparatus therefor. June 8.

8426. A. Longsdon.—From F. Krupp and Co. New or improved processes for the manufacture of gas from water vapour, and for purification and separation of mixed gases. June 22.

9080. W. D. A. Bost and T. F. Haldane. Manufacture of fire-lighters. June 22.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATIONS.

9619. J. Bowing. See Class II.

9620. J. Bowing. See Class II.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

9360. C. D. Abel.—From L. Durand, Huguenin and Co., Switzerland. Manufacture of new bases, applicable for the production of substantive dyes. May 17.

9633. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture and production of new basic dyestuffs. May 20.

10,138. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture of a new class of basic dyestuffs or colouring matters and of sulpho-acids thereof, and of materials and intermediate products relating thereto. May 27.

10,414. E. C. Kayser. See Class VI.

10,465. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture of new basic colouring matters of the auramine class, and of new materials for use therein. June 1.

10,667. C. D. Abel.—From the Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of novel azo colouring matters dyeing directly on cotton. June 4.

10,668. C. D. Abel.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of alumina salts of the naphthol sulphonic acids, called alumnols. June 4.

10,915. Brooke, Simpson, and Spiller, Lim., and T. A. Lawson. Partly communicated by A. G. Green, Germany. Improvements in the manufacture of azo colouring matters. June 9.

11,395. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the production of azo colours on fibre. June 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

11,395. R. Holliday and Sons, Lim., and A. G. Brookes.—From T. Holliday. Manufacture of azo colours. June 15.

12,589. H. H. Lake.—From Kalle and Co. Manufacture of colouring matters. June 22.

14,294. J. Y. Johnson.—From The Badische Aniline und Soda Fabrik. The manufacture and production of new sulpho-acids, and of new colouring matters therefrom. June 22.

1892.

3791. A. J. Boulton.—From W. Bruns and Co. Manufacture of colours specially applicable for colouring photographs. June 22.

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATIONS.

9219. E. Carter. A new or improved asbestos yarn. May 16.

9281. W. B. Walters. See Class XII.

10,612. C. A. Sahlström and E. Parr. Improvements in and connected with the cleansing and bleaching of wool, hair, silk, cotton, flax, and other vegetable or animal fibres or fabrics; the recovery of by-products, such as oil, and fat such as contained in such fibres or fabrics, and the recovery of the whole or part of the ingredients used in the process. June 3.

10,642. R. Dewhurst and Co., Lim., and A. Stockdale. See Class VI.

10,834. A. Bayer and K. Herold. A process and apparatus for freeing sheep's wool from pitch and other impurities. Complete Specification. June 8.

11,095. J. C. W. Stanley. Improvements in or relating to the treatment of fibres. June 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

10,134. G. L. P. Eyre and T. J. Hopkins. Apparatus for treating and scouring or cleansing wool and other materials, for removing therefrom greasy or other matters, and for analogous cleansing and separating operations. June 22.

11,391. A. Mitscherlich. New process of manufacturing from wood fibres capable of being spun, and by-products of the same, and apparatus therefor. May 25.

13,967. E. Appenzeller and E. Filleul. An apparatus for testing the strength of cotton, wool, and other fibres in the raw or unmanufactured state. June 22.

1892.

243. C. Hanson. Process of extracting deleterious matters from wool and other textile materials. June 1.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

9651. B. Haigh. Improvements in dyeing woollen and other woven or felted fabrics. May 21.

9952. E. J. Pizzey and G. E. Upton. Improved means and method for dyeing materials and substances of a porous nature. May 26.

10,267. R. Shaw. Improvements in apparatus for treating fibrous materials with dye or other liquors. May 30.

10,381. H. H. Lake.—From C. Castellani, Italy. An improved chemical preparation to be used for washing, scouring, fulling, bleaching, boiling, and other purposes. May 31.

10,414. E. C. Kayser. Improvements in the production of colouring matters on textile fibres and fabrics, and on other material. June 1.

10,612. C. A. Sahlström and E. Parr. See Class V.

10,642. R. Dewhurst and Co., Lim., and A. Stockdale. A new or improved means or process of producing coloured patterns or designs upon silk plushes, or upon wool or velvet plushes. June 4.

11,027. W. J. S. Grawitz. Improvements in dyeing and printing with alkaloids. June 11.

11,057. G. M. Marchant. Improvements in machinery for scouring, dyeing, and drying hanks of yarn. June 13.

11,318. A. S. Lyon and J. H. Lorimer. Improvements in apparatus for skein-dyeing. Complete Specification. June 16.

11,366. J. Kennedy. Improved composition or compound to be used in bleaching cotton, linen, or woollen fabrics. June 17.

11,395. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. See Class IV.

11,416. F. F. Grafton and W. Browning. An improved process for the production and fixation of colours in conjunction with aniline black upon woven fabrics. June 18.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

13,102. G. A. Cannot. Process of and apparatus for bleaching and treating the fibre of peat, or other fibrous substances. June 22.

13,509. C. F. Pike. Method and apparatus for bleaching and treating textile fabrics. June 22.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

9563. W. L. Wise.—From W. Feld, Germany. Improvements in the manufacture or production of sulphur and sulphurous acid from sulphuretted hydrogen, and in apparatus therefor. May 19.

9787. L. Bemelmans. Improvements relating to the treatment of metallic sulphurets and sulphur ores. May 23.

9884. W. P. Thompson.—From A. L. Lawton and W. S. Dodge, United States. Improvements in or relating to the manufacture of salt (chloride of sodium). Complete Specification. May 24.

10,104. A. S. Ramage. Improvements in the utilisation of ferrous liquors, especially those from galvanising and tinplate works. May 27.

10,225. F. M. Lyte. Improvements in the production of chlorine and of commercially pure lead, and in the recovery of silver, if present. May 30.

10,281. E. Hermite and A. Dubosc. A process and apparatus for the manufacture of persalts of iron. May 30.

10,326. C. Négrier. Improvements in and connected with the manufacture of sulphate of iron and sulphate of copper. May 31.

10,450. E. J. Barbier. Process and apparatus for the production of neutral sulphate of soda and sulphuric acid from bisulphate of soda. June 1.

10,517. E. Hermite, E. J. Paterson, and C. F. Cooper. A process for purifying bleaching liquor. June 2.

10,599. E. Lohmann. Improved process for producing pure carbonic acid gas. Complete Specification. June 3.

10,851. A. MacNab. An improvement in the manufacture of bay salt. Complete Specification. June 8.

10,913. W. S. Rawson and Woodhouse and Rawson United, Limited. Method for production of oxide of zinc. June 9.

11,034. H. S. Elworthy. Improvements in processes for obtaining carbonic acid gas, and in apparatus to be used in such processes. June 11.

11,203. J. Graham. An apparatus for the continuous concentration of sulphuric acid. June 15.

11,222. J. J. Lish. Improvements in the treatment of chloride of magnesium, sulphide of sodium, and other analogous chemical compounds. June 15.

11,366. J. Kennedy. See Class VI.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

4820. G. T. Beilby. Process and apparatus for the manufacture of cyanides. June 22.

8692. F. M. Lyte. Production of caustic alkali and chlorine. May 25.

9561. W. Walker. An improved method of recovering carbonic acid gas from lime-kilns and furnaces, and apparatus in connexion therewith. June 8.

9781. L. Labois. See Class II.

10,476. Comte T. Brochocki. Manufacture of peroxide of barium and of peroxide of hydrogen. May 25.

11,311. T. Goodall.—From S. Peacock and H. A. Galt. Improvements in obtaining chromates and bichromates of potash and soda. June 1.

11,484. L. Labois. Improvements relating to the refining of sulphur and the distillation of sulphur and other ores, and to apparatus therefor. June 15.

13,409. W. H. Higgin. See Class XIX.

13,424. G. I. J. Wells. Apparatus for the extraction of ammonia, applicable for ammonia-soda works and the like. June 15.

1892.

3880. E. Rijn. Manufacture of oxalic acid and cellulose. June 1.

8964. W. P. Thompson.—From W. B. Brittingham. New or improved bleaching compound. June 22.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

9235. T. M. Rymer-Jones. An improvement in the manufacture of refractory and non-conducting bricks, blocks, tiles, slabs, and pipes. May 16.

9397. T. C. J. Thomas. Improvements in the manufacture of plate glass, and in apparatus therefor. May 18.

9428. E. Walsh, jun. Improvements in plate glass, in the art of rolling same, and in machinery therefor. Complete Specification. May 18.

10,123. H. L. Doulton and S. H. Leech. Improvements in the manufacture of terra-cotta and like materials, and in apparatus therefor. May 27.

10,532. M. Laffont. See Class IX.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

10,208. J. B. Adams. Apparatus for making balls or other articles from molten glass, or other molten or plastic material. May 25.

10,661. W. W. Pilkington. Kilns for annealing plate glass. June 1.

11,617. T. Severn. Kilns for heating or burning pottery and the like. June 15.

13,738. W. Schleuning. Process of producing imitation terra-cotta. June 15.

1892.

7793. C. F. E. Grosse. Method of producing marbled glass. June 1.

7906. H. C. Bull. Casting tables for glass and glass-making. June 1.

9428. E. Walsh, jun. Improvements in plate-glass, in the art of rolling same, and in machinery therefor.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

9217. T. C. Iznd. Improvements in the production of ornamentation in clay for architectural and other purposes, and in the apparatus for producing same. May 16.

9258. J. B. I. Julhe. Improvements relating to the hardening of plaster and the development of colours mixed therewith. May 16.

9332. A. J. Boulton.—From J. A. Chanler, United States. Improvements in pavements. Complete Specification. May 17.

9542. T. Castle. Improvements in mills for grinding cement and other matters. May 19.

9723. N. Procter and W. Wells. Procter and Co.'s antiseptic waterproof and airproof composition. May 23.

9767. E. M. Fox.—From R. F. M. Chase, United States. Improved composition for artificial stone for ornamental and other purposes. May 23.

9857. H. B. Price. Improvements in fireproof floors and other structures. May 24.

9974. H. A. Majewski and W. Beyenbach. A process of manufacture of artificial marble. May 26.

10,010. J. Hoyle. Apparatus for purifying and grinding the residue of Portland cement and other materials. May 26.

10,160. J. Baines. Composition for making of artificial stone. May 28.

10,196. P. A. H. Webuer. Improvements in the manufacture of artificial wood. Complete Specification. May 28.

10,253. J. Turner. Improvements in and relating to the seasoning or preserving of wood. May 30.

10,355. W. Joy. Improvements in apparatus for separating the finer from the coarser particles of ground cement, clinker, and other matters. May 31.

10,532. M. Laffont. Improved manufacture of material suitable for building and architectural purposes, and for ceramic and other similar works. June 2.

10,927. H. Birkbeck.—From H. Heise, Germany. A process for the preparation of a material for building or other purposes. Complete Specification. June 9.

11,054. H. Salmon. Improved pumice stone. June 13.

11,170. G. W. Parker. Improvements in the construction of floors, ceilings, and roofs of buildings; also applicable to the construction of side walks and pavements. Complete Specification. June 14.

11,226. G. C. Taylor. A fireproof composition or cement for boilers, flues, and furnaces. June 15.

11,241. W. Lancaster. An improved method of laying concrete, cement, and other similar materials for footpaths, floors, and other purposes. June 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

9561. W. Walker. See Class VII.

13,016. G. Williams. Manufacturing hydraulic cement. June 22.

13,616. C. Bloemendal. Process and apparatus for producing hydraulic mortar. June 15.

13,983. W. P. Winter. Improvements in and relating to securing moulds in the manufacturing of artificial stone-paving, and other uses. June 22.

1892.

4408. C. H. Dobbs. Manufacture of scoria or slag blocks for paving and other purposes. June 1.

7502. W. P. Thompson.—From L. O. Roeser Müller and B. Deike. Manufacture of plaster for building purposes. May 25.

7850. E. T. Warner and T. F. Curry. The art of making mortar. June 1.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

9352. Sir A. Hickman. Improvements in the treatment of crude or cast iron for the elimination of sulphur. May 17.

9370. G. D. Burton. Improvements relating to the forging of metals for making steel and iron tools. Complete Specification. May 17.

9442. J. Bowing. Improvements in the method of treating blue billy or purple iron ore, sand and other ores in a similar condition, for the purpose of preparing them for the reducing furnace. May 18.

9443. J. Bowing. Improvements in the method of treating blue billy or purple iron ore, sand, and other ores in a similar condition, for the purpose of preparing them for the reducing furnace. May 18.

9522. J. E. Filassier and J. Fauré. Improvements in metallurgical furnaces for steel making or cementation purposes. Complete Specification. May 19.

9523. J. E. Filassier and J. Fauré. Improvements in or relating to the manufacture of cast steel. Complete Specification. May 19.

9701. J. Simpson. Improvements in the extraction of antimony from the mineral sulphide. May 21.

9765. W. E. May. Improvements in the manufacture of steel and other metal castings. May 23.

9841. W. A. Briggs. An improved alloy of aluminium. May 24.

9859. J. C. Fraley. Process for rendering iron, steel, and similar metals homogeneous. Complete Specification. May 24.

10,225. F. M. Lyte. See Class VII.

10,261. G. C. Taylor and P. Hulme. A rustless metallic alloy for parts of agricultural ploughs. May 30.

10,354. H. J. Walduck. Improvements in machinery or apparatus used for galvanising or coating sheets or plates of iron, steel, or other metals or alloys with zinc or with tin or true metal or other metallic alloys. May 31.

10,390. C. T. J. Vautin. An improved method or process for the production of zinc from blende. May 31.

10,459. F. G. Bates and W. R. Renshaw. Improvements in coating iron and other metals with lead, and in the alloying or treating of lead to render it suitable for this purpose. June 1.

10,497. W. A. Briggs. An improved alloy of aluminium for use in cycle manufacture. June 2.

10,528. F. B. Stone. A process for freeing copper from arsenic. June 2.

10,580. W. Darby and W. P. Thompson. Improvements in or appertaining to melting aluminium or in crucibles therefor. June 3.

10,583. W. P. Thompson.—From B. Talbot, United States. Improvements in the treatment of iron and basic slag, and in extracting silicon and phosphorus. June 3.

10,756. J. Lakin. Improvements in the manufacture of wrought iron. June 7.

11,297. J. P. Bayly.—From J. J. Naef, United States. Improved process of recovering tin from tin scraps. June 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

9219. H. Niewerth. Obtaining metals, half-metallic elements, and other minerals. June 1.

9342. J. H. Rogers. Manufacture of tin and terne plates. June 1.

12,813. A. Crossley. Apparatus for producing ferro-ferric and ferric oxides. June 8.

13,068. B. Rosiog. Treating lead for purifying it, and for obtaining litharge, or for separating the lead from the precious metals contained in it. June 22.

13,395. E. Meyer. Extraction of aluminium hydrate or aluminium salts from aluminium silicates or clay. June 22.

13,888. J. E. Stead. Carburising fluid, iron, or steel. June 22.

14,290. H. L. Herrenschildt. Treatment of certain mattes and ores for the separation of nickel and cobalt from copper. June 22.

15,482. T. H. J. Eskuchen and H. A. Hanmann. Manufacture of briquettes of purple ore. June 15.

19,457. J. L. Hopper. Furnaces for roasting, smelting, and separating refractory and other ores. June 15.

1892.

2214. T. D. Bottome. Casting and tempering pure copper. June 1.

7069. G. J. Atkins. Apparatus for separating gold, silver, and other metals from their ores. May 25.

7378. P. C. Choate. Producing metallic zinc. May 25.

7909. G. Wegner. A process for coating aluminium with other metals. June 22.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

9319. A. Henneton. Improvements in or connected with anodes for the electrolytic decomposition or formation of chemical compounds. Complete Specification. May 17.

9346. C. Kellner. Apparatus for the production by electrolysis of chlorine and alkalis. May 17.

9347. C. Kellner. Process for the separation of the alkali obtained by electrolytical decomposition of halogen compounds from the electrolyte which has not been decomposed. May 17.

9379. G. D. Burton. Improvements relating to the heating and working of metal bars by electricity. Complete Specification. May 17.

9380. G. D. Burton. Improvements in mechanism for converting electric currents, and in the method of applying the same to the working of metals. Complete Specification. May 17.

9541. F. Schmalhaus. An improved electric accumulator or secondary battery. Complete Specification. May 19.

9569. C. P. Shrewsbury and J. L. Dobell. Improvements in or connected with electric batteries. May 19.

9623. J. Vernhet. Improvements in electric batteries. May 20.

9799. D. G. FitzGerald. Improvements in apparatus and means for the electrolysis of alkaline chlorides which may be in conjunction with earthy chlorides. May 24.

10,197. J. W. Caon and R. E. Commans. Improvements in electric furnaces and in the treatment of auriferous sulphides and similar refractory ores by means of the same. May 28.

10,200. C. Kellner. Improved process and apparatus for the electro-chemical production of bleaching agents. May 28.

10,388. E. Freund and L. Bristöl. Improvements in secondary batteries. May 31.

10,520. A. van Boeckxsel. Improvements in and connected with electric batteries. June 2.

10,690. T. Parker and A. E. Robinson. Improvements in anodes for use in electric cells for treating chlorides, fluorides, or other compounds and the like. June 4.

10,735. H. C. Bull. An improved process and apparatus for making sodium, potassium, and like metals by electric action and producing ferric chloride as a dry powder. June 7.

10,850. H. Weymersch. Improvements in primary voltaic batteries. Complete Specification. June 8.

10,855. H. F. Kirkpatrick-Picard and H. Thame. Improvements in secondary batteries. June 8.

10,932. W. J. Birnie. Improvements in primary and secondary batteries for electric lighting and power. June 9.

11,087. W. L. Wise.—From T. Rosati, E. Righetti, and G. O'Connell, Italy. Improvements in galvanic batteries. June 13.

11,126. J. Paterson. An improved element by the aid of which a current of electricity may be generated. June 14.

11,147. H. H. Lloyd. Improvements in secondary or storage batteries. Complete Specification. June 14.

11,154. W. P. Thompson.—From C. L. Coffin, United States. Improvements in the method of welding metals electrically. Complete Specification. June 14.

11,382. H. Niewerth. An improved process for manufacturing compound and elementary bodies or chemical products by means of electricity, and apparatus therefor. June 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

10,371. F. R. E. Branstion. Production of light and the generation of heat and electricity. June 1.

12,491. C. L. Baker, and Woodhouse and Rawson United, Lim. Construction of rheostats or similar electrical instruments. June 1.

1892.

3881. K. Kahabka. Electrical accumulators. June 22.
 6112. H. H. Lake.—From W. Schleher, jun., and G. A. Mosher. Secondary batteries and accumulators. May 25.
 6722. W. W. Donaldson and R. Macrae. Battery plates for secondary batteries. June 15.
 8572. H. Beckmann, E. Beckmann, and J. Schmitt. Improved galvanic element. June 15.
 9319. A. Henneon. Anodes for the electrolytic decomposition or formation of chemical compounds. June 22.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

9281. W. B. Walters. Improvements in and apparatus for effecting the separation or extraction of grease, oils, gums, or resins from wool, flax, or other materials by means of volatile solvents. May 16.
 9292. G. W. Scollay. Improvements in the art of treating vegetable oils. Complete Specification. May 17.
 9432. R. H. F. Finlay. Improvements in the process of making soaps. May 18.
 9769. A. C. Irwin.—From S. Wohle, France. A new or improved manufacture of detergent. May 23.
 10,438. A. C. Irwin.—From S. Wohle, France. A new or improved manufacture of detergent. June 1.
 10,612. C. A. Sahlström and E. Parr. See Class V.
 10,765. W. P. Thompson.—From W. R. Brittingham, United States. Improvements in detergent compounds. Complete Specification. June 7.
 10,784. C. D. Abel.—From N. Osuchowski, Russia, and A. S. Zivierchowski, France. Manufacture of hard soap. June 7.
 10,858. E. Barker and E. Bannister. Improvements in the manufacture of soap. June 8.
 11,094. J. C. W. Stanley. Improvements in or relating to the treatment of seed for oil extraction and refining oil, and in apparatus therefor. June 13.
 11,173. E. Noppel, B. Grosche, and T. E. Tack. Improvements in apparatus for purifying oil and separating new oil from drippings. Complete Specification. June 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

4446. W. S. Chenhall and W. F. S. Chenhall. Method for the solidification of mineral, animal, and vegetable oils, and volatile and inflammable fluids. June 15.
 10,837. O. C. Hagemann and T. C. Palmer. See Class XIII.
 13,189. H. Pfützner. Apparatus for smelting tallow. June 8.
 16,557. W. R. Dodd. The manufacture of an improved soap. June 22.

1892.

6955. E. J. J. B. Benoit and J. S. y Vila. Method of extracting stearine and oleine from tallow, and apparatus therefor. June 8.

7581. R. Stewart. Soap or washing-powder. May 25.
 9292. G. W. Scollay. Treating vegetable oils. June 22

XIII.—PAINTS, PIGMENTS VARNISHES, AND RESINS.

APPLICATIONS.

9803. J. Witherspoon. Improvements in rubber compounds. May 24.
 9812. W. H. Bodin. Improvements in or relating to colour washes. May 24.
 10,853. C. D. Hodgson, J. Abell, and C. T. Chivers. Improvements in anti-fouling compositions. June 8.
 11,069. D. Marens.—From J. Curio Co., Japan. Preparation or material for lacquering or covering surfaces. June 11.
 11,089. R. Matthews and J. Noad. Improvements in the production of carbonate of lead and lead pigments. June 13.
 11,166. H. E. Sérullas. Improvements in, or connected with, and apparatus for the obtainment or extraction of gutta-percha or the like. June 14.
 11,337. R. W. E. McIvor and W. Smith. Improvements in the manufacture of white lead or basic carbonate of lead and other matters, and in means or apparatus employed therein. June 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

9526. L. Labois. Manufacture of white lead, and apparatus for use therein. June 8.
 10,837. O. C. Hagemann and T. C. Palmer. Manufacture or treatment of varnish, oils, and the like, and apparatus therefor. June 8.
 13,041. T. H. Rees and W. P. Blackham. Manufacture of blue or other colouring or bleaching materials for washing purposes. June 22.
 14,948. H. Seiling. Improved composition containing coal-tar applicable as a preservative composition or cement for building and other purposes. June 8.

1892.

6516. G. W. Scollay. Manufacture of pigments. May 25.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

9889. L. Thery. Improvements in or relating to the manufacture of artificial chamois leather. Complete Specification. May 24.
 10,385. L. Roger and A. Walther. Improvements in the preparation of materials used in the tanning of leather. May 31.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

5689. F. Riegert. A process for waterproofing all kinds of skins and rendering them more durable. June 8.

7698. A. J. Boulton.—From A. E. Ebert. Manufacture of substitute for leather. June 1.

8469. H. H. Lake.—From Durio Bros. Tanning hides and skins. June 8.

XV.—AGRICULTURE AND MANURES.

APPLICATION.

11,341. B. E. R. Newlands and J. A. R. Newlands. Improvements in the manufacture and production of manure from raw phosphates. June 17.

COMPLETE SPECIFICATION ACCEPTED.

1892.

8859. T. M. Smith. Manufacture of fertilisers. June 15.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATION.

11,125. A. G. Berry. See Class I.

COMPLETE SPECIFICATION ACCEPTED.

1891.

13,260. T. Drost. Process and means for manufacturing crystallised sugar in refineries. June 15.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

9344. K. Schlagenhauser and J. Blumer. Improvements in the manufacture or production of yeast. Complete Specification. May 17.

9538. H. Hirzel. Improvements in still columns. Complete Specification. May 19.

9777. B. J. B. Mills.—From The Brewing Improvement Co., United States. Improvements in treating hops for brewing purposes. May 23.

9855. J. G. Müller. A new or improved filtering bag for breweries, distilleries, and the like purposes. Complete Specification. May 24.

10,078. H. Myers. A process for the manufacture of compressed brewers' yeast into bakers' yeast and for use in distillers' worts. May 27.

10,126. D. Wickham. See Class I.

10,305. B. J. B. Mills.—From The Universal Carbonating Co., United States. Process and apparatus for impregnating beer with carbonic acid. Complete Specification. May 31.

10,376. F. Baxter. Improved means and apparatus for destroying bacteria and other germs in brewers' plant and other wooden vessels. May 31.

10,442. W. P. Thompson.—From L. Schmied, Austria. Improvements in the manufacture of crystal colouring malt. Complete Specification. June 1.

10,496. J. Barton. Improvements in the method of and apparatus for mashing and brewing ale, beer, wines, and other fermented liquors. Complete Specification. June 2.

10,518. W. Garner and A. E. Garner. Improvements in the treatment of grain or cereals in order to render them suitable for various useful purposes, such as brewing, distilling, and vinegar making, or as articles of food, and in means or apparatus to be employed therein, and for other uses. June 2.

10,780. C. H. Jolliffe. Improved means and ingredients for preserving wines, beers, and yeast. June 7.

10,836. R. G. Ross, J. B. Hilliard, and W. Paterson. See Class I.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

11,237. T. White and J. Lee. Apparatus employed in the brewing of beer. May 25.

12,606. A. Walker. Mode of manufacturing yeast. June 1.

12,659. V. Denamur. Apparatus for the manufacture or brewing of beer. June 1.

1892.

5059. G. Sobotka and A. Kliehmetschek. Method of and apparatus for producing clear wort. May 25.

6075. G. Sobotka. Method of and apparatus for separating yeast. May 25.

8952. P. M. Justice.—From A. W. Billings. Apparatus for the manufacture of malt liquors. June 15.

9344. K. Schlagenhauser and J. Blumer. Manufacture or production of yeast. June 22.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

9361. J. Y. Johnson. — From The Rumford Chemical Works, United States. Improved baking preparations. Complete Specification. May 17.

9483. D. Rylands. Improvements in the use of carbonic acid gas as applied to the preservation of fruits, meats, and other comestibles. May 19.

9667. J. Bibby. Improvements in the manufacture of composite cakes for cattle feeding and the like. May 21.

9912. W. Chadwick. Improvements in the manufacture of jams and fruit preserves. May 26.

10,217. A. Bernstein. Improvements in the treatment of milk. May 28.

10,788. H. Bates, jun. Improvements in and relating to the production of an alimentary product from Indian corn or maize. Complete Specification. June 7.

B.—Sanitary Chemistry.

9685. C. H. G. Harvey. The manufacture of a porous magnetic ferric oxide filtering medium. May 21.

9733. M. A. Lutzner. An improved method of and apparatus for removing particles of soot and ash from the waste gases emitted by chimneys. Complete Specification. May 23.

9760. H. Stier. A new or improved process for the purification of waste or refuse water from sewers, mills, works, factories, and the like. Complete Specification. May 23.

9780. J. B. Alliott. Improvements in the treatment of sewage sludge, and apparatus therefor. May 23.

10,308. H. Lockwood. Improvements in tanks or vessels and apparatus used in the purification of sewage and other foul waters by precipitation, and in the treatment of the sludge obtained in such process. May 31.

10,887. G. C. Purvis. New or improved method in sewage precipitation. June 9.

C.—Disinfectants.

10,150. F. Thomas and J. Murray. See Class II.

11,049. M. Syer. Improved disinfecting compound. Complete Specification. June 13.

11,275. J. M. Raymond. An improved antiseptic, disinfecting, and deodorising compound. June 15.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1891.

10,415. A. Collingridge.—From V. Cornet and A. Jones. Treatment of common salt intended to be used for curing food, such as meat, game, fish, and poultry. May 25.

11,045. E. Leconte. Preparation of leaven for use in the manufacture of bread, pastry, and biscuits. June 22.

12,549. J. H. H. Duncan. Manufacture or production of butter. June 15.

1892.

7043. C. Saville. A new or improved food product, and process of producing the same. May 25.

8264. G. Müller. Process of producing sterilised butter. June 15.

9361. J. Y. Johnson.—From The Rumford Chemical Works. Improved baking preparations. June 22.

B.—Sanitary Chemistry.

1891.

10,563. A. Hossack and H. C. Bull. Treatment of sewage, and obtaining certain useful products thereby. June 1.

12,025. W. H. Munns.—From A. F. Black. Apparatus for treating sewage. May 25.

14,038. J. Makinson. Apparatus for treating foul air and noxious vapours or gases. June 22.

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

9466. E. A. Heath. Improvements in the manufacture of paper, card, and the like. May 18.

10,812. A. Brin and E. H. E. Pyle. An improved process of treating peat for the manufacture of paper pulp. June 7.

11,053. E. Castier. An improved cardboard and method of making the same. June 13.

11,123. J. M. Campbell. Improvements in the manufacture of paper to make paper of a uniform strength. June 14.

COMPLETE SPECIFICATION ACCEPTED.

1891.

13,409. W. H. Higgin. Treatment and utilisation of esparto liquor and other similar waste liquors and by-products. June 22.

XX.—FINE CHEMICALS, ALKALOIDES, ESSENCES, AND EXTRACTS.

APPLICATIONS.

9472. The Hon. L. W. Palk. An improved salt or chemical compound for medicinal or other purposes. May 18.

9714. H. H. Lake.—From La Société Bain and Fournier, France. An improved manufacture of aldehyde compounds. May 21.

10,185. H. Barotte. Manufacture or production of extract of tea. May 28.

COMPLETE SPECIFICATION ACCEPTED.

1891.

9023. W. Smith and W. Elmore. A new and more economical method for the production of nitrous oxide. May 25.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

9218. E. J. Browne. A process of treating gelatin-chloride of silver papers by development and toning same without gold or other metals. May 16.

9926. A. Burchett. Improvements in photography by means of coloured glasses used in combination with the photographic lens. May 26.

10,942. H. V. Weyde. An improvement in photography. June 9.

11,175. H. V. Weyde. Improvements in photography. June 14.

11,253. J. B. B. Wellington. Improvements in or relating to the manufacture of photographic films and plates. June 15.

11,254. J. T. Clarke. Improvements in or relating to the manufacture of sensitised films for carbon printing. June 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

3791. A. J. Boulton.—From W. Bruns and Co. See Class IV.

6342. V. Mathien. Process for producing coloured photographs. June 8.

8145. C. E. Fillett. Artificial - light photography June 8.

10,493. P. Lorenz and R. Wuppermann. Improvements in and relating to matches. June 2.

10,620. B. F. Kettle. A new or improved match. June 3.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

3957. H. P. Merriam. Fuzes. June 8.

7981. J. Lawrence. Extraction of nitro-glycerin from the waste acid formed in the manufacture of nitro-glycerin. June 15.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

9284. C. F. Cross, E. J. Bevan, and C. Beadle. Improvements in nitrating cellulose and other vegetable fibrous substances. May 16.

9359. J. G. Lorrain.—From G. Schnebelin, France. A new or improved manufacture of gunpowder. May 17.

9749. E. von Brauk. Improvements in the manufacture of explosives. May 23.

PATENT UNCLASSIFIABLE.

APPLICATION.

11,174. W. Read, jun. Improvements in solvent compounds, and the method of making the same. Complete Specification. June 14.

THE JOURNAL OF THE Society of Chemical Industry:

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The Secretary is prepared to offer 5s. apiece for copies of the Society's Journals for January 1883 in saleable condition.

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Deaths.

Professor C. Schorlemmer, Owens College, Manchester.

A. Norman Tate, at Benarth, Oxtou, Birkenhead; July 22nd.



PROCEEDINGS

OF THE

ELEVENTH ANNUAL MEETING.

THE Annual General Meeting of the Society was held on Wednesday, the 20th July, in the Hall of the Drapers' Company, Throgmorton Street, a large number of members being in attendance.

The President, Professor J. Emerson Reynolds, took the Chair at 3 o'clock, and called upon the General Secretary to read the minutes of the last General Meeting. These having been duly confirmed—

Messrs. A. G. BLOXAM and L. J. de WHALLEY were, upon the motion of Mr. J. C. Gamble, seconded by Mr. F. N. Sutton, appointed Scrutators.

The ballot was then declared closed.

The PRESIDENT then called upon the General Secretary to read the

REPORT OF COUNCIL.

WE have the honour to report that the number of members on the register is 2,782, compared with 2,697 at the last annual meeting. During the year 255 members have been elected, and 170 have been removed by death, resignation, and other causes, showing a net gain of 85.

At the head of the long list of those who have died stands the name of Professor A. W. von Hofmann. To his irreparable loss allusion has been lately made at a meeting of the London Section; when a resolution expressing sympathy with his family and recognition of his great services to chemistry was passed. Among others who have also died are Professor Wm. Dittmar, Freeland Professor of Chemistry in the Glasgow and West of Scotland Technical College; Charles Heisch, Gas Examiner to the City of London and one of the founders of the Chemical Society; Dr. Theophilus Redwood, Emeritus Professor of Chemistry and Pharmacy to the Pharmaceutical Society; Dr. C. Meymott Tidy, Official Analyst to the Home Office and an

eminent authority on sanitary questions; G. H. Makins, formerly Assayer to the Mint and Master of the Society of Apothecaries; Richard Smith, of the Royal School of Mines; Thos. W. B. Mumford, able Secretary of our London Section; Francis C. Hills, a pioneer of chemical industry and inventor of the oxide method of gas purification; and lastly Dr. C. Schorlemmer, Professor of Organic Chemistry at Owens College, Manchester.

During the past session 74 original papers have appeared in the Journal as against 77 the year before.

The revenue last year, as will be seen from the treasurer's report, exceeded the expenditure by 53*0*l. 18*s.* 8*d.*, as against 107*l.* 7*s.* 11*d.* in 1890. This satisfactory result has been achieved in part by greater economy in the production of the Journal, mainly in the direction of keeping down expensive illustrations and excluding matter not strictly connected with chemical industry, as recommended by a special committee which sat in the previous year.

No new Section has been formed during the year, but those already formed have done good work; and to their chairmen and officers our best thanks are due for their labours.

In July last the Council offered its hearty co-operation to the Society of Arts, as Royal Commission for the Chicago Exhibition, which met with a cordial response. Later on it was suggested that the annual meeting next year should be held in the United States, but the general sense of the members declared against a meeting there in an exhibition year.

In April last legislation was introduced into Parliament to amend the Alkali Works, &c. Regulation Act, whereby many more industries were added to the schedule of inspected works. Your Council protested against legislation on these lines as not comprehensive enough, and insisted upon the necessity of providing for the inspection of all works evolving certain specified noxious gases. The Bill has nevertheless passed into law.

In April last a fire occurred in the warehouse of Messrs. Eyre and Spottiswoode, the Society's printers, whereby some four or five thousand back numbers of the Journal were damaged by water. The loss was fortunately covered by insurance.

The Council takes this opportunity of placing upon record its sense of gratitude to those who have served during the year upon the various Committees of the Society. To their labours is due the continued progress of the Society and the efficiency of its Journal; and it would be difficult to over-estimate the amount of valuable aid which they have rendered to chemical industry.

An invitation to meet next year in Liverpool will be laid before you, for which we ask your most cordial consideration.

MR. FORBES CARPENTER, in moving the adoption of the Report, said that he considered the increase in the membership during the past year, though small in comparison to the total number, very satisfactory. As the number of members increased it could not be expected that ratio between it and the yearly increment would be maintained. The losses of members by death had been exceptionally heavy both in quantity and quality, and it was to be hoped that the ensuing year would not be so notable for the removal of distinguished members. It had been said that no new Section had been established during the past year; but he would remind the meeting that the Yorkshire Section had commenced its work now, and from what he knew of the district he expected that good results would follow. Referring to the last paragraph in the Report, he was sure that the members felt thankful to the Publication Committee for maintaining the Journal at its present high standard of efficiency.

DR. G. G. HENDERSON seconded the motion, which was carried unanimously.

THE Hon. Treasurer (MR. E. RIDER COOK) then presented the accounts for the year, printed on page 570, and in doing so gave a brief summary of the receipts and expenditure of the Society during the past twelve months and of its present financial position.

STATEMENT OF REVENUE AND EXPENDITURE FOR THE YEAR 1891.

REVENUE.		EXPENDITURE.	
	£ s. d.		£ s. d.
Annual Subscriptions for 1891:—		Journal Expenses:—	
194 subscriptions received in 1890	117 6 0	Publishing	1,442 2 9
2,463 subscriptions received in 1891	3,093 10 7	Editorial:—	
13 subscriptions received in 1892	10 5 0	Editor's Salary	500 6 0
	3,137 1 7	Expenses	29 12 7
2,510		Abstractors	378 11 9
5 Life Composition Fees	75 0 0	Portion of Secretary's Salary	160 0 0
Interest on Deposit Account	24 7 7	Patent Lists	72 12 7
Interest on Metropolitan Stock	113 10 0	Indexing Journal	49 16 0
Journal:—		Foreign Journals	10 7 0
Advertisements	588 0 0	Sundry Journals	2 17 9
Sales	271 17 4		1,134 17 8
	859 17 1	Sundries: Printing	2,577 0 5
		Sectional Expenses	48 14 0
		Expenses in connexion with Annual Meeting, Dublin ..	214 1 11
		Secretary's Salary (Balance not included in Journal	189 12 5
		Editorial Expenses)	250 0 0
		Hon. Treasurer's Assistant	42 0 0
		Office Expenses	108 1 1
		Stationery	41 11 3
		Auditors' Fee	16 10 0
		Library—Sundry Purchases and Binding Books	18 14 11
		Bank Charges	2 3 0
		Treasurer's Petty Cash	24 1 2
		Secretary's Petty Cash	77 7 8
		Balance of Revenue over Expenditure	530 18 8
			£4,131 16 6
	£4,134 16 6		

THE TREASURER—IN ACCOUNT WITH THE SOCIETY OF CHEMICAL INDUSTRY FOR THE YEAR 1891.

Dr.	£ s. d.	£ s. d.	Cr.	£ s. d.	£ s. d.
To Cash on Deposit (1st January 1891)	150 0 0		By Journal Expenses:—		
To Balance at Bank (1st January 1891)	214 6 7		Publishing	1,437 7 5	
Balance in Treasurer's hands (1st January 1891)	5 0 0		Editorial	1,150 16 10	
Balance in Secretary's hand (1st January 1891)	4 1 2		Insurance of Stock	1 5 0	
Annual Subscriptions:—		370 7 9	Sundries, Printing, &c.	2,649 9 3	
1 subscription for the year 1888	1 5 0		Sectional Expenses:—		
12 subscriptions for the year 1890	15 0 0		Glasgow Section	32 16 0	
2,463 subscriptions for the year 1891 ..	3,093 10 7		Liverpool Section	31 18 5	
(less 4s. 6d. short paid)			London Section	89 18 0	
80 subscriptions for the year 1892	100 0 10		Manchester Section	8 4 6	
1 subscription for the year 1893	1 5 0		Newcastle Section	11 5 0	
2,497		3,121 1 5	Secretary's Salary (balance not included in Journal		214 1 11
Sundry amounts on account of Subscriptions for 1890,			Editorial Expenses)	250 0 0	
1891, and 1892	1 15 0		Hon. Treasurer's assistant for work in 1891	42 0 0	
Life Composition Fees	75 0 0		Annual Meeting at Nottingham	100 0 0	
Interest on Deposit Account	24 7 7		Expenses in connexion with Annual		
Interest on Metropolitan Stock	113 10 0		Meeting, Dublin	173 6 10	
Journal:—			Reporting Proceedings at Annual Meet-	16 5 7	189 12 5
Advertisements	588 0 0		Office Expenses		108 1 1
Sales	276 0 8	864 0 8	Purchase of £163 2s. 3d. 3 ⁴ Metropolitan Stock		105 0 0
			Stationery, &c.		41 6 3
			Auditors' Fee		10 10 0
			Library		18 11 11
			Bank Charges		2 3 0
			Sundries		1 1 0
			Treasurer's Petty Cash		24 1 2
			Secretary's Petty Cash		77 3 1
			Cash on Deposit (31st December 1891) ..	500 0 0	
			Balance at Bank ditto ..	181 10 0	
			Balance in Treasurer's		
			hands	6 16 0	
			Balance in Secretary's		
			hands	3 17 4	692 3 4
					£4,570 2 5
	£4,570 2 5				

* In addition to this there is an amount of £3,983 5s. 6d. Metropolitan 3⁴ Consolidated Stock, invested in the names of Mr. David Howard and Mr. Edward Rider Cook.

We have compared the above Statement with the Receipt Book Counterfoils, Vouchers, and Books of the Society, and certify it to be correct. We have also verified the amount of the Metropolitan 3⁴ Consolidated Stock, £3,983 5s. 6d. by reference to the Books of the Bank of England.

23, St. Swithin's Lane, London, E.C.,
22nd February 1892.

(Signed) THOROLD BROS. & MALL,
Chartered Accountants.

Sir F. A. ABEL moved the adoption of the accounts and a cordial vote of thanks to Mr. Rider Cook for the able manner in which during the past year he had managed their financial affairs. To that sagacious control was largely due the prosperity of their flourishing Society, and the very least they could do was to give the Hon. Treasurer their heartiest thanks.

Dr. J. CAMPBELL BROWN seconded the motion, in putting which—

The PRESIDENT said that he must express his own admiration for the way in which Mr. Rider Cook had managed his department. His experience as President had shown him that the Society owed an immense deal to the care and watchfulness with which its Hon. Treasurer had looked after its interests. He therefore put the motion to the meeting with the utmost confidence.

The vote having been carried by acclamation—

Mr. RIDER COOK briefly thanked the members for their continued confidence in him.

The PRESIDENT then delivered his address:—

PRESIDENTIAL ADDRESS TO THE SOCIETY OF CHEMICAL INDUSTRY.

By J. EMERSON REYNOLDS, M.D., D.S.C., F.R.S.

Read at the Annual Meeting in London, July 20th, 1892.

THE Report of Council which you have heard read presents a picture whose lights and shadows are in strong contrast. The membership of this Society has reached the large number of 2,782; our revenue last year amounted to 1,134*l.* 16*s.* 6*d.*, which proved to be more than we required to expend; while the Journal bears ample record of the good work accomplished by our active Sections. These are the bright and encouraging parts of the picture. But the shadows are heavy indeed; for death has been busy, and many honoured names disappear from our roll of members. Dittmar, Heisch, Tidy, Richard Smith, F. C. Hills, Makins, Mumford, Schorlemmer, the venerable Dr. Redwood, and other names in our long obituary list, recall to our minds numerous examples of excellent work in the various departments of analytical and industrial chemistry, as well as in the special branch concerned in providing the physician with the means of combating disease.

Keenly though the loss of such men must be felt, what small I say of that very recent one which science has suffered by the death of the illustrious August Wilhelm von Hofmann? A teacher of teachers; the source of the primary impulses from which great industries have sprung; the brilliant investigator of some of the most difficult problems in the philosophy of chemistry; the wise counsellor of princes, and the sincere friend of every lover of nature—truly a noble man has gone from amongst us! It were almost irreverent to slightly sketch the work of so great a master, hence I do not attempt it. Need I remind you that Dr. von Hofmann was one of the earliest members of this Society, and always took a warm interest in its work; or that in the persons of many of the eminent chemists who were his pupils and are amongst the most influential of our members, he has left us a legacy of the highest value. I hope that my distinguished successor, Sir John Evans, when he addresses you next year from this Chair, may not have to record as many important losses to science and to our Society.

But we may not unduly dwell on the sad side of any picture; rather should we seek to imitate the illustrious dead in utilising to the utmost our present opportunities, that we may establish a good foundation for future development.

You are aware that our Journal is intended to contain a faithful record of the real advances made during each year in the applications of the science of chemistry to the various arts, and I think you will agree with me that under the constant care of the Publication Committee and Editor it is increasingly successful in attaining the object in view. But the success of the Journal in this respect renders any

presidential *résumé* unnecessary, hence several of my distinguished predecessors in this Chair wisely abstained from acting as chroniclers, and I shall venture to adopt the same course. Several Presidents—notably Sir F. Abel, Dr. Perkin, Mr. Ludwig Mond, and Sir Lowthian Bell—have given in their valuable addresses the results of their own life work in the scientific investigation of certain great industrial operations; and others, following Sir H. Roscoe, have dealt with the relations of education and legislation to technical development. I should ill requite the confidence with which you have honoured me if I were to devote this address to the abstract and philosophical side of chemistry in giving you an account of my old thio-organic work, or even the studies of later years in the silico-organic department of the science, as few of the products of either line of investigation are within measurable distance of practical application; moreover, in matters of technical education and legislation it would be more fitting for me to come to you for information. I therefore propose to take as my theme the modern developments in regard to fuels and their use, as the subject is one which has occupied much of my time and attention for many years, and links in practical interest chemical and other industries with the still wider considerations of social economy.

The fuel question is one which concerns those of us who live on the western side of St. George's Channel even more seriously than it does you, as our coal beds have been washed away in ages past, and of native fuel there is practically none save peat; hence industries which require large quantities of cheap coal cannot flourish in Ireland under existing conditions. It is therefore our interest to watch closely the development of improved and economical methods of using such fuel as we can obtain from other countries and apply them in the utilisation of our bulky but abundant peat. It is evident that no other fuels need be considered save coal, peat, and petroleum, hence my remarks can take somewhat the form of a trilogy, minus the dramatic element, precedence being given to the solid fuels, and the first place necessarily to

COAL.

We are much too prone to assume that coal will always be a cheap fuel, and that the supply is inexhaustible; but both assumptions can be shown to be erroneous. I think it is desirable to briefly indicate the grounds for that statement, as a presidential address necessarily has its public as well as technical aspect, especially in dealing with the topics I have chosen, and therefore needs to be somewhat explanatory in order to be intelligible to those who do not possess your special knowledge of applied science. Moreover, my general aim being to connect somewhat different lines of work, rather than to attempt novelty, it will be necessary for the sake of completeness to restate much that is already familiar to you.

The reasons for concluding that coal cannot very long remain a cheap fuel are not far to seek. Labour combinations in various parts of the world tend to increase its cost directly or indirectly. These combinations are to a certain extent the consequences of the operation of economic laws, and in so far are not mere accidental factors. The wider distribution of manufacturing activity tends in the same direction; and the increase in depth from which coal must be won leads altogether and regularly to greater cost of production. Therefore, some causes which are spasmodic in their effects and others which are continuous must make coal dearer. The immediate practical effect of such considerations should be to check waste in the use of coal, but I fear we have not gone very far in that direction as yet, since few realise the extent of the danger ahead.

Again there is the more remote consideration that the world's supply is not and cannot be inexhaustible. No doubt "common sense" people take little account of posterity in such matters, though they will carefully but inconsistently guard the transmission of property in land for hundreds of years in advance. We clearly owe a similar duty to posterity in the right but not wasteful use of materials which seem to be absolutely necessary to the well-being of the race.

Now, the world's annual output of coal is about 489 million tons, and the countries contributing to this enormous

total are named below, together with the amounts they produced in 1890, unless otherwise specified:—

	Million Tons.
British Islands (1891).....	185
America, U.S. (estimated for 1891) ..	141
Germany.....	90
France.....	28
Belgium.....	20
Austria.....	9
Russia (1889).....	6
Others.....	9
	<hr/> 488

During the last 20 years there has been a very marked increase in the consumption of coal, which is, no doubt, commensurate with increased industrial activity. Thus, comparing European countries alone, the average annual output for the period 1881–90 was upwards of 62 million tons greater than during the previous decade, and this rate of increase bids fair to be maintained, so that the world's consumption of coal will soon reach 500 million tons per annum, if it has not already done so.

The question arises how long can this supply be maintained? If, in answer to this question, we cannot give an approximate estimate for other countries we certainly can for our own.

The Royal Commission on Coal Supply, which commenced its sittings in July 1866, and reported in July 1871, after inquiring into all probable sources of coal in Great Britain, arrived at the conclusion that not more than 146,480 million tons were available at depths not exceeding 4,000 ft. from the surface. Therefore at our present rate of increase of population and of coal consumption our supply would not last for 230 years. But Mr. Hall, one of Her Majesty's Inspectors of Mines, who has special experience of coal mining, forms a much lower estimate of the supply practically available with our present means, and considers 170 years as the more probable duration of our coal beds. This estimate is based on fuller information than that possessed by the Royal Commissioners; we are therefore justified in concluding that the inhabitants of Great Britain 170 years hence will have little, if any, home-raised coal to burn if we continue to use it in our present wasteful fashion.

It was pointed out by the Royal Commissioners in 1871 that we cannot suppose "the production of coal could continue in full operation until the last remnant was used, and then suddenly cease. In reality a period of scarcity and dearth would first be reached. This would diminish consumption and prolong duration; but only by checking the prosperity of the country." . . . "Much of the coal included in the returns could never be worked except under conditions of scarcity and high prices. A time must even be anticipated when it will be more economical to import part of our coal than to raise the whole of it from our residual coal beds." As the area of coal-bearing strata in North America is fully 70 times greater than ours, it is easy to see where our future supplies must come from. The rate of increase in the use of coal has been greater than the Commissioners anticipated in 1871, and Mr. T. Foster Brown, C.E., President of Section F. of the British Association at Cardiff last year, has placed on record his opinion that at the end of only 59 years from the present time the increased cost of coal will be severely felt. Pessimism is never pleasant; nevertheless we cannot afford to ignore reasonable inferences from fairly ascertained facts.

I apprehend that there are few ordinary consumers likely to be influenced in avoiding waste by the knowledge that we are within measurable distance of the end of our store of British coal, as that calamity may still be some generations off. But the case is very different with large consumers: the inevitable, if gradual, increase in the cost of coal has effectually arrested the attention of those directly concerned in our great industries or anxious for the maintenance of that manufacturing supremacy to which this country chiefly owes its wealth and power. Keen international competition in trade has quickened the effort to get the utmost work out of fuel, and therefore to diminish waste.

No such considerations have, however, produced any effect on the domestic conscience. A spasmodic increase in

cost of coal stimulates the use of various economical devices which are almost wholly given up when prices fall back nearly to their former level. A small residual effect is left, which, though slight, is on the right side. But that economy in the domestic use of coal which could not be effected by a patriotic desire to avoid the too rapid exhaustion of our coal beds, or by a fear of permanently dear coal, is likely to be brought about by the growing nuisance of large towns, namely, fog, for whose increase our "hearths and homes" are in a greater degree responsible than the much abused factory chimneys. The primary consideration in seeking to cope with the fog demon no doubt is to avoid the production of solid particles during the combustion of any fuel we may use, hence that method which avoids the formation of smoke at any time, and is both more convenient and economical, must ultimately "hold the field." As you well know, various suggestions have been made for the purpose of avoiding the production of smoke, and it has even been proposed that the use of non-flaming coal should be made compulsory in all large towns, notwithstanding the difficulties known to attend the combustion of anthracite or similar substances in open grates. But even if the fog demon could be satisfactorily exorcised by such means the fact would remain that the combustion of any solid fuel in an open grate is a most wasteful proceeding. On the other hand, closed grates or stoves have not been popular in these countries. How then can we combine economy in the use of coal with smokeless combustion and domestic convenience? The answer is sufficiently obvious—we must more or less completely gasify the coal prior to its complete combustion.

The late Sir William Siemens showed us long ago how to convert coal completely into gas by means of his great "producer" furnaces, and demonstrated the applicability of the comparatively poor "producer" gas to operations requiring very high temperatures as well as to the minor work of steam raising. Siemens showed that when so used one ton of coal can perform as much work as 1·7 tons directly burned. In such comparisons the "producer" gas was, of course, burned at a short distance from its source and under the regenerative system. This mode of using coal seems to be the most economical of which we have practical experience; but the gas which is produced seldom contains less than 65 per cent. of useless nitrogen, and therefore is not rich enough in combustible matter for general distribution.

The Wilson method of gasifying coal and that employed by the Leeds forge permit the production of a richer gas. The Wilson process involves the formation of a certain proportion of "producer" gas in raising the temperature of the coal up to the point at which it can decompose steam, and then affords a mixture of carbon monoxide and hydrogen, or so-called "water-gas." The former can be used for steam raising or furnace work in the immediate vicinity of the producer, while the water-gas can be transmitted through mains as readily as ordinary town gas and loses nothing by carriage save its initial heat. Thus one general method affords two qualities of fuel and gasifies the coal in an economical manner.

Whether by the Siemens method in its modern form or by the more or less complete conversion into rich water-gas, a great saving in coal can now be secured in almost all large operations requiring the command of high temperatures; and the use of such gaseous fuel is so steadily extending that we may expect in the near future to reach the maximum practicable economy of coal in our greater industries and of smoke abatement as well.

Between the complete conversion of coal into gas and the very partial process included in the production of ordinary illuminating gas is a wide gap which needs to be bridged over in the interests of the small manufacturer and the domestic consumer alike before we can secure that economy in the use of coal which we know to be necessary. For it must be granted at once that our ordinary 16-candle illuminating gas is seldom an economical fuel at an average price of 3s. per 1,000 cubic feet, though it is capable of being so used as to effect distinct saving under special circumstances. As an example of its economical use, even near the price stated, I may cite the case of the kitchen of St. John's

College, Cambridge, where gas and steam have been substituted for coal, and an annual saving effected amounting to about 80/. But in establishments which cannot be systematically conducted coal gas at 3s. is too expensive a fuel. Several solutions of this important practical problem have been proposed; one group of suggestions involving the supply of two distinct gases, an illuminating and a fuel-gas and therefore requiring two sets of street mains; but the progress of electric lighting is so rapid that gas companies would not be justified in outlay of capital on a second set of mains. Another proposal is to supply one gas of high calorific value but low illuminating power at a cheap rate, and this gas, when used for lighting, to be charged at the point of consumption with vapours of suitable hydrocarbides. But the true solution involves a compromise much on the lines along which gas managers are at present apparently working.

You are aware that the average produce of 16-candle gas per ton of coal is about 9,500 cubic feet. By the introduction of steam to a small extent the volume of gas can be materially increased, but at the expense of the illuminating power. In order to compensate for this loss, rock or other oils are injected along with the steam and the illuminating power is maintained. An objection to this practice is that carbon monoxide is present in such gas, but it is also found in many samples of ordinary coal-gas, and provided the gas has a strong and characteristic odour, so that its escape can be readily detected, no risk need attend its use. The supply of the richer bituminous coals is steadily diminishing, hence the practice must grow of supplying a modified water-gas instead of coal-gas as we have hitherto known it. Better far in the interests of producer and consumer alike that the inevitable change in the character of the gas manufacture should be carried out with the full knowledge and assent of the public after due parliamentary inquiry, and in such a manner as to secure the maximum advantage without undue interference with the great monopolies enjoyed by the gas companies. So many satisfactory methods are known by which the illuminating power of a gas can be increased at or near the burner, and gas as an illuminant is moreover being so certainly displaced by the electric light that the objections hitherto urged against the supply of gas of high calorific value but low illuminating power have almost ceased to have any practical force. On the other hand the supply of a cheap gas of the kind I refer to would prove a great boon to small manufacturers as well as to the domestic consumer, and competent gas engineers inform me that no real difficulties lie in the way.

The rapid extension of electric lighting in our large towns brings us within measurable distance of some such sweeping change in the character of gas used, in its applications, and in its mode of employment, while the existing mains would serve for its conveyance, and comparatively trifling alterations in our domestic appliances would only be necessary.

It is in this direction, then, that the best prospect of solving a considerable part of the smoke fog difficulty seems to lie, and it is in the same direction that we are to look for true economy in the use of coal. The completion of the system of electric lighting in towns is therefore to be desired by the community, not only on account of its great and obvious advantages for illumination, but because it will render possible the provision and distribution of a cheap gas for heating purposes; and the shareholders in gas companies of such fortunate towns should specially rejoice, as herein lies a good prospect not merely of maintaining but of considerably increasing their dividends. Gas companies would not only become purveyors of heat energy for domestic use, but for many manufacturing purposes as well, not excepting the production of the electric light.

Hence our duty to posterity and our own immediate interests coincide in requiring the use of more economical methods of using coal and that which gives promise of the greatest number of advantages involves the conversion of coal as far as possible into gaseous fuel.*

I turn now from coal to

PEAT

which is, as you know, a much less mineralised solid fuel. It is obvious that the question of peat utilisation is one of much importance in Ireland, as nearly one-seventh of the island is bog. About 1,250,000 acres are mountain bog, and 1,575,000 acres are occupied by flat bogs, which occur over the central limestone plain of the country and stretch away to the north-west. This store of peat is an asset which may become valuable when you shall have exhausted your coal beds some 170 years hence. We would naturally desire to realise a portion of our assets at a much earlier date, as nearly all the coal used in Ireland must be brought from the eastern side of St. George's Channel. In this fact I think you have some explanation of the depressed industrial condition of the country, as manufactures involving the use of much fuel can only flourish in Ireland if the margin of profit be considerable; where the margin is small and competition keen (as in the greater industries) they must go under in the struggle with manufacturers having cheaper fuel at command. I grant at once that this is no adequate explanation of the absence of many chemical manufactures which do not involve large consumption of fuel, but it is the inevitable result in the cases to which my remarks apply.

Peat alone, however well prepared, compares very unfavourably with coal in several particulars:—

1. It is a very bulky fuel, in its ordinary condition occupying rather more than five times the space of an equal weight of coal.

2. It contains from 15 to 25 per cent. of water and seldom less than 10 per cent. of ash.

3. At least 2½ tons of average peat are required to perform the same work as one ton of average Staffordshire coal in ordinary fireplaces or furnaces.

Hence the general use of ordinary peat is attended by the disadvantages of requiring much greater storage room than coal, of producing a light and troublesome ash, and requiring more than 13 times the bulk of coal to produce the same thermal effect. The last-mentioned consideration practically precludes its use in ordinary furnaces where heat of high intensity is required.

Now the force of the first objection to the use of peat, that of bulk, can be materially diminished by mechanical compression. Many excellent examples of compressed peat have been produced at various times, the most coal-like product I have seen being that of Mr. Hodgson, of Derrylea, who compressed thoroughly disintegrated and dried peat in heated cylinders, and by partially carbonising under pressure secured the cementation of the material. Moreover, the ash of such compressed peat was not so bulky as that of the ordinary fuel.

I need scarcely say that the intensity of the heat obtainable with compressed peat is greater than with the loose material, but the actual thermal effect is not much altered, save in so far as the material is drier and therefore less heat is lost in evaporating moisture.

Extended comparative trials of coal and of good dense peat in steam engines has shown that the work done by one ton of peat was not more than 45 per cent. that of one ton of coal; hence if coal were 18s. per ton, peat could not compete with it under the most favourable conditions unless delivered at not more than 8s. per ton. Now the peat used in these trials did not contain more than 12 per cent. of moisture, but as dug from the bog it seldom contains less than 35 per cent. of water, even when cut from a comparatively dry bog; it must then be stacked and air-dried. The present price of ordinary turf delivered at the bog is about 7s. per ton; when to this is added the cost of handling this bulky fuel, and carriage for 50 miles, the cost exceeds 45 per cent. of that of coal even at inland towns; hence there is no real economy in the use of peat of the common kind in ordinary furnaces and grates instead of imported coal.

But the public are led by promoters of peat manufacturing companies, and others who should know better, to suppose that by certain processes of disintegration and compression peat can be made to approach very closely in

* Since the above was written I have seen a short abstract of Mr. Valon's address to the Institute of Gas Engineers, in which I am glad to find that he takes a somewhat similar view of the situation to that expressed above.

fuel value to an equal weight of coal. There is no doubt that a better looking and denser product can be obtained by these means, and one which requires less storage room; but unless artificially dried as well, the actual heating effect of the fuel is not materially altered. I have no doubt that the cost of winning and treating the rough peat could be much reduced by the use of suitable labour-saving machinery; but all methods with which I am acquainted involving artificial drying as well as mechanical compression, have cost so much that the product could not compete with coal at the ordinary level of prices. As I have already said, the Irish peat forms a valuable asset but one not capable of being realised on any considerable scale at present; at least when used as fuel in the ordinary way as a substitute for coal. But it is possible to solurn peat that it shall compare much more favourably with coal, and this solution of the problem is obtained by converting rough peat into gas.

You doubtless remember that in 1872 the cost of coal advanced even beyond the panic prices which prevailed for a week or two about the beginning of the present year. But the coal famine of 1872 lasted for a considerable time, and serious efforts were then made in Ireland for the utilisation of peat. It soon became evident that the continuance of dear coal meant the suspension of several industries and their probable loss to the country; hence, leaving to others the attempts to convert peat into a suitable fuel for general domestic use, I took up the industrial side of the problem.

I saw that the best chance for economically applying peat for most manufacturing purposes lay in gasifying the material in a Siemens furnace, as two special and important advantages must obviously be gained thereby:—1. The use of peat in the rough state without artificial drying. 2. The avoidance of the injurious effects of abundant ash by burning the peat-gas at some distance from its source, and under such conditions that the comparative value of coal and peat should be nearly in the proportion of their percentages of carbon. I therefore moved the Royal Dublin Society to appoint a committee of engineers and other scientific men to have the value of peat tested in the way proposed. The outcome was that the directors of the Great Southern and Western Railway of Ireland, acting on the recommendation of the able locomotive engineer, Alexander Macdonnell, C.E., decided to erect a complete Siemens regenerative gas furnace for working up scrap iron in their engine factory at Inchicore. This furnace was supplied only with rough peat, often containing as much as 38–40 per cent. of water, but no difficulty was found in keeping the welding chamber at a bright white heat for months at a stretch. The average consumption of fuel was 5.09 tons of peat for each ton of iron forged from scrap to finished work. Before the Siemens furnace was built the ordinary air furnace fed with coal was employed, and the average consumption per ton of iron was 4.96 tons of coal. I need scarcely say that peat is practically useless in such a furnace. Therefore peat used in the gas furnace as compared with coal in the ordinary welding furnace not only proved in practice to answer extremely well, but performed 97 per cent. of the work done by an equal weight of coal. As the price of peat was about half that of coal at the time, Mr. Macdonnell estimated that a saving of *£* 7s. 9d. per ton of finished forgings was effected. If therefore the coal beds were exhausted we have a good substitute in peat for operations in which a very high temperature is required, provided the fuel is used in the gas furnace or according to some similar plan.*

The above remarks refer to work done 20 years ago. Now, thanks to the valuable investigations of Mr. Ludwig Mond, F.R.S., detailed in his Presidential Address of 1889, the production of ammonia from peat along with gas according to his method will probably pay for gasifying the fuel and materially facilitate the utilisation of peat.

Much to my surprise and regret this work remains the sole practical outcome of our efforts in the direction of peat utilisation during the fuel famine of 1872, so far as

Ireland is concerned. Manufacturers now know how they can economically use peat for high temperature operations, and Dr. Bindon Stoney, F.R.S., has suggested that peat should be gasified at the bogs and carried to convenient centres of industrial activity. This could undoubtedly be done, especially if instead of "producer" gas a fuel were manufactured approaching water-gas in composition, and such a gas of good calorific power can be manufactured from peat. Thus, as in the case of coal, peat could be made economically to provide light and heat energy as well for domestic use as for manufacturing purposes. Would that we could apply even a small portion of the energy stored up in peat to stimulate those who should be most active in utilising in the best and most economical way the abundant material almost at their doors!

If, then, there are many and great advantages in converting our bulky solid fuels into gas and distributing them in that form for heating purposes or supplying power by means of gas engines, it is clear that such advantages must be confined for the most part to towns or special manufacturing centres unless the gases are condensed to the liquid form, and so rendered portable to considerable distances; but nature has already done a great part of this work for us in providing the wonderful material we call

PETROLEUM.

I do not think "wonderful" is too strong an adjective to apply to this material, whether we consider its nature, speculate as to its probable origin, or attempt to measure its value in the world's work; and in this, the concluding section of my address, I propose to sketch in broad outline the main points of public interest which relate to this, the most important of our liquid fuels. Fortunately our Journal is rich in the technical literature relating to petroleum, and has been the means of communicating some admirable original papers on the subject, notably those of Mr. Boyerton Redwood on the Russian and Galician centres of the oil industry, and Dr. Armstrong's on the Pintsch and Keith's systems of converting rock oil into permanent gas.

As you well know, the general term petroleum "oil of stone" or "rock-oil"—is applied to the fluid mixtures of hydrocarbides, containing approximately 85 per cent. of carbon and 15 per cent. of hydrogen, which are found at many points on the earth's surface, either saturating the soil or rising in springs of inflammable liquids. The existence of these combustible natural oils or naphthas was known before the present era, probably many centuries before Christ, and various ancient historians mention their use for illuminating purposes.

Down the centuries we find traces of the use of these naturally occurring oils, especially in South-Eastern Europe, and from very early times the naphtha of Baku, in Southern Russia, was used for illuminating purposes and as fuel. More or less spasmodic efforts in the direction of utilisation were made, nevertheless the petroleum industry was virtually non-existent 50 years ago.

In examining the history of any industry it is interesting to seek for the primary impulse which set the necessary forces in motion, and I think in the case in question that impulse was given not quite 50 years ago by a keen observer and distinguished chemist, who is, I am happy to say, still with us. In 1847 Sir Lyon (then Dr.) Playfair recognised the nature of a dark oil met with in a Derbyshire coal-mine, and at his instance the late Mr. James Young produced from this material illuminating oils, as well as solid paraffins. Although this particular source of illuminating oils was soon exhausted, and Mr. Young had to turn to other materials from which to distil paraffin, the value of these as illuminants had become generally known, and stimulated the search for natural springs.

No fresh ones of importance were discovered in these islands, but in 1858 Colonel Drake made his celebrated discovery of petroleum in abundance at Titusville, Pennsylvania, U.S.A., and laid the foundation of the great American petroleum industry, which developed with surprising rapidity as new sources were recognised in other States.

* Of course the comparison is more favourable to coal when the latter is used in the Siemens furnace, as it is found that a ton of iron required an average of 5 tons of coal, therefore the work done by peat was about 60 per cent. of that by coal under the same conditions.

The rate of growth of the industry is best shown by the following statistics:—

We find from official reports that the total production of crude petroleum in the United States was in—

1853	2,000 barrels of 42 gallons.
1869	1,215,000 „ „
1879	19,685,000 „ „
1889	31,820,000 „ „
1890	nearly 45,000,000 „ „

The success of the Americans was followed by the development of production in other countries where the existence of oil had long been known, especially in Russia, at Baku, and in the Austro-Hungarian province of Galicia, just north of the Carpathian range, while Germany, distant Japan, and Burmah contributed to the general result. America and Russia are now the principal producers, the Russian output being for:—

1883	about 21,000,000 barrels.
1890	25,000,000 barrels.
1891	estimated at 30,000,000 barrels.

The Galician production is at present relatively small, being, according to Mr. Boyerton Redwood, 523,000 barrels for 1889—90, but according to Pizzola, for 1890, the output was 770,000 barrels. As Mr. B. Redwood states that he regards his figures as considerably under the full output, we may probably take the Austrian estimate as near the truth.

Thus the world's production of crude petroleum may be estimated at fully 75 million barrels per annum or upwards of TEN MILLION TONS.

This amount does not include asphalts (which are probably petroleum residues from which the volatile liquids have evaporated); nor does it include earth wax or ozokerite, 60 million pounds of which are annually produced by Austria.

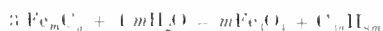
The surprising extent to which the oil industry has grown in little more than 33 years naturally suggests the question whether the supply will continue. Unfortunately no such means of forming even an approximate judgment exist in the case of rock oil as in that of coal. Petroleum, unlike coal, has been found in nearly all geological formations, though chiefly in the older sedimentary strata which are almost destitute of organic remains. Its position in the earth's crust cannot be localised and the probable amount determined. Nor are the strata in which it is found necessarily connected with its production, for, being a liquid, it can gravitate from higher to lower districts. Moreover, being lighter than water, the latter can, in rising through porous strata, carry the oil nearer to the surface. Therefore, from either cause, the oil may be found at a great distance from its real source.

It is a fact, I believe, that the existing large oil-producing districts do not, taken as a whole, afford material indications of diminished productiveness, notwithstanding the enormous drain upon them. Particular wells become exhausted, but new ones are bored and the output is maintained. This, however, is a process which must have its limits, even though the oil-bearing strata are known to underlie great tracts of country, and obviously cannot afford much real help in deciding the question of duration of supply. Of rather greater significance is the fact that rock oils, or such petroleum residues as asphalt, bitumen, ozokerite, &c., have been discovered in almost every country when carefully sought, especially in the neighbourhood of the great mountain ranges of the world, though the quantities found vary greatly. This fact, so far as Europe is concerned, is made very clear by means of a map which appeared at page 96 of the current volume of this Journal, illustrating Mr. Boyerton Redwood's admirable essay on the Galician oil-fields. The occurrence of petroleum at such widely different points in the earth's surface as Pennsylvania, U.S.A., Baku, in Southern Russia, Trinidad, Galicia, Japan, Canada, Sicily, Burmah, &c., indicates a large area from which supplies may be obtained, and further, that stores of the material exist at points hitherto almost untouched. I think we may draw two conclusions from the fact of the

wide distribution of petroleum: the first is that there is ample provision for an abundant supply in the near future at any rate; the second conclusion is the equally obvious one that these mixtures of liquid compounds of carbon and hydrogen result from some process which is general in its operation, and which is or has been most active near to those great crumples of the earth's crust we call mountain ranges.

The views of geologists as to the nature of the general process by which petroleum is formed are elaborately discussed in the Eighth Report of the United States Geological Survey, and the conclusions are there carefully summarised (page 506). In substance they are as follow:—That petroleum is derived from organic matter by a process of slow distillation at comparatively low temperatures; that the organic matter was not in all cases of vegetable origin, but was in some instances derived from animal substances in contact with limestone; and, finally, that the stock of petroleum in the rocks is practically complete. It follows, of course, that the supply is exhaustible, but geologists do not even guess at its duration.

In contrast with all this is Mendeleef's view that petroleum is not a product from organic material, but is chiefly formed by the action of water at high temperatures on carbide of iron, which he supposes to exist in abundance within or below the earth's crust. The cracks and fissures caused by the upheaval of mountain chains permits water to reach the heated carbide at great depths, and carbides of hydrogen result in accordance with the general equation—



The hydrocarbides then distil up and condense within the cooler sedimentary strata. The occurrence of petroleum in active volcanic areas, as in Sicily and Japan, is held to accord with this hypothesis, which latter is also consistent with the remarkable fact that rock oil is usually found in the vicinity of mountains. But my chief reason for referring to this attractive hypothesis is that it permits us to suppose the hydrocarbides are still being formed within the earth's shell, especially beneath the geologically modern mountain chains, and that the supply of petroleum is practically inexhaustible. Whether that view can be sustained we must leave further evidence to decide, and now return after this digression to the consideration of the material itself.

The porous strata saturated with petroleum often lie at considerable depths below the surface soil of the district, and the oil is in many cases prevented from rising by a bed or shell of almost impervious material. In boring for the oil this enclosing shell is penetrated and the result often is the ejection of a column of liquid rising as a fountain of several hundred feet into the air. This violent expulsion of petroleum is due in great part to the pressure of pent up gases, and the crude liquid always contains some of these gases in solution. In some instances gas only issues, and a so-called "gas well" is obtained, from which are emitted enormous volumes of marsh gas and its lower homologues, as well as hydrogen. Some of these American gas wells afford from 10 to 14 million cubic feet per day, delivered at a pressure of as much as 100 pounds to the inch. Such gas is a fuel of high value and, as you know, has been largely utilised for industrial and domestic purposes at such great industrial centres as Pittsburg.

One million cubic feet of the natural gas obtained from the Trenton limestone at Findlay, Ohio, are said to do the same amount of work in heating as about 60 tons of Pittsburg coal. Some of these gas wells have been exhausted, but others have continued in full productiveness for several years. Although this natural gas is compressed and transported in cylinders to considerable distances, it evidently must remain of almost exclusively local value; not so the liquid petroleum which issues along with it or in its immediate neighbourhood. This is the most portable of all fuels obtainable in nature, and therefore is the most convenient means by which light and heat can be transmitted to all parts of the world—hence it is of greater practical interest to us than the natural gas.

You are aware that the hydrocarbides of which the American petroleum consists chiefly belong to the saturated

group C_nH_{2n+2} , whereas those of Russian petroleum are mainly benzenoid hydrocarbides of the general formula C_nH_{2n} , isomeric with the olefines, but really hydrogenised aromatic compounds of the naphthene series. Petroleum from both sources affords some of the lower homologues of marsh-gas, hence in the process of refining crude petroleum by distillation the first products consist largely of butane, pentane, and hexane, which are separated and condensed by pressure, the product being used for refrigerating purposes owing to its high volatility. Between 80° and 120° American petroleum affords a spirit of specific gravity about 0.75, and above 130° the illuminating oils are obtained whose gravities vary about 0.8, while the residue which is not vaporised at 300° includes the heavier lubricating oils, which are also admirably suited for use as fuel, and are cheaper than those generally used for lighting purposes. During this process of refining by simple distillation there is always more or less decomposition in progress, hydrocarbides of high molecular weight being resolved into simpler ones at a comparatively high temperature; and when crude petroleum or its constituents are rapidly heated, this resolution can be carried so far as to convert a large proportion of the oil into permanent gas, valuable alike for illuminating and heating purposes. Thus petroleum is a fuel which can be permanently gasified with facility, and is no doubt wholly converted into gas just prior to combustion in our common lamps.

Several methods are employed for the conversion of oil into rich gas, and storing the latter for distribution through tubes in the ordinary way. In one class of such processes the oil alone is rapidly heated to a temperature of from 800° to $1,000^\circ$ in iron retorts, as in the methods of Pintsch and Keith, thoroughly described by Dr. Armstrong in Vol. III. of our Journal. The yield of gas seldom exceeds 130 cubic feet per gallon, as liquid hydrocarbides of low boiling points are condensed chiefly during the compression of the gas into cylinders for use in railway carriages. The gas is rich in carbon compounds, including methane, ethylene, and crotonylene, and its illuminating power, even after compression, is seldom less than 15 candles. I may add that Mr. Iverson Macadam has given in Vol. VI. of our Journal (page 139), a valuable series of observations on the gas-producing power of various oils treated by a process very similar in plan to that of Pintsch.

Another mode of converting petroleum into gas includes the use of steam, as in the process of Messrs. Rogers and Watford, who inject the oil into red-hot retorts by means of steam, the latter appearing to facilitate the permanent change of the petroleum without the formation of much carbon monoxide. The gas so produced is said to amount to about 110 feet per gallon of heavy oil used, and has, according to Mr. Rowan (this Journal, Vol. VII.), the following composition:—

	Per Cent.
Hydrogen	31.61
Marsh-gas	46.17
Illuminants	16.20
Carbonic oxide	0.11
Nitrogen	5.06
Oxygen	0.75

This gas is stated to have an illuminating power of fully 56 candles, and to lose little either by standing or by carriage to considerable distances.

As such petroleum gas has about 3.5 times the illuminating power of 16-candle coal-gas, it follows that, so far as illuminating purposes are concerned, the gas producible from one gallon of oil by this process is equal to some 525 cubic feet of coal-gas of 16-candle value. I shall later on refer to the heating value of this petroleum gas, but I have now justified the statement with which this section commenced, viz., that petroleum is virtually liquefied gas in a peculiarly portable condition. Hence in all states petroleum can be used as an illuminant as well as a fuel, whereas coal and peat can only be used as illuminants in so far as they can afford carburetted gas.

Let me now proceed to justify the further statement that petroleum is the most concentrated and on the whole the most portable of all the natural fuels met with in considerable quantities.

Weight for weight the efficiency of liquid petroleum in steam-raising is much greater than that of coal. The estimates of relative value necessarily vary with different portions of the crude material used, and with the quality of coal employed in the comparative trials; hence some of the statements of results are often rather vague. Thus M. d'Allest found that one pound of refined petroleum evaporated 12.02 pounds of water, while only 6.5 pounds were evaporated per pound of a rather poor steam coal. The American results with crude petroleum and Pittsburg coal gave respectively 15 and 7.2 pounds of water per pound of fuel. Professor Unwin has recently compared petroleum with Welsh coal in steam-raising, the oil being injected by a steam jet through a highly heated coil and then burned perfectly with a clear flame. In his trials with a not particularly efficient boiler he found that 12.16 pounds of water were evaporated per pound of petroleum, and this result he considers about 25 per cent. better than that afforded by the steam coal. These results agree with those of M. d'Allest so far as the effect of petroleum is concerned, but the coals compared were different in value for steam-raising. Hence for an average coal the proportion is nearly three to two; in other words the practical heating effect of one ton of coal can be obtained by the combustion of only two-thirds of a ton of petroleum, while the comparison with the heavy oils would probably be still more in favour of liquid fuel. Petroleum has another advantage over coal in the matter of storage room, as one ton of the liquid occupies only four-fifths of the space of the same weight of coal, so that the bulk of the petroleum required to perform the same work in heating as one ton of average coal is little more than half that of the latter. It follows that a steamer constructed to carry 1,000 tons of coal could, if provided with suitable tanks, carry 1,200 tons of petroleum equal in fuel value to about 1,900 tons of coal. In addition, the liquidity of petroleum permits it to be pumped and conveyed long distances by gravitation in tubes so that its transport in bulk and in detail is easy. Therefore petroleum is not only a much more concentrated fuel than coal, but it is eminently portable as well and convertible with much greater facility into permanent gas. Against these advantages must, however, be set the inflammability of petroleum, and consequent greater risk of fire.

Now we have to consider the question of relative cost of petroleum used as fuel in liquid or gaseous forms compared with coal—the latter being our standard for reference as in the case of peat. We have already seen that about two-thirds of a ton of petroleum can do the same amount of work in heating as one ton of coal; therefore petroleum when burned directly cannot economically replace coal unless two-thirds of a ton of the liquid can be purchased for less than the cost of one ton of coal. We know the cost of ordinary lamp petroleum in these islands is at present far beyond that limiting value; even the heavy oils which are not good enough for lamps, and yet are too "thin" for lubricants, only compare favourably with coal where the latter has to be carried long distances, and is therefore dear. However, all practical difficulties having been overcome in the use of these heavy oils for steam-raising, a comparatively small advance in the general price of coal would at once render them economical for industrial use as fuel.

But when we compare petroleum gas with ordinary coal-gas the comparison is much more favourable to the liquid fuel; unlike coal, petroleum is already more than half-way on the road to conversion into gas. As you know, one ton of coal affords about 9,500 cubic feet of 16-candle gas. On the other hand one ton of oil of sp. gr. 0.85 can afford about 24,000 cubic feet of gas, having an average illuminating power of 60 candles, or the equivalent of about 70,000 cubic feet of 16-candle value, and this rich gas admits of preparation on the small scale suited to country places, while the retorts used in the production of the gas can be heated by petroleum. The petroleum gas of some 60-candle power is said to be producible at about 6s. per 1,000 cubic feet. If we were to assume that the calorific value of the gas is directly proportional to its illuminating power, the cost would correspond to about 1s. 7d. per 1,000 cubic feet of 16-candle coal-gas. But the facts do not justify the assumption, as the calorific value of methane is known to

be greater than that of the heavier carbides to which the high illuminating power is due; hence the comparison is probably less favourable to petroleum gas by about 25 per cent., though further experimental evidence is wanting on this point. However, even after this deduction, petroleum gas is the cheaper fuel as well as illuminant.

The necessary links between the elements of the trilogy on coal, peat, and petroleum are now, I think, sufficiently evident. If we desire to use each fuel in such a way as to develop most economically and conveniently its store of heat-energy, we must first partially or perfectly gasify it. The newest member of the triad—petroleum—is the one which lends itself most easily and completely to such treatment, in consequence of its physical condition and chemical characters. It is also the material that we must expect to facilitate the production of cheap gaseous fuels from coal and peat which shall at the same time possess sufficient illuminating power for most purposes. Chemical industries would probably benefit to a greater extent than others by the supply of cheap fuel of the kind in question; hence I have ventured to tax your patience by dwelling on this topic in your presence to day.

SIR JOHN EVANS moved a vote of thanks to the President, and in doing so said that it was a very satisfactory thing to preside over such a Society, numbering as it did some 2,800 members engaged in every variety of industry in which chemistry played a part. To find a subject which would be interesting to all was no easy matter, and they might congratulate their President and themselves that in selecting fuel he had dealt with a matter that affected all both in comfort and purse. The subject of the address was one of such supreme importance that he wondered it had not received more attention from manufacturers. If England was to continue to be the most successful manufacturing nation, something must be done to secure further economies in the production of steam power, and they had in the able address to which they had just listened many hints to assist them in attaining that object. It was satisfactory to find that in that sister country which he trusted would long be united to Great Britain there were such valuable stores of fuel which eventually could be brought into use. It was only, however, by unceasing study that they could hope to find means for rendering available those latent powers for heat and light with which peat was endowed. The third member of the President's "trilogy" was a growth of quite recent times, and they could only hope that the child which had risen with such surprising rapidity would not dwindle away and perish; that the sources of petroleum would prove to be as inexhaustible as they were mysterious. It was in the highest degree probable that the advances in the use of petroleum which had been made during the last 20 years would continue to even a greater degree during the next 20, and result in still greater economies in its production. He had listened to the address with great pleasure, and felt that the members owed the President their best thanks for the admirable way in which he had compiled and delivered it.

MR. W. THORP, in seconding the motion, said that when the minds of men were so exercised with the "Irish Question" it was a great source of relief to feel that in their Society they had no "Irish Question." Their relations with their Irish brethren were thoroughly harmonious; their President was an Irishman, and no one had been more heartily welcomed than he.

SIR JOHN EVANS then put the vote to the meeting, and it was carried with great enthusiasm.

The President having briefly returned thanks—

MR. R. MORRIS proposed that Messrs. Theobald Brothers and Miall be re-elected auditors for the ensuing year at a remuneration of ten guineas.

MR. DAVID HOWARD seconded the motion as one who knew the admirable way in which those gentlemen did their work.

The motion was then put, and was carried unanimously.

MR. A. G. BLOXAM then read the report of the scrutators, from which it appeared that 105 voting papers had been

examined, one of which was spoilt, and that the result of the voting was the election of Messrs. R. Forbes Carpenter, C. C. Hutchinson, John Pattinson, A. G. Salamon, E. C. C. Stanford, and Thos. Tyrer as ordinary members of Council, and the confirmation of the nominations of the Council to the offices of president, vice-president, &c.

The following is therefore the composition of the Council for 1892—93:—

President.

Sir John Evans, K.C.B., F.R.S., &c.

Vice-Presidents.

Sir Lowthian Bell, Bart., F.R.S.	Prof. J. Emerson Reynolds
Wm. Crowder.	M.D., D.Sc., F.R.S.
David Howard,	Jno. Spiller.
Dr. F. Hunter.	J. C. Stevenson, M.P.
B. E. R. Nowlands.	Prof. T. E. Thorpe, F.R.S.
Dr. W. H. Perkin, F.R.S.	Sir John Turney.

Ordinary Members of Council.

A. H. Allen.	Prof. R. Meldola, F.R.S.
Arthur Boake.	John Pattinson.
R. Forbes Carpenter.	Boverton Redwood.
Dr. Charles Dreyfus.	A. Gordon Salamon.
H. Grimshaw.	E. C. C. Stanford.
C. C. Hutchinson.	Thos. Tyrer.

Honorary Treasurer.

L. Rider Cook.

Hon. Foreign Secretary.

Ludwig Mond, F.R.S.

MR. LUDWIG MOND proposed the re-appointment of Mr. Rider Cook as the representative of the Society on the Board of the Imperial Institute. In doing so he said that Mr. Cook had so discharged the functions of the position during the past year that he was sure they could not have a more fitting representative.

MR. L. ARCHBUTT seconded the motion, which was then put and carried unanimously.

MR. HENRY BRUNNER, as chairman of the Liverpool Section, had much pleasure in inviting the Society to hold the next annual general meeting in that city. It was seven years since the Society had been to Liverpool, and though they might not be able to show the members anything very new in the shape of chemical manufactures, they would do their best to make the visit a pleasant if not a very instructive one.

MR. BOVERTON REDWOOD, in proposing that the next annual meeting of the Society should be held in Liverpool, said that there could not be a doubt as to the cordiality of the reception they would meet with there; and there were so many obvious material advantages attaching to Liverpool as a place of meeting that it was unnecessary for him to say anything in support of the motion.

Professor MELIOLA seconded the motion.

After a few words from the President, the motion that the invitation of the Liverpool Section to hold the annual meeting of 1893 in that city was put and carried unanimously.

The President then said that but one duty remained for him to perform before leaving the chair, to propose that the hearty thanks of the Society be given to the Drapers' Company for so kindly permitting the use of their magnificent halls for the meeting that day. It was very satisfactory, when one heard so much said against some of the great city companies, to be able to turn to records of good and useful work achieved by others; and the great Company who were their host that day had been one of the most prominent in the movement for aiding technical education. He therefore had much pleasure in proposing that the Council be requested to convey to the Drapers' Company the hearty thanks of the Society for the hospitality extended to its members that day.

MR. RIDER COOK, in seconding the motion, said that in his opinion there was a peculiar fitness in the Society meeting in the hall of one of the city guilds. They did

not profess to be a scientific society in the pure sense of the term, most of them were manufacturers who availed themselves of the help of science in their operations. The city companies were beginning to realise that as they bore the names of the great trading interests of the country with which they were once intimately associated, it was their duty to justify their existence by practically interesting themselves in the great industries they represented. He was glad to say that the Drapers' Company had given ample proof that they appreciated this position; and the way they had received the Society that day showed, he thought, that they were willing as representatives of commerce to shake hands with and encourage those who were seeking to ally science more and more closely with the trade and commerce of the country.

The vote was then put by the President and was carried by acclamation.

RECEPTION AND SMOKING CONCERT.

At 8.20 about 100 members and friends were received by the President in the galleries of the Royal Institute of Painters in Water Colours. The President was supported by Sir John Evans, K.C.B., F.R.S., Sir F. A. Abel, K.C.B., F.R.S., Mr. L. Mond, F.R.S., Mr. E. Rider Cook, Mr. E. K. Muspratt, Colonel Gamble, Professors Campbell Brown, Clowes, W. Foster, Henderson, and Ramsay, with several members of Council.

From 9 p.m. to 11.30 p.m. a capital selection of vocal and instrumental music was performed under the direction of Mr. J. C. Butterfield, F.L.C., F.C.S.

The following programme was provided:—

Glee.....	"STRIKE THE LARK".....	Cooke.
	Messrs. Barnby, Bryant, Campbell, and Butterfield.	
Song.....	"NAYMPS AND SHEPHERDS".....	H. Parrell.
	Miss Ethel Winn.	
Solo (Violin).....	1 st "ROMANCE".....	Festfeld.
	2 ^d "CAPRICE".....	Behan.
	Mr. Percy Ould.	
Song.....	"THE FLIGHT OF AGES".....	F. Boran.
	Miss Emily Hinning.	
Song.....	"AN EVENING SONG".....	Blumenthal.
	Mr. Edwin Bryant.	
Duet.....	"THE SAILOR SINGS".....	M. W. Balfie.
	Miss Emily Hinning and Mr. Kirkley Campbell.	
Trio (Violin, Cello, ? and Pianoforte).....	"NOVEMBER".....	Nicks Gade.
	Messrs. Ould, C. Zimmermann, and Miss Adelaide Thomas.	
Song.....	"THE TWO GREENADERS".....	Schumann.
	Mr. J. C. Butterfield.	
Part Song.....	"THE HAPPIEST LAND".....	Hatton.
	Messrs. Barnby, Bryant, Campbell, and Butterfield.	
Humorous Song.....	"THE LAY OF THE VERY LAST MISSTREL".....	
	Mr. Lovett King.	
Quartettes.....	{ "SUMMER EVE" } { "ABSENCE" }.....	Hatton.
	Messrs. Barnby, Bryant, Campbell, and Butterfield.	
Duet.....	"O THAT WE TWO WERE MARRYING".....	A. M. Smith.
	Miss Emily Hinning and Mr. J. C. Butterfield.	
Song.....	"WHEN LOVE IS KIND".....	Moore.
	Miss Ethel Winn.	
Solo (Pianoforte).....	"RHAPSODIE HONGROISE" (No. 8).....	Liszt.
	Miss Adelaide Thomas.	
Song.....	"THE LAST DREAM".....	F. H. Cowen.
	Miss Emily Hinning.	
Song.....	"ANNABELLE LEE".....	H. L. Shie.
	Mr. Kirkley Campbell.	
Solo (Violoncello).....	"GAGLE CAMOU".....	Beaumont.
	Mr. Charles Zimmermann.	
Quartettes.....	1 st "INTEGER VITE".....	Flamming.
	2 ^d "LOVELY NIGHT".....	Chavalot.
Song.....	"SUNSHINE AND RAIN".....	Blumenthal.
	Mr. J. C. Butterfield.	
Humorous Song.....	"THE POLKA AND THE CHOR BOY".....	
	Mr. Lovett King.	

SECOND DAY.—THURSDAY, JULY 21ST.

THE VISITS TO WORKS ON THE THAMES.

The members of the Society were conveyed by the steamer "Mermaid" from Charing Cross Pier, in two parties, one specially, so as to see other works, and the second party to visit, first—

1. THE DEPTFORD STATION OF THE LONDON ELECTRIC SUPPLY CORPORATION.

The visitors were conducted round the works or station by Professor Fleming, F.R.S., the consulting electrician, who explained all the details of the apparatus and process.

This great electric lighting station was designed by Mr. Ferranti with the object of supplying a large area of the Metropolis with alternating electric currents from a station situated considerably outside the limits of the area to be served. A site was selected by the Corporation on the banks of the Thames, not very far distant from Greenwich Hospital, and here the station buildings were erected. The building is a brick and stone structure, about 210 ft. long by 195 ft. in breadth. The engine and dynamo room is divided into two bays, separated by a row of cast-iron columns. A longitudinal girder is carried down both sides of each bay on the tops of these columns as well as on the wall buttresses, and supports the two large overhead travelling cranes, each capable of lifting 50 tons. The roof, an iron and glass structure, is 100 ft. from the floor. The boiler-room is designed to contain two tiers of Babcock and Wilcox water-tube boilers. Of these the 24 boilers forming the lower tier are already in place. At each end of the boiler-room rises a smoke-stack, divided into four separate shafts by partitions, and each batch of six boilers sends its furnace gases into one quarter of the chimney. The height of the shaft is 150 ft. The feed-water supply is taken from a large tank capable of holding 800,000 gallons of water. The boilers are each nominally of 500 horse-power, and are arranged in four batches of six each. Beneath the boilers is placed a forced draught engine to facilitate steam-generation during sudden loads. A noteworthy feature of the steam supply system is the multiple steam-pipe, employed to obviate the risks incurred by the use of single steam-piping of large diameter. Mr. Ferranti invented this new safety steam-piping, and it consists of a large pipe formed of a bunch of smaller solid-drawn copper tubes.

At Deptford one multiple Ferranti pipe delivers steam to a pair of 700 horse-power engines 130 ft. away from the boilers, with a loss of not more than 5 per cent. of pressure. All the steam-piping at the Deptford station is erected on this system.

The steam-generating plant delivers steam to four engines, two of 1,500 horse-power and two of 700 horse-power. They are all compound Corliss engines. The fly-wheel of the two smaller engines is 24 ft. in diameter and weighs 35 tons. It drives its associated dynamo by 17 ropes running in grooves in the fly-wheel edge. The smaller engines are horizontal ones, the larger ones, vertical engines, having a fly-wheel 22 ft. in diameter and weighing 60 tons. The driving-power is transmitted to the dynamo by 40 five-inch ropes, running in grooves in the periphery of the fly-wheel. The two 700 horse-power engines drive each a 625 horse-power alternating-current dynamo, which generates current at 2,400 volts, and this pressure is raised to 10,000 volts by means of step-up transformers. The fields are excited by means of a Siemens direct-current dynamo, driven by rope gearing from the dynamo-shaft. These exciters furnish current at 100 volts up to 98 or 100 amperes, the maximum exciting current required. The speed of the armature is 250 revolutions per minute. The two larger dynamos are each of 1,250 horse-power, and generate current directly at 10,000 volts. In these machines an enormous grooved pulley is the most striking feature. The armature is about 13 ft. in diameter. The exciting current is about 400 amperes at 50 volts. These armatures are driven at 208 revolutions a minute, and can furnish a maximum current of 100 amperes at 10,000 volts, or sufficient to maintain 30,000 30-Watt lamps. The current is led out of one side of the armature by a copper rod insulated in the interior of

the armature shafts by an ebonite tube. The other end of the armature is in conducting connexion with the frame of the machine. One pole of the machine is thus always "to earth" and the other pole, or "live pole," is insulated and sends current through the collector rings to the mains. These mains run to the four distributing stations in London, viz., Grosvenor, Trafalgar, Blackfriars, and Pimlico stations. The approximate length of each main is six miles. The object of the "earthing" system above referred to, is to prevent any sudden alteration of pressure on the inner or live side of the main. If a dynamo has both poles insulated, then assuming it to be giving a mean potential difference of 10,000 volts, each pole is alternately 5,000 volts above and 5,000 volts below the earth, in potential. If by any means one pole of the dynamo is put to earth, the potential change of the other pole will be altered, and will change from 10,000 volts above to 10,000 volts below the earth. Sudden variations of pressure might thus take place over great ranges due to accidental earthing of one side. This is avoided by leaving one side permanently earthed.

In the sub-stations are placed sets of the 150 horse-power transformers, which can be connected as desired on the high-tension side to one or other of the trunk mains which enter the station. In these transformer chambers measuring instruments show the current and pressure on each side of the transformers. The sub-stations are fireproof chambers, having channels in the floor to receive the incoming and outgoing cables. The necessary switch gear is erected against the walls and in the centre of the room.

To Professor Fleming indebtedness is due for the information upon which the foregoing description is framed.

2. THE WORKS OF THE LINDÉ BRITISH REFRIGERATING CO., LIMITED.

The visitors, in alternate parties, according to arrangement, were shown over the works of this company at Shadwell, by the managing director, Mr. T. B. Lightfoot, C.E., who, with his representatives, courteously explained to them the Lindé refrigerating process and its operation, as illustrating a problem of chemical physics on a large scale successfully solved in the interests of trade industry.

The Lindé ice-making plant consists of three parts, viz., the compressor, the condenser, and the ice generator, with which is combined the refrigerator. The ammonia compressor is a double-acting pump, an important feature of which is the stuffing-box, which is specially constructed so as to prevent the escape of the ammonia vapour. In the stuffing-box there are two systems of packing with a space between them, and a small pump continually forces a thin stream of oil over the piston-rod, which is thereby kept perfectly as well as continuously lubricated. Thus, leakage of ammonia is almost entirely avoided, and the value of that which is lost is inappreciably small. To prevent any of the sealing-liquid entering the condenser or refrigerator coils, and so reducing their efficiency, a collecting vessel is inserted in the delivery pipe from the compressor. The liquid here collected is taken to a small rectifying apparatus, in which the absorbed ammonia is separated from the oil, and condensed into the suction pipe, whilst the rectified oil is again used in the stuffing-box. Chemists like the use of reliable colour indicators of the completion, or even condition at certain states of a chemical reaction, and in the present case of a physical process, a useful indicator is found in the white coating of frost covering the suction pipes. These suction pipes must always thus be covered, and so be white, for correct working, whilst the delivery pipes must be just hand-warm, these indicated criteria testifying to proper economy in working the machinery.

The ammonia condenser consists of a number of wrought-iron tubes, each welded into one single length. These tubes are usually formed into helical coils of varying sizes, placed one within the other in a cylindrical water-tank. The compressed ammonia vapour enters these coils at the top, and is condensed by the cooling action caused by the circulation of cold water in the tank.

The liquid ammonia is then led back to the refrigerator through a regulating valve.

The ice generator adopted by the Lindé Company consists of a wrought-iron rectangular tank filled with brine and containing in its lower part the refrigerating coils, the ice moulds being suspended in the brine. These moulds are placed in suspended frames running on wheels upon horizontal rails, and the frame-systems can be moved forwards or backwards by suitable gearing. Moved forwards, the moulds in their frames, arranged in parallel lines (one frame of moulds succeeding another)—approach that end of the tank at which the completely frozen moulds are taken out, thus leaving a space at the opposite end of the tank where the returned and empty moulds are re-charged with the water to be frozen, and can then re-enter the refrigerating bath. The process is thus continuous, and as regards the apparatus, circulatory. When one row of moulds has reached the end of the tank and is frozen up, it (the frame) is lifted from the tank by means of a travelling crane and is for a brief period lowered into a long narrow tank of warm water. Here the ice becomes detached from the moulds, and on raising these in their frame and tilting the latter, the blocks of ice slide out upon a wooden platform. Only one workman is required for the whole of the water-charging and freezing operations.

Ice produced from water without special precautions is opaque more or less. To produce clear or "crystal" ice, the water used must either be agitated during the freezing process to expell air, or distilled water must be employed. The latter is furnished at the Lindé Company's works in the boiler house, where an apparatus is at work for utilising the exhaust steam from the engines, after being condensed and filtered. The condenser is of the surface type. In full work about 60 tons of condensed water are produced per 24 hours.

The blocks of ice as furnished by the moulds weigh about 2 cwt. each for the larger set of moulds, and 1 cwt. each for the smaller. The opaque ice in large blocks is chiefly crushed, and in this condition the company sometimes supplies to fishing-boats alone as much as 75 tons of crushed ice per day.

The capacity of the plant is about 150 tons of ice in 24 hours, the equivalent of some 20 tons of which is used for cooling air for cold storage.

3. THE UNION OIL AND OIL-CAKE MILLS, LIMITED.

After inspecting the Deptford Electric Station and the Lindé Ice Company's works, Shadwell, the visitors proceeded to the Globe Pier for the Union Oil and Cake Mills, Limited, at Rotherhithe, where they were met by the director, Mr. Alan Lambert, who with his manager and others, showed them the plant and processes. These processes excited a great deal of attention and interest, and a proportionately large share of gratitude is due to Mr. Lambert and his company for throwing open their doors so unreservedly to the visitors.

The factory has been established for over 30 years, and is now capable of dealing with from six to seven hundred tons of seed per week. The processes include linseed and cotton-seed crushing, oil-boiling and refining. The cotton seed is imported from Egypt. The seed warehouses front the River Thames, so that the seed is landed direct from the barges, and then distributed by hoists and elevators to the several floors. In the warehouse there is storage room for 1,500 to 2,000 tons of seed. The raw seed is first passed through a set of chilled iron rollers, where it is thoroughly broken up. It is then "picked up" by elevators and passed into a kettle sufficiently heated to allow of the oil being freely expressed in a subsequent operation. The requisite quantity of meal to form a cake is drawn from the kettle into a mould, from which it is immediately passed into the hydraulic presses. The greater part of the oil is thus expressed, leaving however a sufficient residue in the meal to form a cake of the desired composition. The sufficiently pressed cakes are now removed, and after having their rough edges taken off by a kind of shearing apparatus, they are placed in racks to cool, and are then ready for the market.

Linseed Cake, as is well known, is the most valuable artificial food for cattle.

Cotton-seed Cake is coming into increasing favour for sheep and dairy farmers. These two articles further possess a very high manurial value, a point often overlooked in estimating their value.

The oils, flowing from the presses, are pumped into large tanks, of which there is a storage capacity for 500 tons.

Very different proportions of oil are obtained from the two materials linseed and cotton seed, linseed furnishing under the treatment sketched upwards of 40 per cent. of oil, whilst cotton seed yields not more than from 24 to 25 per cent. It may also be mentioned that besides the lesser yield of oil from cotton seed, the trouble of difficult and imperfect or rather wasteful decortication, and especially that of the colouring matter and tannin present, are a constant source of worry to the cotton-oil extractor. The tannin is doubtless derived from the shells, and oil containing much of it, when stored in iron vessels, or otherwise brought in contact with iron, is liable to turn a dark purple colour (see this Journal, 1885, 719-721).

Boiled Oil.—The capacity of the plant for this product is equal to an output of 100 to 120 tons per week. The process is one of oxidation, for which each manufacturer has his own particular method, the chemical agents known as "*driers*" being introduced, whilst the oil is meanwhile raised to a high temperature.

Refined Cotton Oil.—The plant here is capable of turning out 150 to 200 tons per week. The refining process involves, broadly stated, the breaking up and removal of the colouring matter contained in the crude oil, by means of a treatment with alkali, followed by a settling process (see this Journal, 1892, 619).

The crude oil, which is very dark owing to its containing colouring and mucilaginous matters derived from the seed, is filtered through rough filters made up of layers of sawdust, cotton waste, and sacking, and transferred to vats in which it is raised to a temperature of 100° F. An aqueous solution of caustic soda, of a strength of 16° B., is prepared, and some 4 or 5 per cent. of it allowed to come in contact with the oil by distribution through a sprinkler consisting of a pipe bent into the form of a circle and disposed a few inches above the surface of the oil. While the addition of the alkali is being made the oil is agitated by means of a current of air, and full admixture is thus obtained. The colouring matter and other impurities are soluble in caustic lye under these conditions. It is owing to the treatment with caustic soda that cotton-seed oil is, if freshly refined, almost entirely free from fatty acid, whereas other oils—like rape, for example—which are refined by treatment with sulphuric acid, invariably contain it in greater or less amount. There is no real reason, other than the slight extra expense due in the first case to the cost of alkali, and in the second to the additional shrinkage that the oil would undergo, why rape oil, whose freedom from free fatty acid is important in regard to its use in railway lamps, should not be washed with caustic alkali after the regular refining process has been completed. It is also evident that a considerable economy might be effected by substituting soda ash for caustic soda whenever possible; it seems reasonable to suppose that it would be equally effective in removing free fatty acid, and it would not tend to cause the partial saponification of the neutral oil itself. The question of residuals in oil refining is of importance, because when a refiner has to sell a residue from the refining process, it is seldom that he can obtain the market value calculated on the content of oily matter that it possesses.

Erith was reached about 1.30 p.m., and here a sumptuous lunch was given by Chas. Beadle, Esq., at the wharf. A vote of thanks for this generous hospitality was unanimously accorded to Mr. Beadle. Mr. Tyrer then moved, and the President warmly supported, a vote of thanks to the General Secretary, Mr. Creswell, for his services in connection with the meeting. One party then proceeded to the works of Messrs. Easton and Anderson, and the other to the extensive works of—

4. THE MAXIM-NORDENFELDT GUN AND AMMUNITION COMPANY, LIMITED.

By the courtesy of the managing director, Captain H. D. Acland, the members of the Society were enabled to inspect the processes carried out in this remarkable factory, under the guidance of the obliging superintendent, Mr. J. W. Wainwright. But their very special thanks are also due to Mr. Hiram Maxim, who kindly explained his remarkable inventions to the visitors and exhibited specimens of them.

The buildings of the factory enclose an enormous space, the main machinery block, measuring 100 ft. by 250 ft. It is divided into 14 bays of about 25 ft. span each, and in this huge shop there are more than 700 machines of the most modern pattern. The factory is divided into departments for gun building, shell, carriage, gun-fitting, sighting, Nordenfolt machine guns and Maxim apparatus, the latter being chiefly devoted to the Maxim guns. Outside the shops is a furnace 50 ft. high, in which guns are oil-tempered and hardened. Elsewhere are separate departments for the manufacture of shells and fuses of all kinds, and for the browning and annealing of shells, as also for the browning and plating of the guns and their fittings. The steel that is used at Erith has a breaking strain of 46 tons per square inch, with an elongation varying between 17 and 25 per cent. in a length of 2 in. It is interesting to note how much of the work is done from the solid. There is a collection to be seen of all the forms of Maxim guns from the first to the latest and most improved, an interesting object-lesson or study of one department of evolution. Conspicuous among the objects displayed in the gun department are arms of the larger calibres, fitted with the helioidal breech mechanism lately introduced, and lending itself to a greater rapidity of fire than is possible with the old method. In the matter of functional capacity, the shops can turn out 600 6-pounder Nordenfeldt guns per annum, besides a number ranging up to 6-in. calibre, or from 700 to 1,000 Maxim guns of the English small-bore or Martini-Henry rifle calibre. Shells can be supplied at the rate of 4,000 per week, and fuses to the extent of half a million per annum.

The Maxim gun tested by Government in 1887 was only stipulated to fulfil the conditions that it was not to exceed 160 lb. in weight, was to fire 400 rounds in one minute, 600 in two, and 1,000 in four minutes. However, in a final test, one of the guns tested fired off a maximum of 1,000 rounds in one minute and a half! To prevent overheating of the weapon by such rapid firing, the barrel of the gun is enclosed in a water-jacket. Even then it is found that, after 600 consecutive rounds, the water begins to boil. This water is in actual contact with the barrel for about two-thirds of its length, and is automatically admitted from a small cistern, into the barrel-casing, by the recoil of the barrel, escaping eventually as steam at the end of the tube near the muzzle of the gun. The gun has a single barrel arranged in such wise, that the slight recoil in its bearings on firing acts on the feeding and firing gear, so as to load and discharge the next round. Whilst the supply of cartridges lasts therefore, the gun will fire round after round. Simply by the force of the recoil the empty case is extracted and ejected, the next round brought into position, pushed home, and the gun cocked and then fired as the striker is liberated. This automatic action renders it only necessary to hold back the trigger, to continue the firing until all the cartridges in the belt are exhausted. Thus the single man in charge of the weapon can devote his whole attention to aiming. A further point of the Maxim system is the fact that the gun ceases to fire in the event of a miss-fire. Jamming is thus avoidable. The mechanism finally can with ease be taken out, cleaned, and oiled by hand without instruments. If necessary to abandon the gun, it is also possible to remove the breech-block containing nearly the whole of its mechanism, and carry it away off the field. The function of the 6-pounder Nordenfeldt quick-firing gun is to pierce the unarmoured batteries or ends of vessels and even to penetrate light armour plating.

It must be added that Mr. Maxim explained to the visitors the mechanism of his remarkable guns, and himself illustrated its perfections, by firing a great many rounds of blank

cartridge in an incredibly short space of time. In answer to a question by a visitor, Mr. Maxim said he knew no substance that could withstand the continued impact of even a small lump of grease, fired from one of his guns. He had thus penetrated a plate of steel, and even one of platinum.

The historic collection of guns illustrating the different stages in the development of the complete invention of the Maxim gun as it now is, was also explained in an interesting and racy manner by the distinguished inventor, and he also referred to the event which first suggested to his mind the idea of utilising the recoil of a gun through the reaction of a spring for discharging spent cartridge and recharging the weapon. This was during the late American war, when after repeatedly firing a musket he found his shoulder black and blue. He mentioned the idea of utilising the recoil to his father, who discouraged it, but Maxim persevered, with the results so well illustrated on this present occasion.

Captain H. D. Acland furnished the following particulars as to the fulminates and explosive agents used for fuses, shells, &c., in the Maxim-Nordenfolt factory.

We are passing through a stage of transition, leaving mechanically mixed and old-fashioned powders behind us, and adopting chemical products which do the work required with more certainty, economy, and efficiency. This change will without doubt alter considerably the whole science of artillery, and lead to corresponding and mechanical changes in the guns themselves. The fulminates used for fuses consist of a mixture of fulminate of mercury, chlorate of potash, and sulphide of antimony in proportions determined by a series of experiments according to the sensitiveness required. Further experiments have then to be made to determine the pressure to be applied to the compound to form it into a cap of the necessary density without sacrificing its sensitiveness.

The fuses are manufactured to $\frac{1}{1000}$ th of an inch with regard to their mechanical parts, are put together without safety-pins or any other external protection against accident, are absolutely safe to handle, and undergo all the rough treatment in the services, and yet when fired are so sensitive that the impact of a $\frac{1}{16}$ in. metal plate will not fail to set them in action and burst the shell.

The following powders are those we chiefly use:—

For shells, the strongest and best class of fine-grain powders, and for guns through the whole range of R. L. G. and quick-firing or Q. F. powders, until we come to the moulded or prismatic black and brown powders, whilst in smokeless powders, after many trials, we find that *Ballistite*, manufactured under Nobel's patents, of different sizes of grain and of different forms, has given by far the most satisfactory results.

5. MESSRS. EASTON AND ANDERSON'S ENGINEERING WORKS.

Besides possessing a most extensive ironworks, machine, and gun factory at Erith, this firm has a process and apparatus for the purification of water, in which the scrap, finely divided, or spongy iron may be usefully employed. W. Anderson (Eng. Pat. 7665, May 13, 1884; this Journal, 1884, 529) patented this process in 1884. The water supply of Antwerp is purified by it. The passage of the water through the cistern or apparatus containing the finely divided iron is continuous, and the means adopted for ensuring the cleanliness of the metallic particles makes it unnecessary to prolong the period of contact. Thus, the maximum effect of purification on Antwerp water is produced in 3.5 minutes. The quantity of iron going into solution amounts to 0.1 grain per gallon. More iron is taken up by longer contact, but the purification is not materially increased.

G. H. Ogston shows that the albuminoid ammonia in waters is thus reduced to from one-half to one-third of the amount originally present, and the nitrogenous matter remaining behind entirely resists the further action of the iron. Ogston has also shown that water so purified is practically sterilised. As to the apparatus, a wrought-iron

revolving cylinder is used, and means of agitating or stirring up the particles of metal are adopted, so that this metal may continually, or frequently, suffer abrasion and so surface cleansing. Operating with 15,000,000 gallons of water per diem, the cost per million gallons is 9s. 9d.; also about 28 lb. of iron are used per million gallons of water purified. For fuller details and illustrations see this Journal, 1885, 544—545. The visitors had now the advantage of a personal inspection of the apparatus needed for this process, as well as that of seeing an engineering works of such vast extent, and possessing so many interesting examples of hydraulic machinery, for which the firm is famous. In the foundries, provision was made for running a special casting whilst the visitors were present.

THE DINNER.

At 6.30 about 110 members and their friends left the "Mermaid," and adjourned to the "Ship" at Greenwich for the annual dinner.

The President, Professor J. Emerson Reynolds, F.R.S., occupied the Chair.

In proposing the first toast, "The Queen and the Royal Family," the President said that Her Majesty had in the year gone by passed through one of the many sad experiences of her somewhat chequered life. He was sure that all present sympathised with her in that most recent sorrow that had cast a shadow on her later days, and would delight in an opportunity of showing once more their loyalty to her by expressing their wishes for her continued health and happiness.

The toast having been loyally honoured,—

Mr. RUDOLPH COOK proposed "The Society of Chemical Industry." In doing so he explained that he was taking the part assigned to Sir Frederick Abel, who had telegraphed that he was unable to attend in consequence of an attack of neuralgia. He regretted Sir Frederick's absence on account both of its cause and its effect, it being difficult to supply the place of so accomplished an after-dinner speaker. However, he accepted the responsibility which had been cast upon him, partly because it would ill become him to refuse any service which he could render to the Society, and partly because the toast entrusted to him was one which he could propose from the bottom of his heart. The Society had now existed for eleven years, and had made a distinct mark for the better upon the industry of the country. The influence of its Journal alone had effected a vast amount of good; but he believed that the past record of the Society was small as compared with what its future would be, if those who were present not only drank to the toast, but tried to work for the Society each in his own way. They had already nearly 3,000 members, and there was no reason why that number should not soon be doubled. Large numbers of the manufacturers of this country were still jogging along in the old-fashioned rule-of-thumb way, and had not thought of calling to their aid all the resources of chemistry and science. In proof of that he would mention that only last autumn, while travelling, he happened upon a porcelain factory of an interesting character, and sought permission to see over it. Holding the position he did, he ventured to ask that he might be shown over by the chemist of the establishment. To his astonishment he was told that they had "not got a chemist." The manager explained that the reputation of the factory was so good that they did not need such an assistant. In the course of the inspection, he showed among other specimens kept in what was known as the "museum," a certain pot which he said they had endeavoured to manufacture to meet German competition, which specimen, however, was the only one they had ever succeeded in getting of the exact colour required. This gave him the opportunity of retorting "My friend, you have advanced exactly the argument that I should have wished to use to you in advising you to at once start a laboratory and become a member of the Society of Chemical Industry. There is no such thing as chance in dealing with substances and forces; and if you had had a chemist here he would in all probability have seized upon the conditions which gave the colour you wanted in that instance, and would have been able to reproduce it." While

that sort of thing went on there was not only room for the Society to exist but to expand; and if England was to hold its own as a manufacturing country they must take care that every manufacturer to whom chemical knowledge would be of service was induced to open a laboratory and bring science instead of rule of thumb to bear upon his work. Having said that there was room for the Society to expand, he would take this opportunity of urging that the time had come when they ought to have a house of their own. He would like to see the money they had saved, aided by some generous subscriptions, devoted to that purpose, and in that house he would like to see a room in which could be exhibited diagrams, plans, models, &c.; and in the house he would establish a registry office for the purpose of bringing chemists who wanted situations in connection with manufacturers who required chemists. Let them with their eleven years of success hold up their heads and go on. Let them get proper head-quarters, and make use of them not only as a laboratory registry office, but as a centre to which their country members could come and make themselves comfortable. He was happy in the toast entrusted to him, because he had to couple with it the name of the President. Those who had had the privilege of hearing the address he read yesterday, must have recognised the fact that the Society was happy in having for its President sometimes teachers and representatives of pure science and sometimes manufacturers who were conducting their business on scientific principles. In preparing that paper the President seemed to have been carried away from the laboratory and the lecture table and to speak from the point of view of a manufacturer and a member of the Society. The paper itself contained much that would set them all thinking; and it would be strange if it did not result in many of them taking out their old boilers and putting gasifiers in their places. He was glad to associate the name of Professor Emerson Reynolds with the toast. He was sure they would drink it with enthusiasm; but he hoped that they would not be content with that, but would go away determined each one to make the Society a greater one in the future than it was that day.

The President, in responding, after thanking Mr. Cook and the members present for the kind allusions to and cordial reception of himself, said that his chief duty was to acknowledge heartily the response given to the toast of the Society itself. The Society represented many great principles, one of the most important of which was the wholesome principle of decentralisation. They had a general body controlling the various Sections. Those Sections did their work well, and each contributed to the sum total of the effect produced by the Society as a whole. But while leaving each Section a certain amount of autonomy, they carried the principle of devolution a little further by placing in the hands of the Publication Committee the control over matter to appear in the Journal. His own experience had shown him that the members of that Committee did their duty in the most thorough way. But the principle of devolution was carried further still. They had admirable chairmen of Sections in the general work of government; they had excellent secretaries of Sections who combined in the work of government also. But while the principle of devolution acted splendidly in those directions, it, like many other good principles, broke down occasionally; and the particular way in which it seemed to him to break down was in the selection of the President—speaking from his own experience only—for he considered that it had broken down thoroughly in his own case. But while it might be possible for an individual President to fail, the Society itself never did so, but was always ready to come to his aid. Mr. Cook had given them from his own experience a remarkable instance of the importance of a knowledge of chemistry in connection with the porcelain manufacture, and that had brought to his mind a similar and equally striking illustration. He happened on one occasion to be in the company of an elderly gentleman who was concerned in working a porcelain manufactory. This gentleman, knowing that he had something to do with chemistry, began to talk in the usual way about his business. He (Prof. Reynolds) commented on the beauty of many of his friend's products and particularly on that of a special glaze. His friend remarked

that it had cost him a lot of money to produce it, and showed great astonishment when he (Prof. Reynolds) expressed his surprise that it should have done so, as he presumed that he had used a certain method which need not be an expensive one. His friend said in astonishment, "How do you know that? It has cost me 20,000*l.* to find out that secret!" To which of course he replied that he was sorry to hear it, as he might have got it from him or almost any chemist for 10*l.* In illustrating the same point with greater force, Mr. Rider Cook had thrown out a suggestion that seemed to him a very practical one, namely, the idea of extending the scope and usefulness of the Society. He hoped that that suggestion would be realised. He would not go further into the question then, but he might say that the enthusiasm with which they had received the suggestion gave him good reason to hope that Mr. Rider Cook's wishes would be carried out.

Col. GAMBLE, in proposing the next toast, "Trade and Commerce," said that he felt strongly that whoever undertook to speak upon a matter which so closely affected the hearths and homes of the members ought to be able to say something instructive upon the business of the country, and he regretted therefore that it had not been entrusted to a better qualified person. He could not say of himself, as it had been said of many, that when they got into the troubles of pounds, shillings and pence they lost their taste for scientific matters. He was as fond of chemistry as anybody, but he found it difficult now to learn what was new and to remember what he had learnt. He would not attempt to say anything that might be construed into advice as to what they should do in the future or comment upon what had been done during the last 12 months in their branch of the trade of the world. His first knowledge of chemical manufactures began 65 years ago. He did not pretend that his chemical education began then, but at that time he saw in his father's works the manufacture of sulphuric acid as carried on by boys with iron spoons and a mixture of nitrate of potash and sulphur. The product was used for converting sulphate of alumina into potash alum. That sulphuric acid was worth 1*s.* 6*d.* a pound in those days; he had known it since then to be worth a great deal less than one farthing. At that time, too, he had seen common salt which had cost more than 30*l.* a ton being weighed over by the excise-man as it was put into the bleaching-powder still, where it was mixed with manganese. The product of that decomposition was on the one hand converted into sulphate of soda, which, he was afraid, was sometimes sold as Epsom salts, and on the other hand into bleaching-powder of 21 per cent. of chlorine. This latter was produced by spreading powdered lime upon a wooden floor and inverting upon it a sheet-iron vessel of about 12 ft. square and 18 in. deep, so as to intermix the chlorine and the dust. He believed it answered very well for the bleaching-powder which was made in those days, but it would not do now that they had to make it of 36 per cent. strength. That bleaching-powder he had seen sold at 1*s.* 6*d.* a pound; but he was sorry to say that he had had to sell it at much below a penny per pound since. He was a child in those days and he was telling them what he saw, not what he did. He had, however, made and sold salt cake at 6*d.* per ton, and caustic soda at 20*l.* per ton, and also at something like 7*l.* He had passed through these vicissitudes, but to have done so implied that old age, which he must ask the members to take as an excuse for his having nothing more interesting and instructive to say. He was consoled to some extent by knowing that the gentleman who was to respond to the toast was free from such complaints as he suffered from; at any rate such illness as he might have experienced had not prevented him from keeping quite up to date in all matters relating to chemical manufactures. He was, in fact, an example of what a manufacturing chemist ought to be. He wished that the toast he had to give them had been "The Trade and Commerce of this Empire;" but he would follow orders, for the trade and commerce of the whole world was interesting to every man who believed in the progress of his fellow creatures.

Mr. E. K. MURRAY responded, and in doing so remarked that Mr. Tyrer had committed a mistake—the first in his

life—in asking two gentlemen of the same trade to propose and respond to the same toast, for it was well known that two of a trade never agree. He was glad to say, however, that the members of the alkali trade not only agreed but had united, and he hoped that the United Alkali Company would do something to retain the commerce in chemical products for this kingdom as against the world. There could be no doubt that trade and commerce were intimately related to chemistry, and that they were naturally dependent one upon the other. If England was to retain its commercial position it could only be by the application of scientific knowledge to its industries. The very object of the Society was to bring about a closer connection between science and chemical industry, and it had already done very much towards attaining that end. At the present moment, owing to the Society's Journal, it was in the power of every one connected with chemical industry to know what was being done in other countries in that direction. Liebig had said 50 years ago that the civilisation of the world might be measured by the amount of soap consumed, and its industry by the quantity of sulphuric acid produced. That was still true to a great extent; and he regretted to say that England was not holding now the position it held 50 years ago in relation to chemical industry. Englishmen had formidable competitors, and the most formidable were the Germans, the reason being that the Germans sooner than they had recognised the necessity of scientific education. The United Alkali Company recognised this fully, and were therefore happy to have in their service members of the Society who were among the most eminent technical chemists in the world. They had erected at Widnes a very complete chemical laboratory which would not only be worthy of the great company to which it belonged, but would be an example to all the other chemical industries of what should be done if they were to hold their own in competition with the rest of the universe.

Mr. LUDWIG MOND, in proposing "Our Visitors," said that as the members were not only "industrious" but civil chemists, he had no doubt that they would join most heartily with him in drinking to the gentlemen who had honoured the Society by their company that night. They would do so the more heartily when he reminded them that their visitors of to-night had in many cases been their hosts throughout the day. Some of their hosts of the morning were unfortunately unable to be present and had sent letters expressing their deep regret thereat. Among these were Mr. Maxim, Mr. Wainwright, Capt. Acland, Dr. Anderson, and Mr. Lambert, of the Union Oil Mills, all of whom he was sure they would include in the toast. The gentlemen whose names he especially wished to associate with the toast were Mr. Lightfoot of the Lindé Refrigerating Company, Mr. Charles Beadle, who had so sumptuously entertained them at lunch that day, and his own personal friend, Professor Fleming, who had so ably explained to them the method by which London was, in future, to be lighted from Deptford. It gave him special pleasure to couple Professor Fleming's name with the toast because it gave him an opportunity of expressing the admiration he felt for his work generally, and more particularly for his excellent treatise on the theory and practice of electric transformation, a work which was highly valued, not only in England but throughout Europe.

Professor FLEMING, who responded, said that at that late hour he felt inclined to imitate the example of a brilliant after-dinner speaker who, when called on under similar circumstances to reply to the toast of "Applied Science" said that the only application of science which seemed to him appropriate at the moment was the application of the domestic lucifer to the bedroom candle. They might guess the author of the remark when he told them that it called forth from a guest opposite, the lines:—

"O wise Sir Frederick, would that all could catch
Your striking brevity and find your match."

His duty was simple and he would do it as briefly as possible. He and the friends whom he represented felt deeply the hospitality that had been extended to them; such of them as had been in any degree instrumental in adding to the pleasure of the Society during the day had

an additional reason for feeling pleased and gratified at that moment. It had given him great pleasure to show the members the works in which he was concerned, because he felt sure that they took a deep interest in the question of the application of electricity and fully recognised the importance of the problems that still remained to be solved conjointly by the chemist, the engineer, and the electrician.

Mr. CHARLES BEADLE expressed the pleasure which the visit of the Society to Erith had given him. As an "outsider" he had the utmost admiration for the work which the Society was doing and for the marvellous improvements which the science it represented was effecting in all directions.

Mr. W. THORP proposed "The Press." He was sure that all the members of the Society felt grateful to the press for the services it rendered to science and industry. The days when it was looked upon with the feelings of suspicion which were portrayed in Sir Walter Scott's "Ivanhoe" had entirely passed away, and the press-man was now welcome everywhere, and nowhere more so than in the scientific world. The Society's Journal was a new departure in scientific work, a sort of daughter of the Chemical Society's Journal, dealing as efficiently with technological matters as the older journal did with questions of pure chemistry. For that good work they were greatly indebted to their able editor, Mr. Watson Smith, whose name he had great pleasure in coupling with the toast.

Mr. WATSON SMITH, in replying, said that the absence of the usual representatives of the press that evening enabled him to speak in terms of unstinted praise of the kindness, consideration and courtesy that had always been extended to him as editor of the Society's Journal by the gentlemen connected with other chemical journals in this and other countries. Mr. Muspratt had referred to German competition; but he thought he might say that at any rate so far as technological and patent literature were concerned the Journal of the Society held its own with German or any other similar productions. Among other friends and colleagues of the scientific press he would like to refer to were Mr. George E. Davis, the first general secretary of the Society and now editor of the Chemical Trade Journal; to Dr. Krause of the Chemiker Zeitung; Dr. Quesneville, Dr. H. Kast, Professor Remsen, Mr. Cawley, Mr. Perry Nursey, Dr. Paul, Drs. Lehne, Jacobsen, and Fiseher, and the editors of the Journal of the Franklin Institute, the Chemist and Druggist, with many more, to all of whom he was indebted in one way or another. He could not conclude without referring to his friend the general secretary, Mr. Charles G. Cresswell, to whose ever ready help and sympathy he was much indebted. Nor would he omit one other duty that he felt he had never adequately discharged before, namely, to express his gratitude to the admirable staff of abstractors to whom the Society generally and himself in particular owed so much. He was only representing the wishes of all his colleagues in returning sincere thanks for the kind sentiments expressed by Mr. Thorp in proposing the toast.

The PRESIDENT claimed the indulgence of the meeting while he discharged a further pleasant duty, namely, to propose a hearty vote of thanks to Mr. Tyrer for the extraordinary care that he had taken of them and for the enormous amount of work that he had undertaken, not only on behalf of the Society at large as Chairman of the London Section and Member of Council, but in connection with the present General Meeting. No one could have gone through the programme without noting the vast amount of thought which was compressed into an extremely small compass. The proceedings so far had gone as smoothly as they possibly could, and that was owing primarily to the Organising Committee of the London Section, but especially to the chairman of that committee.

The toast having been drunk with great enthusiasm and musical honours—

Mr. THOMAS TYRER briefly responded, and in doing so referred to the gratification which it afforded the London Section to make such return as it could for the splendid hospitality which had been extended to its members by other Sections, notably at Glasgow, Manchester, Liverpool,

Nottingham, and last, but not least, at Dublin, the home of their President. Referring to the remarks which had fallen from the President early in the evening, he would point out that it was in that Society that the full advantages of Home Rule under Imperial control were realised. Changes of rulers occurred, but there was a consistent continuity of policy, and the evidence adduced by the President, Mr. Thorp, and the Editor clearly showed that the Society was what he had always held it to be, a great Federation of Powers all working to one end. They had the entire British-speaking world in association with them, as was proved by the fact that their membership included nearly 300 Americans and a very large number of Europeans of all nationalities.

The pleasures of the evening were greatly enhanced by a selection of vocal music tastefully rendered by Messrs. Butterfield and Campbell, Mr. Tyrer kindly assisting them as accompanist.

THIRD DAY.—FRIDAY, JULY 22ND.

WINDSOR AND CLEVELDEN EXCURSION.

A special train from Paddington (Great Western Railway) at 9.50 a.m. conveyed a large party of visitors to Windsor. On arrival, the company proceeded to visit the Royal State apartments and Round Tower at Windsor Castle, opened to the Society by permission of the Lord Chamberlain.

About 12 o'clock the visitors entered, and indeed well filled St. George's Chapel, when a recital was given on the grand organ by R. M. Ackermann, Esq., the deputy organist, by permission of Dr. Walter Parratt, organist of the Royal Chapels.

PROGRAMME OF MUSIC.

Overture in C	Adams.
Cantata in B minor	Guilmant.
Toccata and Fugue in D minor	Bach.
Andante in D	Solus.
The Nun's Hymn	Wily.
Finale in D	Lemmens.

Luncheon was provided at 1 p.m. in the Town Hall, kindly granted the Society for this purpose by the Worshipful the Mayor of Windsor, J. Brown, Esq., who joined them as their guest on this occasion. After luncheon the Royal Stables beyond the Town Hall were inspected. At 2.40 p.m. the visitors embarked at the quay in steam launches (provided by Mr. J. Douglas, of Windsor) for Clevedon, the seat of the Duke of Westminster, and so famous for its magnificent woods. Tea was provided at 5.30 at the "Cottage," and about 6.30 the steam launches commenced the return journey, conveying the visitors to Maidenhead Bridge for Taplow Station, whence a special train started with them about 8.30 p.m. for Paddington, thus terminating one of the most enjoyable annual excursions the Society has yet seen.

It would be ungrateful in connexion with this excursion to forget the valuable assistance rendered in the arrangements, and the carrying of them out, by Mr. G. Sainty, engineer to the Corporation waterworks.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: Wm. Thorp.

Vice-Chairman: W. Crowder.

Committee:

C. F. Cross.	F. G. Adair Roberts.
A. G. Green.	A. Gordon Salomon.
D. Howard.	G. N. Stoker.
C. C. Hutchinson.	F. Napier Sutton.
W. Kellner.	T. E. Thorpe.
B. E. R. Newlands.	T. Tyrer.
W. Ramsay.	Frank Wilson.

Hon. Local Secretary: John Heron,
Ellerdale, Cottenham Park, Wimbledon.

Meeting held Monday, 13th June 1892.

MR. THOS. TYRER IN THE CHAIR.

THE PRODUCTION OF OIL-GAS FROM RUSSIAN PETROLEUM.

BY VIVIAN B. LEWES, F.I.C., F.C.S.

IN April 1884 Professor H. E. Armstrong read a paper on the "Manufacture of Gas from Oil," which was perhaps one of the most suggestive and interesting papers ever brought before this Society, as besides the description of plant and processes, he also touched upon many points bearing on the genesis of the gaseous and more volatile hydrocarbons produced during the decomposition of the heavier hydrocarbons forming our oils, and in the concluding paragraph of that paper he proposed to consider in a future communication the composition of oil-gas and the temperature at which decomposition is effected. Eight years have now elapsed, and the subject, which was then of great theoretical interest, has now become one of the greatest practical importance, as the increase in the price of canal coal has driven the gas managers of the country to the serious consideration of how best to utilise the cheaper oils for the enrichment of ordinary coal-gas of low illuminating power, and until our knowledge of the changes taking place during the conversion of liquid into gaseous hydrocarbons is considerably increased, the attempts to utilise oil in place of canal must to a great extent partake of the character of haphazard experiments which may or may not prove successful, and it is under these conditions that I venture to bring this paper before you, hoping that it may prove to be a link in the evidence concerning this important subject.

In the paper before referred to, Professor Armstrong gives the result of his analyses of the liquid deposited from oil-gas under pressure which show it to be rich in such benzenoid hydrocarbons as benzene and toluene mixed with hydrocarbons of the C_nH_{2n} and C_nH_{2n-2} series, an observation of great interest, as it shows that the vapours of these compounds are present in the uncompressed oil-gas; but inasmuch as the deposition of nearly a gallon of these liquid hydrocarbons from 1,000 cubic feet of the gas only reduces its illuminating value from between 50 and 60 candle-power to 40, it is evidently important to gain an insight into the nature of the hydrocarbons present not only in the gas but also in the tarry residues which distil over during the decomposition, whilst in order to trace the

decompositions taking place it is necessary to examine the products formed at lower temperatures than those usually employed in the manufacture of oil gas.

In order to carry out the destructive distillation of the oil for the earlier of these experiments I employed an iron retort 10 in. long and 4 in. in diameter, the mouth of which was closed by a flat iron disc flanged on to it, and secured by bolts. Through the front disc passed the oil supply pipe which led to within half an inch of the back of the retort, whilst the gas was led away by a pipe passing upwards from close to the mouth of the retort, to the vessel in which the residue was condensed.

The furnace in which the retort was set, and also the disc on front of retort, were provided with sight holes through which the temperature of the side and interior of the retort could be observed, whilst the retort itself was packed with coarse iron turnings to give as large a heating surface as possible.

The gases were led into small 10 cub. ft. gasometers, and were analysed directly they were cold.

The method of analysis used for the gases was the one described by me before this Society in April 1891. Carbon dioxide and sulphuretted hydrogen being first absorbed by a 50 per cent. sodic-hydrate solution; oxygen by alkaline pyrogallate, and then the unsaturated hydrocarbons were estimated by absorption with a solution of bromine in potassic bromide. After absorption of bromine vapour the carbon monoxide is absorbed by acid cuprous chloride, and the residual gas is allowed to stand over prepared paraffin oil with occasional agitation for at least 30 minutes so as to absorb the higher members of the paraffin series, ethane, butane, &c., and the remaining gas is exploded with oxygen in order to estimate the remaining saturated hydrocarbons, and hydrogen and nitrogen are estimated in the usual way.

In the tables the hydrocarbons are given as saturated and unsaturated, my experience being that at present it is absolutely impossible to attempt any subdivision of these bodies, and that where it has been attempted the results are most misleading.

The illuminating value of the gases was determined in an Evans photometer, the burner, pressure, and rate of flow being carefully regulated to suit the quality of gas and give the most perfect flame, the results being then calculated to a consumption of five cubic feet per hour. With this exception the testings and corrections were all made according to the Gas Referees' instructions, standard candles being used as the unit of light, and in order to render the total illuminating power obtained from the oil clearer, the candle power is also calculated to candle units per gallon of oil used, and their equivalent in grains of sperm.

The form of apparatus used did not lend itself to direct pyrometric determination of the temperatures employed, and these were judged on the basis of Pouillet's experiments:—

TABLE OF TEMPERATURES. (Pouillet.)

	C.	F.
Incipient red.....	525	977
Dull red.....	700	1,292
Incipient cherry.....	800	1,472
Cherry red.....	900	1,652
Clear cherry.....	1,000	1,832

The oil experimented with was the so-called "Russian distillate oil," a once-refined Russian petroleum which is being used on a very large scale for carburetting water-gas at the Gas Light and Coke Company's works at Beckton, and the results are contained in the following table:—

TABLE I.

Oil used.....	Russian "distillate oil,"			
Specific gravity.....	0.864			
Flash point.....	149° F. = 65° C.			
Temperature of retort.....	500° C.	700° C.	900° C.	1,000° C.
Cubic feet of gas per gallon.	12	60	72	84
Percentage of residuals.....	59.1	22.7	12.7	11.8
Illuminating power:—				
In candle power, per 5 c.f.	51.8	50.7	57.1	42.2
In candles per gallon of oil.	131.5	608.4	822.2	708.0
In grains of sperm per gallon.	15,782.4	73,008.0	98,668.8	85,075.2
The gas contains:—	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Unsaturated hydrocarbons	39.13	36.56	36.55	22.04
Saturated hydrocarbons...	42.41	49.45	53.97	54.83
Hydrogen.....	13.58	6.26	11.86	21.54
Acetylene.....	0.052	0.084	0.38	0.46

DISTILLING POINTS OF THE RESIDUES FROM RUSSIAN "DISTILLATE OIL," EXPRESSED IN PERCENTAGES OF ORIGINAL RESIDUE. TEMP. = °C.

Temperature.	100°—110°.	110°—120°.	120°—125°.	125°—130°.	130°—135°.	135°—140°.	140°—150°.	150°—160°.	160°—170°.	170°—180°.	180°—190°.	190°—200°.	Specific Gravity.	Flash Point.
Original oil.....	..	..	..	..	..	..	..	..	1	1	1.5	0.864		P. 19°
Residue after decomposing at—														
500° C.....	..	..	..	..	..	..	1	3.5	0.5	2.5	3	2	0.866	58°
700° C.....	..	..	9	1	2	1.25	9.5	4	1.5	3.5	3	2	0.908	Below 32°
900 C.....	1.6	5	3.3	3.3	5	3.3	6.6	5	6.6	5	..	..	0.926	Below 32
1,000° C.....	..	..	..	..	..	..	10	1	2.5	2	Nil	1	1.019	46°

In decomposing the oil at 500° C., the gas was small in quantity and white in colour, the hydrocarbons being present almost entirely as vapours, a large proportion of which went forward with the gas and condensed in the holder, so that the 59 per cent. of residuals condensed in the receiver do not represent the total condensible hydrocarbons.

After condensation of the vapours, the gas only amounted to 12 cubic feet, and contained the saturated and unsaturated

hydrocarbons in nearly equal proportions, whilst on examining the tarry residuals it was found that the flash point was considerably lower than that of the original oil, and also that 11 per cent. distilled over below 200° C., whilst with the original oil only 3.5 came over below that temperature.

The retort and pipes were then cleaned and heated to 700° C., and on decomposing the oil at this temperature the yield of gas was increased to 60 cubic feet per gallon

of oil used, and was of a buff colour. In the gas the unsaturated hydrocarbons were 2.5 per cent. less in quantity than in the former case, and there were 7 per cent. more saturated hydrocarbons. On examining the residuals, the effect of the increase in temperature was found to be most marked, they had decreased in quantity from 59.1 per cent. to 22.7 per cent. of the original oil decomposed, whilst the flash point had fallen below the freezing point, and 36.5 per cent. of the residual distilled below 200° C. Nine per cent. of the residual distilled at 123 to 125° C., whilst 9.5 per cent. distilled at a temperature of 140° C. to 150° C. At 900° C. the decomposition of the oil yielded a still larger volume of gas, in which the percentage of unsaturated hydrocarbons was the same as before, but there was a large increase in the quantity of saturated hydrocarbons and a slight increase also in the illuminating value of the gas.

The residuals at this temperature fell to 12.7 per cent. of the oil used, and on fractionating them more than a per cent. distilled at 100° C., and 5 per cent. at a little over 110° C.

On now raising the temperature to 1,000° C. another increase took place in the volume of the gas, 84 cub. ft. being obtained per gallon of oil decomposed, and the illuminating power fell from 57 to 42. On analysing the gas it was found that the percentage of saturated hydrocarbons had slightly increased, whilst the percentage of hydrogen had risen from 11.86 to 21.54 per cent.; on the other hand, the unsaturated hydrocarbons had fallen from 36.5 to 22 per cent. The colour of the gas as it left the retort had lost its rich chocolate brown colour and had become "sooty" from separation of carbon, and this, as well as the increase in hydrogen, showed that the temperature had been forced to a point at which some of the hydrocarbons were entirely broken up, and that it has been the unsaturated hydrocarbons which have been destroyed.

The residuals collected from the gas made at this temperature were of nearly the same volume as those obtained by decomposing the oil at 800° C., but differed from it in containing nothing with a lower boiling point than 140° C. to 150° C.

In these experiments the results, as far as yield of gas and total illuminating value were concerned, were considerably lower than the results I had obtained when decomposing the same oil in larger retorts, and I therefore made some further experiments to see how far the surface in the retort affected the changes taking place.

For one experiment a retort was made by taking an iron tube 4 ft. 6 in. in length and 2 in. in diameter closed at one end, and with an oil tube passing down the centre and terminating about 1 in. from the closed end, whilst the gas was led away from the other. For the second experiment a Patterson's oil retort 3 ft. 6 in. long and 9½ in. in diameter, with two oil tubes passing to the back, was employed, and a temperature of 900° C. was used in each case.

In this way it was possible to find out the conditions under which the oil could be decomposed to the best advantage, as the experiments already described gave the cracking of the hydrocarbons with very little heating of the gases after their formation, whilst the long, 2 in. in diameter, tube retort gives an excess of heating by contact with the red-hot side of the tube, and the large round retort on account of its capacity enables us to trace the effect of less contact with the sides of the retort, but a longer baking in mass of the oil gases and vapours.

The results obtained are given in the following table in which also, for the sake of contrast, the results obtained in the short four-inch retort at 900° C. are also embodied:—

TABLE II.

The effect of size of retort upon the resulting gas and residue oil used—Russian "distillate oil."

—	A.	B.	C.
Size of retort	1 10" × 1"	4 6" × 2"	3' 6" × 9½"
Temperature	900° C.	900° C.	900° C.
Cubic feet of gas per gallon.....	72	92	98
Percentage of residuals	12.7	18.3	20.2
<i>Illuminating Value.</i>			
In candle power per 5 cubic feet	57.1	46.0	49.6
In candles per gallon of oil.....	822.2	867.4	972.1
In grains of sperm per gallon....	98.6888	101.5680	116.6592
<i>Composition of the Gas.</i>			
Unsaturated hydrocarbons.....	36.55	29.79	33.16
Saturated hydrocarbons	53.97	62.30	45.15
Hydrogen	11.86	17.79	19.65

DISTILLING POINTS OF THE RESIDUES OBTAINED FROM THE VARIOUS RETORTS IN PERCENTAGES OF ORIGINAL RESIDUE.

—	60°— 70°	70°— 80°	80°— 90°	90°— 100°	100°— 110°	110°— 120°	120°— 130°	130°— 140°	140°— 150°	150°— 160°	160°— 200°	Flash Point.	Specific Gravity.
A.....	..	..	..	..	1.6	5.0	6.6	8.3	6.6	5.0	11.6	Below ordinary temperatures.	0.926
B.....	..	..	..	6.0	4.0	2.5	2.5	2.5	4.0	1.0	4.5		0.930
C.....	5.0	8.4	7.8	2.2	8.1	3.5	3.5	15.8	6.3	4.2	4.0		4.944

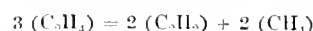
Russian petroleum is widely different from the Pennsylvania product and has been shown by the researches of Schutzenberger, Ioniue, Markownikoff, and Oglobini to consist largely of hydrocarbons of the $C_{12}H_{22}$ group—pseudocidelines or naphthenes, and with the exception of $C_{13}H_{26}$, a complete series from C_8H_{16} to $C_{15}H_{30}$ have been separated from it.

When this oil is first cracked by contact with a heated surface it decomposes, yielding both saturated and unsaturated hydrocarbons, the latter containing homologues of acetylene; some of these hydrocarbons are gaseous, whilst the remainder vary in their boiling point from 60° C. to very high temperatures.

It is evident that an insight into the changes taking place in the character of the hydrocarbons present can be best

arrived at by studying the action of heat upon the simpler members of the chief groups of hydrocarbons, and this I have done in an extended series of experiments, the full details of which I hope shortly to bring before the Chemical Society.

From these experiments I find that on heating ethylene by passing through a heated narrow tube nothing happens until a temperature of 800° C. is reached and then that between 800° C. and 900° C. it breaks up into acetylene and methane, probably according to the formula—



if the heat is kept acting upon these, the acetylene polymerises to benzene, which can be condensed from the gas and identified— $3 (C_2H_2) = C_6H_6$.

If the heat be now continued and raised to about 1,000° C., further polymerisation takes place with formation of still higher bodies, amongst which crystals of naphthalene are conspicuous, whilst at 1,100° C., these again break down to acetylene which then decomposes into carbon and hydrogen.

Methane, when heated to 900° C., practically undergoes no change, but ethane at this temperature gives up hydrogen and becomes ethylene, $C_2H_6 = C_2H_4 + H_2$, the ethylene so formed again decomposing into acetylene and methane.

Dr. Armstrong, in the paper which I have before alluded to, raises the question of whether the benzenoid hydrocarbons found in the liquid condensed by pressure from the gas, have been formed synthetically from simpler hydrocarbons such as acetylene, or from corresponding paraffins which have lost hydrogen, and he points out that although the work of Berthelot and Thorpe and Dyson show conclusively that benzene can be formed synthetically from acetylene, yet the absence of this body and its homologues from the liquid deposited on compressing oil-gas, leads him to doubt this being the method by which it is formed during the decomposition of oil.

From my own experiments I have but little doubt that the formation of benzene from the Russian petroleum is due not to one action but to several. In the first place all experimental evidence clearly shows that benzene is formed from acetylene by polymerisation, and that this takes place at temperatures existing in the oil-gas retort, but it is not conceivable that this action can do more than contribute its share to the 20 per cent. of benzene to be found in some of the oil-gas tar from the Russian oil. Then again, when the original oil is decomposed, large quantities of the higher paraffins are formed, and these by elimination of hydrogen may yield benzene, and finally the higher pseudo olefines of which the Russian oil itself consists, probably partly break down directly to benzene and paraffins in the same way that the simplest member of the group (C_2H_4) yields acetylene and marsh-gas.

The ease with which benzene can be obtained from Russian petroleum is shown by the fact that not far from Novogorod it is manufactured on a very large scale by Messrs. Ragosin and Co., who obtain, according to Dr. Dvorkovitch, 400 kilos. of 50 per cent. benzene and 30 per cent. of anthracene from 1,000 kilos. of oil.

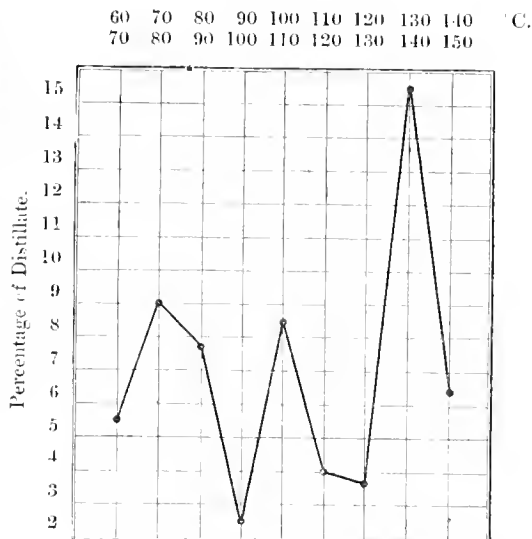
In decomposing oil in retorts two distinct periods of decomposition take place, first the breaking up of the oils under the influence of heat, and secondly the changes taking place in the first-formed products during their passage up the heated retort.

An examination of the constituents of the gases formed during decomposition at a low heat in the short retort, conditions which practically eliminate the secondary action, gives a valuable indication of what is taking place, and we find that in the gas made at 500° C., the saturated and unsaturated hydrocarbons are in nearly equal proportions, but that as the temperature rises the unsaturated hydrocarbons gradually decrease in quantity whilst the saturated hydrocarbons increase, as although the higher paraffins are broken down by the heat they form methane, which is but little acted upon, and also hydrogen, and it is this breaking down of the richer hydrocarbons into a larger volume of simpler ones which gives the great increase in volume found at high temperatures and the consequent loss in illuminating value.

On examining the residuals obtained by "cracking" the oil in the large Patterson retort it was found that the original tar had a specific gravity of 0.944, and on fractionally distilling it there were found certain temperatures at which a far higher proportion came over than at others. This can be shown best by taking the temperatures at the ordinate and percentages at the abscissæ of the following diagram.

This diagram shows, or at least strongly suggests, that the large proportion of paraffins present in the portion distilling between 60° and 150° C. consist of normal hexane and hexylene which boil at 68° to 71.5°, heptane and heptylene boiling at 99° C., and nonane, which boils at from 136° to 138° C., whilst benzene is responsible for the large distillate at 80° C.

TEMPERATURE.



In order to determine the proportion of saturated and unsaturated hydrocarbons present, the distillates below 100° C. were mixed together and treated with diluted nitric acid (half acid to half water), keeping the temperature low until action ceases; this converts the olefines into resinoid bodies, from which the paraffins and benzene separate; these were then drawn off, treated with strongest nitric acid and strong sulphuric acid to convert the benzene into nitrobenzol, this was then well washed, dried, and distilled, the result being:—

	Per Cent.
Olefines	70
Benzene	19
Paraffins	11

The fractions distilling between 100 to 150° C. had a specific gravity of 0.809, and gave:—

	Per Cent.
Unsaturated hydrocarbons	19
Saturated hydrocarbons	81

from 150° to 260° C., sp. gr. = 0.956:—

Unsaturated hydrocarbons	20
Saturated hydrocarbons	80

from 260° to 315° C., sp. gr. = 1.002:—

Unsaturated hydrocarbons	12
Saturated hydrocarbons	88

showing that the higher the distilling point and specific gravity of the fraction, the greater is the percentage of saturated hydrocarbons, whilst in the most volatile portion of the residue the unsaturated hydrocarbons preponderate.

During the fractional distillation of the tar, large quantities of naphthalene volatilised and condensed in the neck of the retort.

The observations of Atterberg and of Lenty, who employed a large surface of carbon in the cracking of oils, as well as the work of Salzmann and Wichelhaus in the same direction, point to the surface of the coke, or other form of carbon used, exercising an important influence upon the products of decomposition.

In order to ascertain if any such action could be detected I took two iron tube retorts 4 ft. 6 in. long and 2 in. in diameter, with oil tube passing down to within an inch of the closed end; one was packed with small pieces of coke the size of peas whilst the other had nothing in it.

These retorts were now fixed side by side in the same furnace, and were heated to a temperature of 900° C., and the results obtained are embodied in Table III.

These results certainly do not encourage the idea of surface action playing a very important part in the cracking of such hydrocarbons as constitute the Russian petroleum, and the small increase in illuminating power would certainly not compensate for the increased risk of choking in the retort and the large addition to the amount of naphthalene formed.

The increase in naphthalene is very marked, and this same fact was observed by Atterberg (Ber. 1878, 1222), who passed wood tar through iron tubes packed with coke. At a dull red heat little or no naphthalene was found, but at a bright red heat it was present in large quantities in the residuals.

In all experiments upon the decomposition of Russian petroleum and in making oil-gas from it on a large scale, great trouble is found in the ready deposition of carbon and pitch which seems to form from it more readily than from shale and American oils, and I imagine that it is upon this that the formation of so large a proportion of saturated hydrocarbons in the residuals depends, as without it one could hardly imagine the residuals from an oil consisting chiefly of members of the C_nH_{2n} group containing 70 to 88 per cent. in the portion distilling above 100° C. of the C_nH_{2n+2} series.

TABLE III.

EFFECT OF DECOMPOSING OIL IN PRESENCE OF RED HOT CARBON.

Oil used.....	Russian "distillate oil."	
Specific gravity.....	0.864	
Flash point.....	119° F.	
Conditions.	Without Carbon.	With Carbon.
Temperature	900° C.	900° C.
Cubic feet of gas per gallon ...	92	92
Percentage of residuals	18.3	23.3
Illuminating value:—		
Candle power per 5 cub. ft.....	46.0	47.11
Candles per gallon of oil	846.4	866.8
Grains of sperm per gallon.....	101.568	101.018
The gas contains:—		
Unsaturated hydrocarbons	29.79	29.59
Saturated hydrocarbons	62.39	58.66
Hydrogen	4.79	7.67

DISTILLING POINTS OF THE RESIDUES FROM RUSSIAN "DISTILLATE OIL," DECOMPOSED WITH AND WITHOUT CARBON PERCENTAGES OF ORIGINAL RESIDUE.

Temperature=0° C.	Without Carbon.												Specific Gravity.	Flash Point.
	70— 80.	80— 90.	90— 100.	100— 110.	110— 120.	120— 130.	130— 140.	140— 150.	150— 160.	160— 170.	170— 180.	180— 190.		
Original oil .....	..	..	..	..	..	..	..	..	..	1	1	..	..	..
Residue after decom- posing at 800 C.	..	..	6	1	2.5	2.5	2.5	4.0	1	5	2	2	0.99	B.O.T.
With Carbon.														
Residue after decom- posing at 800 C.	1	2.5	5	2	7	2.5	Naphthalene came off and choked the tube						0.99	B.O.T.

When cracking the Russian oil by itself the best results obtained were 98 cub. ft. of 48.6 candle-power gas, equal to 972.1 candles per gallon of oil, and this agrees very well with the best results obtained in working in this way on a big scale, but when the Russian "distillate" oil is decomposed in the presence of an inert gas, and is then exposed to a high temperature for some time, a considerable increase in the total amount of illuminating power obtainable from the oil is observed. At Beckton this oil is used on a very large scale for making carburetted water-gas, according to the improved Lowe system, in which the oil is decomposed in superheating chambers in presence of a rapid flow of water-gas, which dilutes the nascent oil-gas and bears it through a mass of red hot brickwork, which converts any vapours into permanent gases, and the illuminating power then obtained and the volume of the gas formed is considerably higher, 1,200 candles per gallon of oil being obtained instead of 972, an increase of over 23 per cent.; and this is due partly to the diluting influence of the water-gas, which prevents the decomposition going too far, and also to the breaking up of the benzene which otherwise would have found its way into the residuals. An analysis of the tar obtained from the carburetted water-gas plant at Beckton, and which was given in a paper read by Messrs. Paddon and Goulden at the May meeting of the Incorporated Institution of Gas Engineers, shows that it contains over 76 per cent. of water, and on removing this only 1.19 per cent. of benzene was found in the concentrated residue.

In conclusion I wish to express my thanks to my assistants for the great help they have given me in these experiments.

DISCUSSION.

Mr. T. FAIRLEY said that he had not any practical experience in the matter of oil-gas, but he had considerable experience with ordinary coal-gas. He would like to ask Professor Lewes if his notes supplied any information with regard to the rate of flow of the oil into the retorts, coupled with the amount of heating surface, and the temperature; also whether experiments had been made to ascertain the effect of varying the pressure in the retorts, as the products obtained would probably vary with the pressure. If the experiments were made under the ordinary conditions in the coal-gas manufacture, the pressure in the retorts would be nearly equal to or slightly less than that of the atmosphere.

Mr. WATSON SMITH, referring to the question of acetylene passing into benzene, and the latter, when heated to a high temperature, being converted into naphthalene, would like to ask the author of the paper if it was a well proved fact that benzene does, on heating to a high temperature, decompose so as to form naphthalene. He had always found that benzene when passed through even red-hot tubes, decomposed but slightly, and that slight decomposition was such as to yield hydrogen gas and diphenyl. It might be possible, however, that benzene, together with some unsaturated hydrocarbon such as ethylene, at such a temperature, might yield naphthalene in small quantity, but not benzene alone (see Lunge's Coal Tar and Ammonia, 1887, page 115). He could hardly conceive it possible that if benzene decomposed at all under such conditions, it could do so without forming diphenyl. But supposing that

naphthalene were formed, the temperature necessary for such formation would also be fully sufficient for a further decomposition of a portion of such naphthalene with elimination of hydrogen, to form small quantities of dinaphthyl.

Mr. BOVERTON REDWOOD said that the paper demanded more consideration than he, for one, had been enabled to give it during the time which had been occupied in its delivery. There were, nevertheless, a few general remarks which he might be permitted to make without having fully digested all that had been put before the meeting. As to the practical importance of the subject, there could not be two opinions. All those who had taken the trouble to consider what had been done in the United States in connexion with the substitution of carburetted water-gas for coal-gas, would see that the time was approaching, and was within measurable distance, when, to a very large extent, the former would be brought into general use in this country. The difficulty of obtaining coal for carburetting was an increasing one, and the labour trouble was, naturally, in favour of such a change. Bearing in mind that in New York, and in a large number of other cities in the United States, the illuminating gas which is supplied is almost entirely carburetted water-gas, it would be seen that such a change was quite possible. Of course circumstances were somewhat different in this country; and, perhaps, as one who had taken special interest in the subject of petroleum, he had expressed too confident a prediction of the change in question. Still, he considered that the subject was thoroughly deserving of careful consideration, and he therefore thought that the members of the Society ought to feel greatly indebted to Professor Lewes for having undertaken its investigation. There was no doubt that much of the work which had been done in England, both experimental and practical, in relation to oil-gas, had been carried out unsystematically and unscientifically; and, he might say, even unintelligently. He had had, in past years, a good deal of experience in the manufacture of oil-gas, and he well knew the difficulties which must beset an investigation such as that which had been undertaken by Professor Lewes. One great difficulty lay in generalising the results, which depended on certain factors, and those factors might be said to hold good only under the particular conditions of the experiments. It was very difficult to conclude from results obtained under certain conditions what results would be obtained under other conditions, and accordingly a very large number of experiments had to be made before anything like a satisfactory generalisation of the subject could be attempted. The theory which Professor Lewes advanced with respect to the formation of benzene was at any rate a convenient and pretty one, and there was doubtless a good deal to be said in favour of it. With reference to the conversion of the hydrocarbons comprising the Russian distillate oil into benzene, he might remind some of those present that he had many years ago read in that room a paper on the subject of the Russian Petroleum Industry, in which he had mentioned that, in St. Petersburg, he was enabled to witness experiments then being carried on by Messrs. Nobel, in the conversion of petroleum residues into benzene, anthracene and naphthalene. The following are the details which were given on that occasion:—The astatki (petroleum residuum) is decomposed in a capola regenerative furnace, which has been patented by Mr. Nobel, to whom I am indebted for the following interesting particulars of the results obtained. The first destructive distillation gives from 30 to 40 per cent. of tar, containing from 15 to 17 per cent. of 50 per cent. benzol. By a second destructive distillation of the heavy oils remaining in the tar after the separation of the benzol, 70 per cent. of tar is obtained, containing from 7 to 10 per cent. of 50 per cent. benzol, 16 per cent. of naphthalene, 2 to 3 per cent. of dry "green grease" (or 30 per cent. anthracene), and 24 per cent. of pitch. There is also obtained in the process 75 to 100 cubic feet per cubic foot of astatki of gas having an illuminating power five times greater than that of coal-gas. The regenerative furnace is first heated to 1,000° C., astatki being, of course, used as the heating agent, and when it has become cooled in the process of

decomposing the astatki it is again similarly heated, the gas remaining in the furnace, and the coke deposited on the hearth, being utilised as fuel. The furnace is stated to remain in working order, without cleaning, for 12 months. Undoubtedly, the hydrocarbons composing Russian oil lent themselves to that change with very great facility, and the oil in question was therefore very suitable for use in the manufacture of oil-gas. On the other hand, he was not at all clear, having in view his past experience in the manufacture of oil-gas, and his more recent experience in the conversion of the heavier liquid hydrocarbons into lighter liquid hydrocarbons, that it was wise to attempt the direct conversion of some of the heavier Russian oils into gas. He confessed that he was not in a position to express his views with much confidence, because he had not experimented in that direction to any large extent; but as far as the experiments of Professor Dewar and himself had gone, they had led him—he spoke only for himself—to the conclusion that it might be desirable, in the use of the heavy hydrocarbons as gas-oil, to effect their preliminary conversion into lighter liquid hydrocarbons, which could be more readily turned into gas. His experience had been that one could more easily control the cracking of the heavy liquid hydrocarbons into other liquid hydrocarbons of a lower specific gravity and higher volatility, and then the conversion of these into gas, than the direct conversion of the heavy hydrocarbons into gas. That was one aspect of the subject which seemed to have been overlooked. He believed that Professor Lewes would find it a fruitful field for investigation. He would in conclusion express his opinion that the paper might probably be characterised as a practical and valuable contribution to their knowledge of the subject.

Prof. WILLIAM FOSTER, referring to the difference between the paraffins and the olefins, said that about 20 years ago Schorlemmer described American petroleum as consisting chiefly of paraffins and the Russian petroleum as mainly made up of non-saturated hydrocarbons. It was just beginning to dawn upon those interested in the petroleum industry that a large amount of work—which had been very aptly described by Mr. Redwood—had been done without any system or science; and that Russian oil was the most favourable for the purpose of carburetting gas, or for illuminating purposes. At the time Schorlemmer wrote, the facts to which he was now going to refer were not known. He had the greatest respect for the work of Dr. Frankland and of his son, Dr. Percy Frankland, which, he believed, had never been appreciated at its true worth even by those who were most interested in the matters considered. It would be within the recollection of some that a few years ago Dr. Percy Frankland showed the relationship between the lighting values of the paraffins. He first tried marsh-gas, which practically is non-illuminating. He then took ethane and propane, and he believed Frankland stopped there. The curious point was that the olefin ethylene (C_2H_4) gave him practically 68·5 candles per 5 cubic feet per hour; marsh-gas was put at 5 candles. Ethane (C_2H_6) had an illuminating power of about 35 candles, and the illuminating power of propane (C_3H_8) was practically 53 candles. His (Prof. Foster's) point was that last year he had an opportunity of experimenting with butylene (C_4H_8) and found that the lighting value of that substance was almost double that of ethylene. The extraordinary thing was that gas engineers had not yet fully recognised that ethylene (C_2H_4) has a lighting value of practically double that of ethane, and that a very large proportion of the constituents of the American petroleum is essentially a mixture of paraffins. If gas engineers wished to obtain a given lighting value they must put the carbon vapour into the gas in some form or other. By using equal volumes of ethylene and ethane very dissimilar lighting values were obtained, although equal weights of carbon vapour were consumed. If it were true that the Russian oils were largely made up of non-saturated hydrocarbons, he thought the tendency of many of the experiments went to show the accuracy of the principles enunciated by Frankland, so far as the paraffins were concerned. He ventured to think that he had filled up a gap by showing the proportional relationship between

the amounts of carbon in members of the olefin series and their lighting values. He believed that he had hit upon a plan of estimating the lighting value of coal-gas by ascertaining the amount of carbon vapour it contained. The quantity of carbon vapour in the gas was necessarily numerically related to the lighting value. The results would be brought forward at the meetings of the Gas Institute to be held in London this week.

Mr. W. J. A. BUTTERFIELD thought he was correct in understanding from Professor Lewes that it was possible at a certain temperature to form acetylene from naphthalene, but he was not clear whether there was an intermediate formation of ethylene or not. In either case, he should like Professor Lewes to tell the meeting what was the temperature at which the transformation occurred, as naphthalene was a residual product in gas-works, and it would be quite easy to make a valuable illuminating gas from it if the exact temperature at which acetylene could be formed from it were known. He was not quite clear on another point, as the paper had been read rather too quickly for him to take in anything but the drift, but he thought 20 per cent. of benzene was stated to be found in the residuum in certain instances. He presumed Professor Lewes meant benzene and not hydrocarbons of the benzene series. It was possible that 20 per cent. of hydrocarbons of the benzene series might be found; but he would like very much to know the conditions under which 20 per cent. of benzene was found in the residuum. As to the amount of benzene in the residuum tar from carburetted water-gas, he believed he was correct in stating that the author gave the quantity as a little over 1 per cent. Was this in the dehydrated residuum, and were there any paraffins accompanying it? As far as his (Mr. Butterfield's) experience of the residuum from carburetted water-gas went, there was 1 to 4, or even 5, per cent. of benzene (not merely hydrocarbons of the benzene series) present; but unfortunately it was associated with large quantities of paraffins of the same boiling point. It would also be very interesting to him to know if there was any large proportion of anthracene in the residuum from pure oil-gas, or carburetted water-gas, as, if over 20 per cent. of benzene was obtainable from the tar in addition to anthracene, it would almost be worth while to make the gas for the sake of the by-products alone. He would also like to know whether the yield of gas, expressed, say, in candles per gallon, was not larger from a heavier Russian oil than from that which Professor Lewes had experimented. He thought Professor Lewes would find that certain Russian distillate oils would give about 1,000 to 1,200 candles per gallon without admixture of water-gas.

Professor LEWES, in reply, said Mr. Fairley had asked for data as to the rate of flow. It was manifest that with the different sizes of the retorts employed in the experiments, it would have been impossible to have used a constant rate of flow. What he did, therefore, was in experiments *a, b, c*, and *d*, which were all made in a retort of the same size, to work with a rate of flow of two pints per hour. With the large Patterson retort he worked with a flow of about $1\frac{1}{2}$ gallons an hour. The way in which the three experiments at 900° C. were made comparable was by noticing the colour of the gas. Anyone who had been engaged in oil-gas manufacture knew that a most valuable indication was to be found in the colour of the gas. When it was made, say, at 500° C. it came off as a dead white vapour, much of which again condensed, as was shown by the small yield of gas obtained. When a temperature of 700° was reached the gas came off a buff colour, which showed a better gas was being made, and at a temperature of 900° (the best temperature for the cracking) it became a rich chocolate brown, and in the experiments made with retorts of various sizes the rate of flow was regulated to give this colour. In reply to Mr. Watson Smith's question as to the polymerising of the acetylene and the formation of the naphthalene, he had worked with very narrow tubes, and had taken the exact temperature of the gas as it passed through those tubes. Under these conditions he found he got acetylene

formed in the gas freely when a temperature of 800° C. and upwards was reached, and that when the temperature rose to 900° C., if he placed at the end of the tube through which the gases passed a small receiving vessel, he obtained a product which had the smell of benzene, and which could not be identified by the aniline test. When the temperature again rose he got smaller quantities of a far heavier substance, which was probably diphenyl. He also found that crystals of naphthalene began to appear, and if the tube were heated to a higher temperature he did not get this, but he simply got carbon and hydrogen. That simply meant that if acetylene was being made at a temperature of 800° C. these changes took place, whereas if it was being made at a higher temperature over 1,150° C. these hydrocarbon compounds were not formed, but there was a direct decomposition of the acetylene into carbon and hydrogen. He believed it was a well-known fact that naphthalene could be produced by heating the vapour of benzene, and this was probably the source of its formation in this case. In reply to Mr. Morrison's question as to the permanence of the gas, he would say that a properly made oil-gas was far more permanent than a coal-gas. If one took a coil of half-inch compo. pipe, say, 120 ft. long made into a coil and immersed in water at 0° C., and if through such a coil 16-candle coal-gas were passed, one could not read the illuminating power of that gas on a photometer. If a well-made oil-gas of 45-candle illuminating power were taken, and it was passed two or three times through the coil, it would be found that there was only a loss of something like three or four candles out of the gas. But that, of course, was a properly made gas. Low temperature gases would not do that. If oil-gases were made at a lower temperature, it would be invariably found that a quantity of paraffin vapours were obtained, and would condense on cooling. Mr. Butterfield's question with reference to the 20 per cent. of benzene arose out of a misconception of what he (Professor Lewes) intended to infer. What he said was that 20 per cent. of the distillate below 120° C. consisted of benzene; 20 per cent. of benzene was a quantity which was actually obtained in the production of benzene from Russian oil. The figures which he quoted were 40 per cent. of 50 per cent. benzol. Mr. Butterfield had stated that naphthalene was a residual product in gas-works, and that it would be a matter of little difficulty to make a valuable illuminating gas from it if the exact temperature at which it could be converted into acetylene were known. This, however, was not so, as neither naphthalene or benzene could be decomposed by heat into hydrocarbons valuable for illuminating purposes. There was no doubt that with Russian petroleum a valuable tar could be made, and that by properly working the residuals it would be possible to get the enriching gases at a very low rate. He had also been asked if it was not a fact that by using a heavier oil a higher illuminating power could be obtained. That was perfectly correct. If a crude Russian petroleum were used an illuminating power of 1,000 candles per gallon would be got, but the pitch and carbon deposited during cracking is so great a nuisance that it cannot be used under ordinary circumstances.

NOTE ON THE COMPOSITION OF A STRATUM OF PEAT UNDERLYING THE LONDON CLAY.

BY WATSON SMITH, F.L.C., F.C.S., AND M. W. TRAVERS.

On the kind invitation of Mr. Cairns, a former student of Chemical Technology in University College, now engaged as an engineer in the construction of the new Blackwall Thames tunnel, we went to inspect a layer of peat, which occurs at a depth of about 12 feet below the surface in the cutting at Poplar, about 200 yards from the Thames. This peat was of distinct brown colour and darkened considerably on exposure to air and light. It was very wet, and was composed chiefly of branches and trunks of trees, twigs, &c. It is about two feet thick, but is said to attain a thickness of six feet on the other side of the Thames.

The substance contained 69.5 per cent. of moisture, leaving of dry carbonaceous matter 30.5 per cent. In the sample taken, of course we avoided any considerable pieces of wood.

The dry peat furnished on analysis 50.03 per cent. of ash, leaving 49.92 per cent. of carbonaceous matter.

The amount of wax or bitumen found by extraction with benzene was 0.16 per cent. on the dry substance.

The composition of the ash (50.03 per cent.) will be a matter of some interest. It was as follows:—Silica 62.48 per cent.; ferric oxide and alumina 21.26 per cent.; carbonate of lime, &c., 16.26 per cent.

The silica existed chiefly as sand.

We should be inclined to regard this deposit as an earthy brown coal in process of formation and development. Every 100 parts of this peat contains about 30 parts of dry substance, half of which is ash and half combustible matter, and has no value as fuel.

It has geological interest as showing that, at a period anterior to the formation of the London clay, an abundant growth of trees and shrubs extended from some distance inland, right down to the water's edge in this locality.

A CONTRIBUTION TO OUR KNOWLEDGE OF THE SOLUBLE AND RESINOUS CONSTITUENTS OF COALS. (Continued from page 975, this Journal, 1891).

BY WATSON SMITH, F.C.S., F.L.C., LECTURER IN CHEMICAL TECHNOLOGY IN UNIVERSITY COLLEGE, LONDON, AND J. C. CHORLEY.

THE conclusion of the late Dr. Angus Smith was pointed to in my last communication on the above subject, where after an examination of the resinoid constituents extracted from peat, he said it was his belief that the resinous matter of peat had grown in the plants when fresh, and was not a product of decomposition (*loc. cit.* p. 975). A description was then given of the remarkable Miike coal obtained from mines in the south-western part of the Japanese Empire and near the coast of Shimabara Bay in Kiushiu Island. It was shown that it contained 9.5 per cent. of resinoid matters soluble in benzene and resembling crude petroleum in general character, and the probability was indicated that this bitumen, like the resins of peat, was a residue of the waxes and resins which existed in the original plants and trees forming the coal (*loc. cit.* p. 977). Seeing, moreover, that the Miike coal contains an ash with about 42½ per cent. of lime, it was deemed probable that it is really an advanced lignite and of tertiary and cretaceous character.

Now if a tertiary, and, therefore, a younger coal, we have at hand one reason for finding more of such soluble resinous

matter than can be found in the older fossils of the secondary strata, the coal measures. For example, boghead, Lancaire, Australian, and American cannel were examined, all secondary fossils, and the amounts of soluble resinoids found only varied between 0.6 and 1.06 per cent.

A tertiary coal, or lignite, will be one in which, other things being equal, the resinoid matters will not have been subjected to such extremes of heat and pressure probably, and certainly not for so great a length of time, and so may be looked for in greater quantity in lignites than in true coals. Nevertheless we are bound to confess that we are unaware of any comparative experiments having yet been made sufficing to establish this point as between lignites and true coals, though Percy certainly mentions lignite from New Zealand and Tasmania very rich in bitumen (Percy's "Fuel," p. 317). It occurred to one of us that it would be very interesting to analyse some other coals from mines not far from the Miike mine, with a view of effecting some comparison. Mr. Watanabe, of the firm of Mitsui and Co., anticipated our wish by sending specimens of two coals from mines situated to the north of the Miike mine, but in the same island of Kiushiu. The determinations of the composition of these two coals, which we will term A. and B., were so interesting in view of the results with the Miike coal, we felt impelled to bring them before this Section of the Society without delay. We now give the composition of the two coals in question (A. and B.) and repeat that of the Miike coal:—

	A.	B.	Miike Coal.
	Per Cent.	Per Cent.	Per Cent.
Carbon	69.56	73.98	74.22
Hydrogen	5.55	4.20	5.84
Oxygen	12.32	12.66	5.61
Nitrogen	1.12	1.53	1.11
Sulphur	0.72	0.80	3.15
Moisture	3.13	2.27	0.62
Ash	7.10	4.56	9.15
	100.00	100.00	5.61
Coke	59	58	60½
Specific gravity	1.365	1.257	1.269
Calorific value	7,940	7,425	7,616
Insoluble	59.55	32.56	14.94
Ash { Ferric oxide and alumina	32.86	14.10	20.91
Lime	2.32	15.38	12.38
Bitumen soluble in benzene	0.57	1.18	9.50

No doubt you will observe a very remarkable thing in connexion with the above analyses, viz., that as the lime increases in quantity so also does the amount of bitumen soluble in benzene. In other words the tertiary coal or lignite of the cretaceous strata, the younger fossil, retains most of these bituminoid residua, whilst the older fossil retains least, the intermediate containing an intermediate quantity.

These coals, too, are fairly comparable, for they all come from the same island in Japan.

Is any argument to be drawn from the fact? I think there is, and we must remember that the resinoid matter of the Japanese—the Miike—coal contained a considerable amount of volatile constituents. The argument is simply this, that we find these resins in the tertiary coals—the lignites—because they are younger fossils and have not undergone the extremes of age, prolonged pressure and subterranean heat, that the secondary coals, or true pit coals, have.

It is an interesting fact that, so far as one can ascertain at present, the waxes and bituminoid matters of peats, lignites, and the true bituminous pit coals, though differing in amounts in the respective fossils, all seem to be much alike in chemical character.

Schorlemmer's analysis of the peat waxes extracted by the late Dr. Angus Smith showed that they contained a considerable proportion of oils of hydrocarbon character, like paraffin oils, and Schorlemmer was sure that solid paraffins were also present. My examination of the resinoid matters of the Mülke coal gave results testifying to the same thing, and the resinoids derived from the cannel coals already referred to also bore evidence in the same direction. Dr. R. Angus Smith and Mr. Binney have both made observations proving that oil accumulates and flows from the peat, and indeed it is probable that ozokerite is thus formed. Finally, Dr. Angus Smith extracted resins from peat and from mosses above the peat, and found them similar. Here, then, is the chain of evidence pointing to the strong probability that these soluble resinoids are the slightly altered resins and oils originally contained in the plants and trees from which either peat, lignite, or coal was derived. In this Mülke coal, so uniformly rich in resinoid matter, we have probably original special flora, and special circumstances since and during fossilisation for the preservation of these matters. We are now extracting a large quantity of this bitumen for special chemical investigation, and are using a large Soxhlet's extractor of copper.

BITUMEN SOLUBLE IN BENZENE CONTAINED IN VARIOUS COALS.

Mülke Coal, with 2.1 per Cent. Lignite.	Japanese Coal A., with 15.1 per Cent. Lignite.	Japanese Coal B., with 2.92 per Cent. Lignite.
0.50	1.18	0.57

Boghead Cannel, Scotland.	Australian Cannel.	American Cannel.	Lancashire Cannels.	
			Hucknall Cannel.	Tyldesley Cannel.

With Small Quantities of Lignite in Ashes, like Coal B. (Japanese).

0.60	0.67	1.06	1.06	0.85
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The increase of bitumen with increase of eretaceous character, and probably more recent character of the coal, is seen on reference to the above table, though more experiments are to be tried in this direction as confirmatory of the argument involved. Of course, in cases where the intrusion of volcanic eruptions was evident, such as trap dykes, &c., any such evidence could not be looked for.

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Obituaries.

PROFESSOR CARL SCHORLEMMER, LL.D.,

F.R.S., &c.

MEMBER OF THE SOCIETY OF CHEMICAL INDUSTRY.

DAKSTADT, the birth-place and home of so many chemists and pharmacists, was the place where Carl Schorlemmer first saw the light. He was born on the 30th September 1834, and was of what is termed humble birth, a circumstance which becomes lustrous when we glance at the heading of this obituary notice and observe the distinctions he has won by sheer hard work, supported and fired by undoubted genius.

But whilst exalted in the science to which he was devoted, and which was by no means confined to chemistry and physics, he never forgot his old home and its associations or the rank of the people from which he sprang, and the writer well recollects, in sorting out his own letters in the Owens College letter-box, the regularity with which every week end he came upon Professor Schorlemmer's number of the "*Sozial Demokrat*" with the Zürich postmark upon it. Yet indeed Schorlemmer's was a gentle order of social democracy, most concerned as to the amelioration of the lot of the poor Bauernvolk of his Fatherland.

Turning to his career as a chemist, this opened in Giessen, where he chiefly studied, though he afterwards went to Heidelberg. In 1858 he came to England first, though for a brief period, as one of the laboratory assistants of the late Dr. R. Angus Smith, and then as private assistant to Professor Roscoe, now Sir Henry E. Roscoe, M.P., who had been shortly before appointed to the Chair of Chemistry at the Owens College. At the time of Schorlemmer's advent there, W. Dittmar, whose sudden death we had regretfully to chronicle but a few months ago, was the college laboratory and lecture assistant. This post he resigned in 1861, and Schorlemmer was his successor. Then came the opportunity of a certain amount of leisure for original research, and none but those whose privilege it was to be under his tuition know how ably he combined the arduous duties of laboratory instruction with the concentration of mind and skilfulness of hand needed in such researches without either slackening in the one or failing in the other. His encyclopædic knowledge of his science, and even apparent contempt for reference to books, by reason of the marvellous memory he possessed, were matters at once of astonishment and wondering comment amongst even the most advanced of the chemical students.

What splendid use he made of the scant leisure for quiet laboratory work at his disposal, every chemist knows who remembers his first paper, published in 1862, and it may indeed with truth be said that Schorlemmer's discovery and clear proofs of the identity of the two bodies then supposed distinct, dimethyl and ethyl hydride, paved the way for those further advances in organic chemistry subsequently made, which have proved of such wide-spread importance both in pure and applied chemistry. During the 10 years following 1862, he carried on in the old laboratories in Quay Street, Manchester, a series of researches which revolutionised our ideas of the constitution of the hydrocarbons. The Royal Society Catalogue gives the titles of some 32 papers, each marking some important step, and representing collectively the rungs of the ladder by which he quietly but irresistibly climbed to the Fellowship of that Society, to which he was elected in 1871, the first occasion on which he appeared as a candidate. The University of Glasgow later on distinguished him by conferring upon him the honorary degree of LL.D. By this time Schorlemmer had gained a European reputation and had spread the fame of the Owens College

laboratories far and wide, for besides his original researches, the publication of a book under the title of the Chemistry of the Carbon Compounds, or Organic Chemistry (of which a German edition appeared, and still enjoys a high reputation in the Vaterland), contributed to extend his reputation as a teacher, author, and investigator. It therefore seemed somewhat singular that the college, for the repute of whose Chemical School he had done so much, should continue to assign to such a man the title of assistant, and should allow him no voice in the academical management of the institution. This state of things lasted, however, not long, and at the urgent request of Sir Henry Roscoe, a Chair of Organic Chemistry was founded, and Dr. Schorlemmer was appointed to fill it. As already hinted, Schorlemmer's scientific knowledge was not confined to chemistry, he was an accomplished botanist, and, indeed, possessed an extensive command of many branches of science. In the meantime Roscoe's *Lessons in Elementary Chemistry* had obtained a world-wide fame, and the work had been translated into almost every tongue. What more suitable arrangement then, than that such forces should be united in the joint authorship and compilation of a complete text-book on the entire subject, both inorganic and organic chemistry, bringing to bear also sufficient of the history of chemistry to leaven the whole, and render it really interesting reading, as well as suitable as a work of reference?

The reply to such a question was anticipated by the decision arrived at that Professor Sir Henry E. Roscoe and Professor Schorlemmer should combine forces in the production of a complete and systematic treatise on inorganic and organic chemistry. This great work was far advanced, one volume remaining to complete it, but, alas, the span of life was too short. The oil had burnt down, and was spent, the light, all too soon, had departed. Thus the volume which was to complete the series will remain unwritten. Of recent years Dr. Schorlemmer was not able to leave his house in the evenings, and confined himself more and more to his college and literary work. Schorlemmer was not a brilliant lecturer, and this in large measure owing to *Sprachschwierigkeiten*, for these he never entirely conquered through the persistency, probably, with which he conversed whenever it was possible in his *Muttersprache*; but his style of writing English, as witness his elegant little work, *The Rise and Development of Organic Chemistry*, was most clear, simple, and forcible. He was a most accomplished laboratory teacher, and those whose good fortune it has been to work under, and especially with, him, will not soon forget the peculiar inspiration they received from his earnest example and his untiring patience, united to a modesty rendered all the more impressive by its failure to conceal the pre eminence of the master mind.

Schorlemmer's assistance and help were most readily extended to the needy and struggling ones who might apply to him, and if he found the cases meritorious and deserving (and singularly quaint were his methods of testing them), his kindness and solicitude never failed.

— W. S.

A. NORMAN TATE, F.C.S., F.I.C.,

A VICE-PRESIDENT OF THE SOCIETY OF CHEMICAL INDUSTRY.

It is with much regret that the somewhat sudden death is announced of a man whose name has been so largely identified with that of this Society, indeed from the very birth of the latter. Since the beginning of the year 1883, he has served as a member of the Publication Committee of the Journal, and his services on the Council of the Society were regarded as being of such value that he was more recently elected a Vice-President. But more particularly will Mr. A. Norman Tate's loss be felt in connexion with the Liverpool Section of the Society, of which he was the Vice-Chairman, and it

must be with a feeling of no little melancholy that his colleagues reflect that his genial and kindly countenance will no longer be seen among them. When we turn, moreover, to page 406 in the May issue of this Journal, and refer to this the last record of the Committee of the Liverpool Section containing his name as Vice-Chairman, but printed in italics, and thus signifying a partial removal, it was little thought that he was so soon to be taken, and in a more serious sense, from the wide circle of friends and colleagues, by the great remover, Death.

A. Norman Tate was born on February 24th, 1837, at Wells, in Somersetshire. He seems to have commenced early, and with great assiduity, the study of chemistry and pharmacy. Later on, he entered the laboratory of Dr. Sheridan Muspratt, in Liverpool, and here he studied general and analytical chemistry very thoroughly. Mr. Tate's name subsequently appeared with considerable frequency in connexion with papers read before the Chemical Society of London, the Royal Dublin Society, &c. He then commenced a course of practical and analytical experience in the laboratory of Messrs. John Hutchinson and Co., alkali manufacturers, in Widnes, which continued for about three years, when he resolved to set up in Liverpool as a consulting and analytical chemist. When the importation of petroleum from America was commenced, the oil being then regarded as a novelty, Mr. Tate made it a particular object of technological study, and soon became a recognised and leading authority,—as witness his little book published at that period, and entitled "Petroleum and its Products," which was soon translated both into French and German. Mr. Tate showed evidence of ability in chemical engineering, for he designed and erected plant and apparatus for the production and refining of coal- and shale-oils, in Flintshire. In the examination of fats, oils, and waters, A. Norman Tate had attained considerable reputation for skill and accuracy. But the greatest praise is due to Tate for his indefatigable labours as a public man, and in benevolent schemes of various kinds. His efforts to popularise the study of chemistry are matters of common knowledge in Liverpool, and even with his large and extending consulting analytical practice, he yet found time to undertake the teaching of chemistry in connexion with the Liverpool trade societies, and the force of his example and precepts greatly contributed to raise the Liverpool Science and Art Classes to become what they now are, a great power in that city. Mr. A. Norman Tate, as honorary principal, had the arrangement of these classes, and for some years he himself taught chemistry, botany, physiology, and general biology, four or five evenings per week, being thus occupied throughout the winter season when usual business hours were over. This work had, in short, become a labour of love.

In 1880 a public meeting was held in the Liverpool Town Hall, and Mr. Tate was presented with a handsome testimonial for work done in connexion with these and other classes, notably the Birkenhead School of Science, from which he received a second address.

Mr. A. Norman Tate founded a School of Technology and Chemistry in Mackins-hey, and hence was obliged to lay out large sums of money on a work of such public spirited character, and more particularly as he conscientiously took steps to guard against interference with the professional work of other Liverpool analysts. He led a quiet retiring mode of life, and was eminently a man of a genial spirit and kind heart. The cheery patience with which he bore his last illness was a splendid as well as a touching proof of the peace and serenity of mind which are the consequences of a good life, which in A. Norman Tate's case certainly meant a life lived mainly to benefit others.—W. S.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Improvements in and relating to the Method of effecting, by Means of Centrifugal Force, the Reaction of Bodies of different Densities on one another. W. P. Thompson, Liverpool. From P. Marix, Paris. Eng. Pat. 8475, May 16, 1891.

THE inventor, having studied the phenomena presented when employing centrifugal separators in obtaining the emulsion of skimmed milk with a small proportion of fatty substances in the manufacture of cheese, has noticed the different character of these emulsions according as the proportions of the two mixtures are varied, or the conditions of temperature, subdivision of parts, or rapidity of operation are altered.

He has devised certain alterations and changes in the centrifugal separators by means of which the above conditions can be varied as required, the invention consisting in producing by centrifugal force the juxtaposition of infinitesimal particles of the substances to be mixed, in then effecting their mixture by causing them to run out through the same orifice simultaneously and continuously under the action of the centrifugal force, and in submitting the substances, whether gaseous, liquid, or in the form of powder, at any period of the process, to any further desired physical, chemical, or mechanical reactions. Two types of shapes of centrifugal vessels, arranged to meet certain conditions, are outlined in the drawings, and there are nine claims, and for a satisfactory comprehension of the patentees' intention the full specification should be examined.—B.

* Any of these specifications may be obtained by post by remitting 8d.—the price now fixed for all specifications, postage included—to Sir Henry Reader Luck, Comptroller of the Patent Office Southampton Buildings, Chancery Lane, London, W.C.

An Improved Means and Method of Closure for the Regulation of Gaseous Pressures. E. J. Mills and C. J. Ellis, Glasgow. Eng. Pat. 9187, June 1, 1891.

THE inventors use an elastic material punctured by one or more holes or slits, for closing bottles, casks, or vessels, the material being of such width and thickness as to permit the passage of gas at a specified pressure; these punctures may be lubricated with a dry powdered lubricant. The application of this invention to the stoppers of bottles, &c. is also claimed.—J. C. C.

Improvements in Apparatus for the Treatment of Water to prepare it for Use in Steam Boilers and for other purposes. R. M. Deeley and L. Archbutt, Derby. Eng. Pat. 11,708, July 9, 1891.

THE apparatus consists of an upper and a lower tank. The upper receives the hard water and also the chemical solution or milk of lime which may be injected with the aid of steam and air with the object of mixing the ingredients and stirring up the precipitate. The softened water, after a period of rest, is drawn off into the lower vessel by means of a hinged pipe placed in the upper tank with floating end, so adjusted that the water is drawn off a short distance below the surface. Carbonic acid gas is drawn or forced down the same pipe, the inner surface of which is crossed by ridges or transverse ribs which cause the softened water in its descent to be splashed into contact with the carbonating gases. The admission of the mixture, the water, and the gas is regulated automatically, and for treating large quantities of water tanks with wells and trajectors can be employed in accordance with Eng. Pat. 1791 of 1889 (this Journal, 1890, 406).—B.

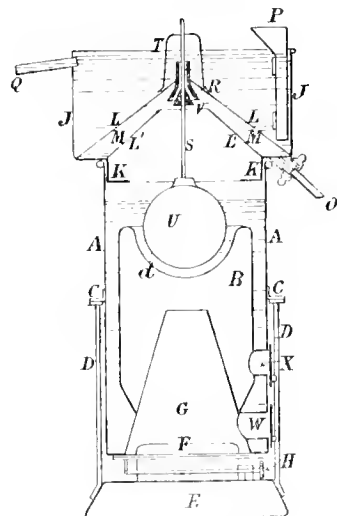
Improvement in Means or Apparatus for Drying or Extracting Moisture from Vegetable, Animal, or other Products or Materials. L. Gye, London. Eng. Pat. 12,401, July 21, 1891.

THE drying or extracting of the moisture is accomplished in chambers by currents of air, the air being agitated and distributed by curtains or suspended diaphragms, and controlled by adjustable blades or deflectors. The air may previously be heated by a furnace as described in the specification.—J. C. C.

Improved Apparatus for Distilling Water. J. Kirkaldy, London. Eng. Pat. 12,578, July 21, 1891.

THE invention embraces the construction of portable apparatus with either combined or separate evaporator and condenser, the fuel employed being oil, though in some forms of the apparatus block or slow burning fuel is used or common combustibles.

The accompanying figure shows one of the arrangements.



IMPROVED APPARATUS FOR DISTILLING WATER.

A is the vessel containing the water to be evaporated supported by the outer ring C on legs D, attached to the oil reservoir E from which the lamp wicks F project into the conical funnel G. The flame heats the inner surface of the combustion chamber B and finds its way out through openings X whilst air for combustion enters by W. The wicks are regulated by the ordinary screws H.

The evaporating vessel is surmounted by a cold water tank J, held in position by the rim K and having two conical bottom surfaces L & L'. The cone L has the central valve seat R, on which fits the reversed valve V carried on the hollow ball U by the spindle S which is guided in the bracket T overhead. The ball floats in the recess D of the heating chamber B and keeps the valve V closed until the water level has been reduced by evaporation sufficiently for admitting a new supply from the tank above. The rising vapour condenses on the under surface of L and collects in the space M, whence it is drawn through the pipe O. Further supply of water for evaporation is admitted through P and the overflow Q allows the surplus to run off.—B.

Improvements in Apparatus for Charging Liquids with Gases. J. H. Minto, Anfield. Eng. Pat. 13,323, August 6, 1891.

The object of the invention is a means of impregnating a liquid with gas a little at the time, in proportion as the liquid is drawn off. This is accomplished by employing two vessels one above the other, separated by a perforated partition or rose and by leading a tube within from near the bottom of the lower vessel to near the top of the upper. The lower end of the tube dips into a shallow layer of liquid in the lower vessel, whilst its upper end reaches above that with which the upper vessel is filled, gas under pressure being admitted into the vessels in any desirable way. So long as the lower end of the tube remains covered with liquid, that contained in the upper vessel is maintained at its existing level. But on the tube end being uncovered through withdrawal of some of the liquid the equilibrium is destroyed, and a new supply descends through the perforations of the rose in a fine shower, readily taking up the gas on its passage.—B.

Improvements in Funnels for Measuring Liquids. J. Richardson, Wigan. Eng. Pat. 15,122, September 7, 1891.

This funnel has a valve in its lower part, operated by a cranked lever kept in position by a spring, and extending above the top of the funnel so as to be easily pressed by the finger. The valve is rigidly attached to the lever and works upon an india-rubber seat. The funnel may be graduated inside so that any quantity of liquid may be allowed to run out at will.—J. C. C.

Improvements in Apparatus for Mixing Liquids with Liquids and Solids. S. H. Johnson and C. C. Hutchinson, Stratford. Eng. Pat. 5377, March 18, 1892.

The patentees suspend a disc to a vertical shaft within a vessel containing liquid. Both above and below the disc are attached concentric tubes which reach near to but not close up to the disc, and are entirely immersed in the liquid. The currents induced by the rotation of the shaft cause the liquid to be drawn towards the disc through both tubes, and to be driven from the circumference of the disc in the opposite direction, thereby producing effective stirring and mixing.—B.

Improvements in Filtering Faucets. H. H. Luse, San Francisco, U.S.A. Eng. Pat. 7419, April 19, 1892.

The aperture in the plug of this faucet forms a chamber which is divided vertically by a sheet of fine wire gauze or perforated plate; this filters the water from debris which collects in the chamber, and may be removed by reversing the plug and allowing the water to carry it away.—J. C. C.

II.—FUEL, GAS, AND LIGHT.

On the Influence of Incandescent Electric Light on Paper made from Wood-cellulose, and its Deterioration through Exposure. J. Wiesner. Dingl. Polyt. J. 1892, 234, 67–69.

THE author has already studied (this Journal, 1888, 44) the influence of gas and that of the arc-light on woody fibre, and has shown that provided there is good ventilation the former is preferable for libraries, the only objection to its use being found in the slight deposit of soot which is invariably deposited on all exposed surfaces, and which, aided by a temperature of over 30° C., is liable—apart from the light—to produce a slight yellowing of all varieties of paper. He has now investigated the action of the incandescent light and finds that after exposure of 552 hours to a light of 144-candle power no yellowing takes place, whilst with gas light after 240 hours of 50-candle power a slight degradation of tone is noticeable. It is to be observed that the action of light may proceed for some time without producing any visible effect, but on treating such paper with potash solution of such a strength as only to give a faint yellow colour with unexposed material, a brownish stain is developed. Incidentally he mentions that whilst direct sunlight after a few hours causes a change in paper made from wood pulp, bright diffused daylight can only effect a similar change after several days.

The tensile strain of the paper diminishes considerably during the process of yellowing; various strips 45 mm. long and 15 wide being broken, 1st, before exposure, 2nd, after attaining a pale yellow colour, and 3rd, when they had turned brown. The average breaking weights of the three samples were respectively:—1st, 3,485 grm.; 2nd, 2,865 grm.; and 3rd, 2,345 grm.

The author concludes, therefore, that although gas light has little influence on paper, the incandescent electric light is the best form of artificial illumination for use in libraries, &c.—F. H. L.

Pyrogenic Hydrocarbons Formed in the Manufacture of Compressed Gas. A. Brochet. Compt. Rend. 1892, 114, 601–603.

WITH the exception of normal hexylene, described by Williams, and erythrene which was obtained by Caventon, no well-defined hydrocarbons have yet been isolated in a pure condition from the light oil of compressed gas; the author finds that this oil may be regarded as an abundant source of normal hydrocarbons, which can only be prepared with difficulty by other methods. After having collected the volatile products in bromine, and separated large quantities of aromatic hydrocarbons by distillation, he succeeded in isolating 20 grms. of amylene, and 40 grms. of hexylene from a litre of the crude oil. He also detected the presence of other unsaturated hydrocarbons in the oil, and found that they all contained a normal chain of carbon atoms.—F. S. K.

PATENTS.

Improved Apparatus for Making Gas. N. Bourgoïn and H. Decoree, Paris. Eng. Pat. 578, January 12, 1891.

THE new apparatus has for its object the instantaneous production of a gas suitable for lighting, heating, or motive power purposes. It consists essentially of a rotatory pump, worked by a weight or other means, which forces air into a bell regulator; from the latter the air passes into a retort heated by means of a gas jet, then, after having been partly cooled in a condenser, through the carburettor, and finally through a reservoir provided with vaporising sheets. The condensed vapours pass from the condenser into the reservoir mentioned above, and are then carried by a pipe and caused to drop into the retort.

The advantage claimed is that all the heat absorbed in the process of evaporation is returned to the carburettor

so that the apparatus works continuously and regularly, and any accumulation of heavy hydrocarbon oil in the reservoir is avoided.—F. S. K.

Improvements in Apparatus for Washing or Scrubbing Gas. J. C. Chandler, Brixton. Eng. Pat. 10,918, June 26, 1891.

INSTEAD of employing laths in the construction of the washers or scrubbers previously described (Eng. Pat. 7691 of 1888) the patentee uses boards, in which there are a number of saw-cuts or slits, for offering a large area of wetted surface.—F. S. K.

Improvements in Magnesium Lights for Photographic and Signalling Purposes. E. Hackh, Stuttgart, Germany. Eng. Pat. 7635, May 2, 1891.

THE object of this invention is to separate the particles of magnesium powder in such a way as to allow of ready access of air when the metal is burnt and so to assist combustion. For this purpose long carded unspun wool is soaked in a mixture of 2 parts of vegetable oil, 2 parts of benzene, and 1 part of Venice turpentine. It is next wrung out and allowed to partially dry and is then covered with particles of the powder and dried. The metal-coated wool is twisted into rope and is ready for combustion. If the rope has been tightly twisted the combustion will be of long duration and the light less intense. If loosely twisted a rapid combustion and intense light will be produced. The rope when used is coiled up and supported on a wire netting placed in a conical metal funnel.—H. K. T.

Improvements in Apparatus for Charging and Drawing Gas Retorts. J. Ruscoe, Hyde. Eng. Pat. 8479, May 16, 1891.

THIS patent relates simply to an improvement on the apparatus previously described (Eng. Pat. 14,720 of 1890; this Journal, 1891, 995); direct acting rams or pistons worked by fluid pressure are substituted for the wheels and gearing previously employed in the apparatus for working the moveable division plate for charging inclined gas retorts.—F. S. K.

Improvements in the Setting and Heating of Retorts. A. J. Boulton, London. From A. Klönne, Dortmund, and F. Breidel, Milwaukee, U.S.A. Eng. Pat. 9310, June 2, 1891.

THE retorts are set in an inclined position, and the fire-chamber is provided with a suitable grate, partly or wholly beneath the retort setting; the fuel is introduced into the furnace through a door at the front side of the bench, whilst the stoking or clinkering door is placed on the opposite side. The object of this improvement is to do away with excavation or an elevated stage or floor on the discharging or front side of the bench.

The retorts are provided with circumferential rings or off-sets made in one piece with the retort; when the retort is placed in position, the surface of the ring rests horizontally on the supports, and in this way sliding and side pressure are prevented.—F. S. K.

Improvements in the Manufacture of Artificial Fuel, utilising Sewage therein. A. O. Jones, Harrogate. Eng. Pat. 11,764, July 10, 1891.

THE sewage is first strained through sieves to remove foreign bodies, it is then filtered through a filtering bed of peat, peat-moss, burnt clay, brick dust, garden mould, forest mould or marsh mould, or a mixture of these. The deposit is mixed with smudge or coal dust and with

materials that will disinfect and fix its volatile constituents; the mixture is then moulded into blocks or briquettes, with or without the addition of a binding agent. The blocks may be then coated with a similar mixture containing carbolic acid.—J. C. C.

Improvements in Hydrocarbon Oil Burners. S. Townsend and P. E. Townsend, Luton, Bedfordshire. Eng. Pat. 18,848, July 13, 1891.

THIS invention consists of an ordinary hydrocarbon burner, above which are placed a series of metal cones, each perforated with a slot corresponding with the wick tube and separated from one another by means of gauze rings. By this means a "light of pure combustion" is obtained. The lamp may be used with or without a glass shade, and is intended to be used in conjunction with Eng. Pat. 15,942 of November 5, 1888.—H. K. T.

Improvements in the Construction and Manufacture of Pottery Ware Domestic Stoves for Heating Purposes. J. Salomon, Berlin. Eng. Pat. 2932, February 15, 1892.

POTTERY WARE stoves as usually constructed have the shell open inside, causing a large amount of heat to pass out of the chimney. In this invention the hot gases are caused to pass up, down, and again up the stove before issuing from the chimney. Further, air passages are made in the outer shell of the stove, through which air from the room passes, thereby becoming warmed, though without passing through the combustion chamber or up the chimney. The shell of these stoves is preferably constructed in two pieces, which may be either fitted or baked together.—V. C.

Improvements in or relating to the Manufacture of Fuel-Gas. A. J. Boulton, London. From the Chicago Heat Storage Company, Chicago, U.S.A. Eng. Pat. 3995, March 1, 1892.

IN the manufacture of fuel-gas in the ordinary way, the fresh fuel introduced into the producer is heated so quickly that the hydrocarbon vapours escape before they have been thoroughly gasified; moreover the temperature of the gases issuing from the producer is so high that the metal conduits, &c. are destroyed. To get rid of these disadvantages, steam is caused to impinge on the top of the incandescent fuel before introducing a fresh supply of coal; in this way the temperature of the upper parts of the fuel is considerably lowered and a layer of ash is formed at the surface, so that the fresh fuel is heated much more slowly than would otherwise have been the case, and the temperature of the escaping gas is also lowered. Steam, or a fine spray of water, is also caused to play on the fresh charges of coal before they are raised to incandescence, in order to further retard the process of distillation.—F. S. K.

Improvements in Generating Electricity and Producing Air in a Luminous State, and in Apparatus therefor. T. Duffy, San Francisco, U.S.A. Eng. Pat. 7253, April 14, 1892.

See under XI., page 619.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Formation of Solid Paraffin. H. Kast and S. Seidner.
Dingl. Polyt. J. 1892, 284, [6].

In the absence of any proof, it is almost universally considered that ozokerite is a petroleum residue, formed by the evaporation or distillation of the original oil. Zaloziński (Dingl. Polyt. J. 1891, 280, 134; this Journal, 1891, 753) holds that the solid substance was formed first from animal fat, and that the oil is a more recent product. His theory has much circumstantial evidence to support it, since it allows of an explanation of the formation of petroleum and ozokerite from animal fats, in a manner analogous to that by which the conversion of peat into brown-coal, and the latter into pit-coal, may be explained. The theory receives further support in that it has never been possible to obtain from the oil any residue having the properties of ozokerite, among other matters.

The authors have lately met with a residue known as "amorphous paraffin," obtained by warming to a temperature of 120° for a long time American cylinder oil which has been previously purified by filtration through animal charcoal. In this way a sticky substance separates out, which, by repeated washing with petroleum spirit, may be divided into a solid and a liquid portion. A similar residue is present in nearly all American oils, separating out on cooling in large masses. On the bottom of the tanks used for storing the crude oil, a mud-like residuum is found, consisting in great measure of the same substance, and yielding on distillation large quantities of crystalline paraffin. This amorphous paraffin closely resembles and is evidently identical with ozokerite, being obtained by repeated washing of the same colour as what is known as "half-bleached" ozokerite from Boryslaw, its specific gravity being 0.915 at 18°, compared with 0.845—0.930 for the natural product, and its solubility and melting points also agreeing very closely. On ultimate analysis the artificial product gives 85.13 per cent. of carbon and 14.69 of hydrogen as against 85.48, and 14.48 for the natural.

Hence there is no doubt that "ozokerite" exists as such in American petroleum, and there is every probability that it will be found also in that from other sources. This being the case, the supposition that it is formed from the oil by evaporation becomes strengthened; and although the fact remains that artificial petroleum residues differ very considerably from the natural product, this may be explained by the difference between the processes employed in the laboratory, and those by means of which nature has effected the changes.

It is certainly more difficult to explain the presence of the ozokerite in the crude oil by means of Zaloziński's theory; it not being clear how the former could be converted into the liquid oil, when it is incapable of being melted even without some decomposition. Further study of the chemical constitution of ozokerite is much needed to assist in answering satisfactorily this difficult question.—F. H. L.

Sulphur Compounds in Petroleum. H. Kast and G. Lagai.
Dingl. Polyt. J. 1892, 284, 69—72.

With the exception of the product from Tegernsee, all varieties of crude petroleum contain sulphur, usually in amounts varying from 0.136 to 1.87 per cent.; but in spite of an assertion by Vohl (Dingl. Polyt. J. 1875, 216, 49) to the contrary, it is always stated that washing with sulphuric acid is competent to remove this objectionable impurity. Other processes have been devised for this purpose, but owing to lack of exact knowledge as to the form in which the sulphur exists in the natural product, they are all purely empirical. Among others may be mentioned the following:—Friedel and Crafts (Jahresb. f. Chem. 1878, 1166) treat the oil with aluminium chloride; Faulbaum (D.R.P. 36,765, 1885) passes a stream of sulphurous acid gas through the boiling oil to obtain decolourisation, as well as the removal of the sulphur; Kennedy's process (Eng.

Pat. 6018, 1887; this Journal, 1887, 503); Pitt and Van Fleck (Eng. Pat. 3830, 1888; this Journal, 1888, 129); Frasch (Amer. Pat. 378,246, 1888), who distils the oil over lead oxide and washes the distillate with sulphuric acid; Gordon (Amer. Pat. 451,724, 1891) also treats the distillate with lead oxide, followed by solution of magnesium sulphate, finishing with acid and alkali as usual; and Kendall (Amer. Pat. 451,660, 1891) employs mercuric chloride, removing the mercury by means of a suitable sulphide, finally distilling the oil over caustic alkali. Unfortunately, information as to the efficiency of the processes is not to hand.

Mabery and Smith (Ber. 22, 3303; this Journal, 1890, 275; and Amer. Chem. J. 13, 232; this Journal, 1891, 629) are the first investigators who have studied the nature of the original sulphur compounds existing in Ohio petroleum, and they state that these substances are present in the form of alkyl sulphides, thiophene compounds and mereaptans being absent. From the acid sludge, these observers have obtained unstable lead and calcium salts decomposed by distillation with steam. No statement is made as to the properties or composition of these salts, but it would seem improbable that the acid exerts merely a solvent action on the sulphides; rather is it to be expected that sulphonic acids are formed, whose lead or calcium salts are decomposed during distillation.

To obtain further information on the subject the present authors have repeated the experiments of Mabery and Smith on Alsatian petroleum, treating the acid removed after treatment of the petroleum as they have described, but evaporating the neutral liquor *in vacuo* to a syrupy consistence, and finishing on the water-bath. By the estimation of the amount of calcium sulphate present in the dilute liquid and of that precipitated during concentration, it was shown that no decomposition took place. The resulting salt, which would not crystallise either from water or dilute alcohol, was dissolved in water and distilled in a current of steam. Although the distillation was carried so far that the salt separated out and began to decompose, no products containing sulphur were found in the distillate, and the same negative result was obtained when the distillation was effected in presence of excess of sulphuric acid. A sample of Ohio petroleum containing 1.0 per cent. of sulphur, or twice as much as that in the product used by Mabery and Smith, was then tried, being washed with acid, 20 per cent. soda and water. The purified oil had lost its unpleasant alliaceous odour, and became transparent, but still contained after drying 0.74 per cent. of sulphur. In fact, although washing is competent to remove the unpleasant odour of the crude oil, which odour is in all probability due to unsaturated hydrocarbons, and not to sulphur compounds at all, a large number of experiments on different oils indicate that whether the oil is washed cold or warm (40° C.), only about a quarter of the total sulphur is removed. The acid was treated as before, but again the calcium salts obtained yielded on distillation with steam *no oil containing sulphur*. By treatment of the salt with sulphuric acid, filtration and long boiling of the filtrate with water, some alcohols were formed which were converted into acids by oxidation.

Further experiments with ethyl sulphide (one of the sulphides mentioned by Mabery and Smith, *loc. cit.*), show that this substance, though easily soluble in acid, is, however, dissolved, almost completely precipitated unchanged on dilution with water, and if the liquid containing the small amount still in solution be neutralised with barium hydrate, neither in the precipitate nor in the filtrate is a soluble or an insoluble barium sulphate discoverable. If the filtrate is evaporated down, a small quantity of a brownish substance is obtained which evidently consists of diethyl sulphone ($C_2H_5)_2SO_2$.

On treatment of their oily distillates with alcoholic mercuric chloride, Mabery and Smith obtained crystalline precipitates; the present authors have only been able to obtain a considerable turbidity in the solutions, but no appreciable amount of precipitated product. On distillation of the crude oil sulphuretted hydrogen was evolved at 150°, so the operation was repeated under a pressure of 45 mm. up to the same temperature. The distillate and residue were treated with sulphuric acid to obtain the calcium salts, but

again with negative results; they were then treated with alcoholic mercuric chloride, when from the distillate a brown tarry substance was obtained, which has not yet yielded a product suitable for investigation, and from the residue a white cheese-like precipitate separated. It was insoluble in water, ether, petroleum ether, acetone, chloroform-benzene, and carbon bisulphide. This substance is decomposed by warming with hydrochloric acid, giving off sulphuretted hydrogen, and when suspended in water may be decomposed by sulphuretted hydrogen. Distilled with steam it yields a faint yellow oil of unpleasant smell, containing sulphur. The corresponding compounds of ethyl sulphide and mercaptan were prepared, but have no resemblance to this substance.

Complete removal of the sulphur from the crude oil by means of mercuric chloride is impossible, the oil after precipitation still containing 0.53 per cent. of sulphur.

The present authors also find that the compound of ethyl sulphide with mercuric chloride melts without decomposition at 90° as stated by Loir (*Annales* **106**, 234, cf. Mabery and Smith, this Journal, 1890, 275).—F. H. L.

On the Reduction of Benzene-hexachloride with Regeneration of Benzene. J. Menoier. *Compt. Rend.* **114**, 75–76.

It is usually assumed that the benzene-hexachlorides are derivatives of the hydrocarbon hexamethylene. The author proves that this does not hold good for the α -hexachloride which he has transformed by complete reduction into its mother-substance, benzene C_6H_6 , using as a reducing agent zinc and acetic acid. The resulting benzene is perfectly pure and is quite free from thiophen.—J. L.

Menthol. A. Berkenheim. *Ber.* **25**, 686.

See under XX., page 632.

An Examination of the Products obtained by the Dry Distillation of Bran with Lime. Preliminary Communication. W. F. Laycock and F. Klingemann. *Proc. Chem. Soc.* 1892 [114], 138.

CONSIDERABLE quantities of bran and unslaked lime, in the proportions of 1 to 2 by weight, were subjected to dry distillation. The resulting distillate consisted of a black oil floating on an aqueous solution. The aqueous solution smells of herring-brine and contains large quantities of ammonia. On boiling the solution, gases are evolved which burn on ignition with a slightly luminous flame. Amines and furfuran are probably present.

The oil, after repeated fractionation, was found to have no constant boiling point. Analysis of different fractions showed that they all contained about 4 per cent. of nitrogen.—W. S.

PATENTS.

Improvements in Treating and Purifying Paraffin Wax, and in Apparatus therefor. N. A. C. Henderson, Broxburn. Eng. Pat. 11,799, July 11, 1891.

THE patentee describes in this specification some improvements applicable to his patented "Sweating Apparatus" (Eng. Pat. 1291, 1887; this Journal, 1888, 116). In the first instance the temperature of 80° F., to which the paraffin is being exposed, is maintained for a longer time, in order to drain off a larger amount of oil from the wax. The inventor dispenses next with the cloth or felt, as it is liable to become clogged with impurities, and replaces it by a wire gauze of suitable fineness.—J. L.

A Method of and Apparatus for Measuring Depth of Water in Oil Tanks. B. Redwood, R. Redwood, and H. Barringer, London. Eng. Pat. 14,030, August 19, 1891.

IN order to ascertain whether at the bottom of petroleum tanks there is any water, and what quantity thereof, the patentees fix a strip of paper which is coated with a substance soluble in water but insoluble in oil, to a suitable frame, and allow this frame to sink to the bottom of the petroleum vessel. Owing to the action of the water, if any be present, the strip of paper will be altered and the extent to which this alteration extends will give a measure of the height of water in the tank. As a suitable material for coating the paper a syrupy aqueous solution of citrate of iron and ammonia is used.—J. L.

Improvements in the Treatment of Petroleum. J. G. Cooper, Chatteris, Cambridgeshire. Eng. Pat. 19,418, November 10, 1891.

THIS is a process which is claimed to render petroleum "inexplosive and unflammable," and consists in adding 2 lb. of copper sulphate to every 40 gallons of petroleum, the whole being well stirred together and left for six hours, when the liquid is ready for use.—H. K. T.

IV.—COLOURING MATTERS AND DYES.

A Method for Determining the Number of NH₂ Groups in certain Organic Bases. R. Meldola and E. M. Hawkins. *Proc. Chem. Soc.* 1892 [114], 133–134.

See under XXIII., page 640.

Note on the Application of Alizarin Yellows, 2 G and R. P. Werner. *Bull. Soc. Ind. Mulhouse*, 1892, 198–199.

THE so-called Alizarin yellows of the shade-marks 2 G and R are azo-compounds (*m*- and *p*-nitrobenzene-azo-salicylic acids respectively), which have the property of yielding insoluble lakes with metallic oxides. Both dyes are remarkably fast to acids, oxidising agents, soap, and light. The 2 G dye gives on the chromium mordant an almost pure yellow, and can replace with advantage Persian berries and other natural yellow dyestuffs, the colouring power of the commercial 20 per cent. paste being three times that of Persian berry extract and eight times that of fustic extract.

—E. B.

PATENT.

The Manufacture of Basic Dyestuffs from Alpha-naphtho-quinone-dichloroimide. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 11,046, June 29, 1891. (Second Edition.)

ACCORDING to Eng. Pat. 4476 of 1888 (this Journal, 1889, 280), Nile blue is prepared by acting on the nitroso-derivative of an alkylated *m*-amido-phenol with α -naphthylamine. Dyestuffs of this class can be obtained by reacting with dialkylated *m*-amido-phenols on α -naphthoquinone-dichloroimide. The latter compound is obtained from 1:4 diamido-naphthalene by the action of hypochlorites in presence of a mineral acid (Beilstein, Vol. 3, 1022). The following is the method given for the preparation of Nile blue according to this invention:—About 8 kilos. of diethyl-*m*-amidophenol and 11 kilos. of α -naphthoquinone dichloro-imide are mixed with about 30 kilos. of wood spirit and warmed to 50°–60° C. A reaction takes place

and shining green crystals of the colouring matter are obtained. After cooling, the mixture is filtered and the precipitate washed with wood spirit until the washings are of a pure blue colour. The dyestuff is then in the form of its hydrochloride and can be converted into its sulphate in the manner described in the former patent. Dimethyl-*m*-amidophenol, dimethyl-*o*-amido-*p*-cresol, *m*-hydroxydiphenylamine, or *m*-hydroxy-phenylnaphthylamine may be substituted for the diethyl-*m*-amidophenol above mentioned.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

The Specific Gravity of Silk. L. Vignon. *Compt. Rend.* 1892, **114**, 603—605.

THE author maintains that his previous determinations of the specific gravity of silk are correct. He also points out that the method described by Charlonnet for determining the specific gravity of silk is liable to give too high results, because the silk absorbs some of the metallic compounds from the solution of cadmium borotungstate; the specific gravity of solutions of this compound in which silk has been immersed for a few hours is perceptibly diminished (see p. 640).—F. S. K.

The Specific Gravity of Textiles. M. de Charlonnet *Compt. Rend.* **114**, 489.

See under XXIII., page 640.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Dyeing and Printing with Gold Salts. E. Odenheimer. *Lehne's Farber Zeitung*, 1891—2, 205.

WHEN textile fibres or fabrics are padded or printed with a gold salt and then treated with a solution of a reducing agent, gold is precipitated on the fibre in the form of a beautiful grey colour which is fast towards acids, alkalis, soap, and light. The reaction is accelerated by gentle heat and by the presence of sunlight. According to the strength of the gold solution and the character of the reducing agent used, black, red-, or blue-toned greys are produced. Thus pyrogallol or hydroquinone (quinol) give blue-greys, whilst oxalic acid gives red-greys. The colouring power of the gold salts is very great, and for light shades 0.01 per cent. of gold solution suffices. When the fabric which has been dyed or printed in grey is subjected to heat, as by passing between heated rollers, the colour is changed at the point of contact with the roller into a beautiful red with metallic reflection. Stronger greys give a purple, and weaker greys a pink colouration. The temperature of formation of the red lies between 100° and 110° C. The printing of gold colours presents difficulties, as the gold solution is affected in the cold by most of the thickening materials available. The best thickener is gum Senegal. Thus a printing colour may be made by adding 0.2 grm. sodium-gold chloride dissolved in 4 cc. glycerin to 50 cc. gum Senegal thickening. The fabric printed with this mixture is then passed over a heated plate (or treated with a solution of a reducing agent), in order to develop the colour. The high price of gold salts is no bar to their use in dyeing, as the quantity used is very minute. Thus, for the development of a beautiful pearl-grey shade on half-silk the cost of gold is only about three farthings per pound weight of material dyed.

—W. E. K.

The Prevention of the Weakening of the Fibre in Discharge Indigo Prints. J. Mullerus. *Lehne's Farber Zeitung*, 1891—2, 127. (This Journal, 1892, 33.)

THE author recommends that the blue-dyed cloth be padded in sodium silicate at 2° to 4° B. before the printing on of the discharge colour, and that a neutral chromate be used in making the discharge paste. The preservative action of sodium silicate on the fibre is considered by the author to be partly chemical and partly mechanical. He explains Scheurer's failure to get satisfactory results from this process to the fact that the latter used an acid chromate discharge colour, the consequence being that the alkalinity of the silicate becomes partially or wholly neutralised before the goods are passed through the discharge vat.—W. E. K.

The Solution of Chloride of Antimony in Saturated Solutions of Sodium Chloride. H. Causse. *Compt. Rend.* 1891, **113**, 1042—1045.

CHLORIDE of antimony (SbCl_3) in contact with water is partially decomposed with formation of oxychloride, SbOCl , and Ditte has proved that in the decomposition the general laws of dissociation are obeyed. In this paper it is shown that, without in the least interfering with the reaction induced by the water, the hydrochloric acid used in dissolving the chloride of antimony may be substituted by such a salt as sodium chloride, and a perfectly neutral solution is thus obtained.

To a number of solutions of oxide of antimony in hydrochloric acid, sodium chloride in excess was added, and then sodium carbonate solution gradually. The amount of sodium carbonate to be added so as just to cause precipitation was found to be just that amount necessary to neutralise the excess of hydrochloric acid. The chloride of antimony was thus kept in solution by the sodium chloride.—W. M. G.

On the Isomeric States of Chromic Sulphate. A. Reconnat. *Compt. Rend.* **113**, 1037—1040.

IN a preceding paper (*Compt. Rend.* **113** [25], December 14, 1891) the author has shown that chromic sulphate, like the chloride and bromide, may exist in the solid state in two distinct isomeric modifications, viz., the green and the violet sulphate, the latter being the normal variety. The green salt is obtained by preparing the sulphate in presence of a very small quantity of water.

This solid green sulphate must not be confounded with the non-crystallisable basic green sulphate, designated the "modified sulphate" by the author, and previously described by him (*Compt. Rend.* of June 22nd, 1891) as existing in a solution of the violet sulphate after boiling.

Three chromic hydrates appear to exist which are respectively capable of combining with 6, 5, and 4 molecules of a monobasic acid. They are represented by the formula $\text{Cr}_2(\text{OH})_6$, $\text{Cr}_2\text{O}(\text{OH})_{10}$ and $\text{Cr}_2\text{O}(\text{OH})_4$.

In this paper the author supplements the statements in his previous communications, and discusses the constitution and some reactions of the solid green sulphate, arriving at the following conclusions:—

The solid green sulphate of chromium has the same composition as the violet sulphate, $\text{Cr}_2\text{O}_3 \cdot 3\text{SO}_3 \cdot 11\text{H}_2\text{O}$, but must possess an entirely different constitution. It does not behave like an ordinary salt since it will not take part in double decomposition, and the presumption is that the chromium is present in the form of a somewhat stable radicle. This view is supported by the fact that when decomposed by alkali, solutions of the green sulphate do not yield the normal hydrate, but one which is capable of combining only with 2 molecules of acid.

The solid green sulphate in solution is quite different from the non-crystallisable modified sulphate already referred to. Solutions of the solid green sulphate are slowly transformed into the normal violet modification. (See also Peligot, *Ann. Chim. Phys.* [3], **14**, 239, 1878.)

—W. M. G.

The Action of Hypochlorous Acid on Wool. E. Lodge.
Jour. Soc. Dy. and Col. 8, 60—64.

MERCER was the first to point out that wool, after treatment with a solution of bleaching powder has a greatly increased affinity for colouring matters, and the process has long been in use by woollen printers, and to a limited extent by dyers. Afterwards Lightfoot patented the above process with a view to producing aniline black on wool; but using his quantities the wool acquires a brownish-yellow colour and harsh feel. The author's experiments were made with a view to ascertaining whether these drawbacks can be overcome and the process made available in ordinary dyeing.

Wool treated with a cold solution of 2 to 2½ per cent. of its weight of bleaching powder—acid being added to liberate the HO.Cl—is not discoloured but slightly bleached; if 3 per cent. be exceeded or the solution become hot the brownish-yellow colour appears, but may be removed by reducing agents, such as SO₂ or SnCl₂. The action of chrome mordant and of colouring matters on wool thus prepared is given in the following tables:—

TABLE I.
Mordanting with K₂Cr₂O₇.

10 Grms. of	(1.) Ordinary Wool.	(2.) Prepared Wool.
K ₂ Cr ₂ O ₇ used.....	Grm. 0·3	Grm. 0·3
K ₂ Cr ₂ O ₇ left in bath.	0·18396	0·07008
K ₂ Cr ₂ O ₇ on fibre (by difference).	0·11604	0·22992

TABLE II.
Results obtained with various colouring matters.

Mordant.	Dye.	Result compared with unprepared Wool.
K ₂ Cr ₂ O ₇ ..	Logwood, Fustic, Alizarin, Alizarin blue, Alizarin Cyanine G, Alizarin Bordeaux, Anthracene brown, Anthracene yellow, Gambine R.....	Considerable increase in depth.
None	Magenta, Safranine, Brilliant green.	Increase in depth and much redder. Very little change.
None	Benzopurpurin, Hessian purple, Chrysamine.	Very little change.
None	Induline, Naphthol yellow S, Naphthol black, Acid black.	Great increase in depth.
FeSO ₄	Logwood, Fustic, Gambine R ..	Poor result.
None	Alkali blue, Camwood, Vat Indigo.	Good result.

More details with regard to the above will be found in the original paper.

In summing up the results it will be seen that dyes requiring mordants give the best result on the prepared wool, which may be accounted for by the increased amount of mordant fixed. Then come those requiring acid to fix them, *e.g.*, induline, naphthol black, &c. Those dyed in neutral baths are little influenced. The bad results obtained with FeSO₄ mordant may be attributed to oxidation to ferric salts, the latter not being good wool mordants.

Owing to our lack of knowledge as to the constitution of wool, it is difficult to determine the chemical or physical action of the HO.Cl, but the author inclines to the opinion that oxidation of the fibre takes place. It cannot be a chlorination since other oxidising agents produce similar results to those obtained with HO.Cl. Probably the reducing agent existing in wool is rendered inoperative by

the treatment, and quite possibly the fading of many colours may be attributed to this reducing agent acting as a carrier of atmospheric oxygen—an idea rendered more probable from the fact that dyes when fixed with oxidising mordants (*e.g.* K₂Cr₂O₇) are faster to light than when used in conjunction with alum or tin. The author is now experimenting with hypochlorites of aluminium and tin with a view to preparing and mordanting the wool in one operation.

Several of the author's statements are at variance with the results of other experimenters, and require confirmation.
— W. M. G.

The Printing and Steaming of Woollen Tissues. Oesterr. Wollen-u. Leinen-ind. 1892, 12, 62.

WOOLLEN piece-goods are now printed exclusively by roller, a thick blanket and soft thick back-cloth being necessary for full impressions. After printing, the pieces should be dried at a gradually increasing temperature, and should be exposed to as little heat as possible after becoming dry. For thickening the printing colours, gum tragacanth paste, British gum, and soluble, natural gums are employed. Examples of suitable printing mixtures are given below.

Black.—For woollen muslins which have been or are subsequently to be dyed pale shades of blue, rose, cream, &c., the following mixture is employed:—2,600 parts of water; 775 Naphthol black; 45 Patent blue B; 2,400 tragacanth paste (1:60); 1,800 British gum; 300 acetic acid at 6° B; 95 alum and 168 oxalic acid; the whole being well boiled, then cooled, and whilst cooling mixed with 120 parts of powdered sodium chlorate.

For printing on scarlet-dyed tissues, a mixture of Naphthol black and Acid green is preferable to the above.

Red.—Excellent bright reds are obtained with the various brands of ponceaux. Ponceau 2R is mostly used, as in the following recipe:—1,550 parts of water; 155 Ponceau 2R, 1,200 tragacanth paste (1:60); 950 British gum; 300 acetic acid at 6° B; 45 alum.

Azoearmine, in spite of its sparing solubility, is very useful for crimsons, yielding very even colours.

For dark reds, Azorubin, Amaranth and Amaranth B are employed. These may be darkened into chocolates, browns, or prunes by addition of various proportions of Naphthol black. Pinks are produced with Erythrosin, Rosebengal, and Rhodamine. The following recipe illustrates the application of the last-named dye:—28 parts of Rhodamine, 600 water; 1,200 tragacanth paste (1:60); and 650 white dextrin are boiled together and whilst hot mixed with a solution of 42 parts of tartaric acid in 400 of water.

Orange.—Any acid orange dye may be used in the same manner as Ponceau 2R.

Yellow.—All the yellow dyes available with the exception of Tartrazin and Miling yellow, which are too expensive for general use, possess the defect of staining the whites. Tolerably good results, however, are obtained with Fast yellow: a standard mixture is made with:—2,800 parts of water; 450 Fast yellow R; 2,200 tragacanth paste (1:60); 1,550 British gum; 775 acetic acid at 6° B; 45 alum; and then reduced according to the shade required.

Latterly, Uranin (fluorescein) has found employment as a brightening-colour. It is applied in the same way as Rhodamine, and although much of it is removed from the fibre on washing, it does not stain the white.

Brown.—Dark red shades of brown, namely, prune, puce, &c., are satisfactorily obtained with mixtures of Amaranth or of Amaranth B and Naphthol black. Yellow shades of brown are difficult to obtain, the various Acid browns not printing evenly. That of the Badische Co. can be employed for small patterns but is quite unfit for ground colours.

Violet.—Acid violet and Fomyl violet give good results. The latter is very suitable for heliotropes.

Green.—Acid green is used along with tartaric acid. For pale shades Malachite green is also employed.

Blue.—The dark blue grounds so much in vogue are obtainable with the following mixture:—2,600 parts of

water; 325 Fast blue 2 B; 1,400 tragacanth paste (1:60); 1,750 British gum; 6,500 acetic acid at 6° B., which is boiled and further mixed with 90 parts of stannous chloride dissolved in 400 parts of water.

Bright blues are produced with Alkali blue or Patent blue, both of which print very satisfactorily.

Steaming.—This must be carried out immediately after printing. The goods are wrapped in folds of damp, unbleached calico and steamed for three-quarters to one hour, as a rule without pressure. They are then washed in running water, and, after squeezing out the excess of water, passed through a thin paste of gum tragacanth and starch, and then dried on a stentering-frame and finally hot pressed.

—E. B.

Progress in Wool Dyeing: a Lecture delivered before the German Society for the Promotion of Industries.
O. N. Witt. Chem. Zeit. 1892, 16, 142—143.

A STRIKING change in the industry of wool-dyeing is due to the greatly increased employment of the so-called Alizarin colouring matters. This has arisen from the demand made of late years for a high degree of fastness of dyed colours, combined with richness of shade, the majority of artificial substantive dyes, although yielding full bright colours, not being sufficiently fast. The group of Alizarin colouring matters at present includes many dyestuffs which are not derivatives of anthracene, and which resemble alizarin only in their mode of application. Such are Carbazol yellow and Wool yellow, which belong to the class of azo-dyes, but which possess the property of combining with the mordanting oxides of the iron group. The members of the nitroso-class of colouring matters are also included since they possess the same property. Several of these, for example, the Gambins (nitrosonaphthols) and Fast myrtle (diuitrosoresorcinol) are especially commendable, on account of the fastness of the colours they yield. The following compounds are all hydroxy-quinones:—

Alizarin, Alizarin S, 2 S, and 3 S (sulphonic acids of alizarin, anthrapurpurin, and flavopurpurin), Alizarin-orange (β -nitro alizarin), Alizarin-maroon (an amido-alizarin), Alizarin-blue, Alizarin-indigo-blue, Alizarin-green (hydroxy-derivatives of Alizarin-blue), Anthracene-brown (anthragalloi), Galloflavin, Coerulein, and Alizarin-black (dihydroxy- α -naphthaquinone). Of these, Alizarin-blue and its allies, Coerulein and Alizarin-black, owing to their slight solubility, could not be employed for dyeing until Brunck discovered a method of rendering them soluble by treatment with sodium bisulphite. The bisulphite compounds so produced are distinguished by the marks S, S W, &c. The Alizarin-blue colouring matters, as a result of this discovery, are now largely employed, and rank amongst the fastest known, surpassing indigo in their resistance to light, washing, soaping, and particularly to rubbing. Coerulein and Alizarin-black are also exceedingly fast. The above colouring matters are almost exclusively applied on the chrome mordant.

The author, in conclusion, draws attention to the fact that indigo and logwood are extensively employed in Germany for dyeing military cloths, and recommends, as a national economy, their speedy replacement for this purpose by Alizarin-blue and Alizarin-black.—E. B.

Progress in Wool Dyeing. Chem. Zeit. 1892, 16, 203.

A CRITICISM of the preceding paper of O. N. Witt. The writer dissents from the opinion that "Alizarin-blue surpasses indigo in its fastness to light, washing, soaping, and especially rubbing," asserting that it is well known that in pale shades the blue is only moderately fast, particularly to light, and greatly inferior to indigo in this respect, whilst in dark shades it becomes, on exposure, darker and duller, whereas indigo retains its primitive colour. Only to rubbing is Alizarin-blue faster than indigo, but it has the advantage of penetrating the material better and of giving better shades than the latter. As regards Alizarin, the fact that this colouring matter bleeds in milling, is an obstacle to its employment for wool.

Alizarin-black is at present too expensive to compete seriously with logwood, the costs of dyeing black with these two dyestuffs being in the ratio of 65:28. This, however, does not prevent the first named dye from finding employment in the production of compound shades, although for this purpose also there are other artificial colouring matters at the dyer's disposal which are quite as fast and at the same time cheaper. It is further worthy of note that a logwood-black dyed on an iron mordant is much faster to light than one dyed on chrome. Anthracene brown is perhaps the one dye of the group worthy of Witt's general praise. This gives very even and fast shades. Wool-yellow, on the other hand, is indisputably inferior to fustic in resistance to light.

The writer agrees with O. N. Witt that a substitution of the Alizarin colouring-matters for imported dyestuffs in the dyeing of military goods is desirable, but not on the ground of the greater fastness of colour in general obtainable with the former, but as a means of augmenting the national wealth of Germany.—E. B.

Progress in Wool Dyeing. O. N. Witt. Chem. Zeit. 1892, 16, 251—252.

A REPLY to the anonymous writer of the preceding article. The author states that he is aware that alizarin is of less importance in wool dyeing than the other colouring matters of the group, but that it is employed along with the others for dyeing compound shades. It gives faster shades on chrome than on alumina. The fact that several azo-dyes yield brighter, cheaper, and equally fast colours, will for most purposes prevent alizarin being largely employed for wool. With respect to the relative costs of the Logwood and Alizarin-blacks nothing was said by the author, who does not deny the greater cost of the latter. He is also unable to refute his critic's remarks as to the greater stability towards light of the iron Logwood-black, but points out that this has long ago been abandoned in favour of the chrome Logwood-black, and that with regard to its behaviour towards acids, the iron Logwood-black is almost as sensitive as litmus paper, whereas Alizarin-black will withstand without injury carbonisation with acids. The author further alludes to the apparent inconsistency in his critic's statement that Alizarin-blue in pale shades is fugitive, whilst in dark shades it is faster than indigo.

—E. B.

The Reduction in Shade of Dyed Alizarin Colours.
E. Schnabel. Färber. Zeit. 1892, 186—189.

To render paler the colours of woollen materials which have been too deeply dyed, the author recommends, in the case of the so-called Alizarin colours, treatment with a solution of potassium permanganate or with hydrogen peroxide. The treatment with potassium permanganate is effected by immersing the wool in a solution of 1.25 per cent. (of the weight of the material) of the salt, acidified with 3 per cent. of sulphuric acid; the wool being moved about in this bath until the colour of the solution has changed from purple to brownish-yellow, which requires from 30 to 50 minutes, and then being treated in a separate bath with a solution of 10 per cent. of sulphurous acid to remove from it the brown deposit of manganese dioxide. This treatment does not sensibly injure the wool, and, provided the potassium permanganate is completely dissolved and the material properly immersed in the solution, it does not produce any irregularity of shade. The hydrogen peroxide is applied by diluting it with four volumes of water, immersing the wool for four hours, and afterwards slowly drying it. Ammonia may with advantage be added to the bath, except in treating Alizarin-red, when it must be omitted, as it alters the hue of the shade. Even when the peroxide is employed in a concentrated state, the wool is not injured, so that there is no possibility of impairing the strength of the fibre by this latter process.

The author has carried out a series of experiments with the object of measuring the diminution in intensity of shade produced by each of the above two methods of treatment.

For this purpose a number of patterns was mordanted with 3 per cent. of potassium bichromate and 2.5 per cent. of tartar and dyed with the various colouring matters mentioned in the appended table. Portions of them were then treated in the manner indicated above and compared with portions kept for reference and with patterns similarly mordanted but dyed with different amounts of the same colouring matters. The results are given below :—

Name of Dye and quantity Employed.	Effect of Treatment with Potassium Permanganate.	Effect of Treatment with Hydrogen Peroxide.
Anthraccene-brown (paste), 10 per cent.	Loses about 55 per cent. of colour.	Loses about 60 per cent.; shade becomes yellower.
Cerulein (paste), 10 per cent.	Becomes much paler and yellower; original shade may be re-obtained by dyeing with 3 per cent. of Alizarin-blue S W (paste).	Becomes much paler, duller, and redder; similar to shade obtained with 3 per cent. of Cerulein and 1 per cent. of Anthracene-brown.
Alizarin - black S W (paste), 10 per cent.	Is changed to a shade obtainable with 3.5 per cent. of Alizarin-black and 2.5 per cent. of Anthracene-brown.	Loses 20 to 25 per cent.
Alizarin - black S R W (paste), 10 per cent.	Affected similarly to preceding dye.	Loses 40 per cent.
Alizarin - grey G, 10 per cent.	Loses 20 per cent. and becomes redder.	Becomes paler and redder, like shade produced with 5 per cent. of Alizarin-grey R.
Alizarin - green S W (paste), 10 per cent.	Loses 15 to 20 per cent.	Loses about 20 per cent. and becomes rather yellower.
Alizarin - orange (paste), 10 per cent.	Is rendered slightly paler and yellower.	Unaltered.
Galloflavin (paste), 10 per cent.	Loses its reddish hue and is reduced about 20 per cent.	Is changed to a dull drab.
Alizarin - yellow (paste), 10 per cent.	Becomes redder and slightly duller.	Is changed to a buff-yellow, like that obtained with 10 per cent. of Galloflavin W.
Alizarin W B (paste), 10 per cent.	Paler and much yellower, resembling shade obtained with 3 per cent. of Alizarin W B and 2 per cent. of Alizarin S (powder).	Unaltered.
Alizarin S (powder), 2 per cent.	Is changed similarly to preceding dye, but to a less extent.	Unaltered.
Alizarin-blue S W (paste), 10 per cent.	Loses 10 per cent.	Loses about 20 per cent.; shade rendered greyer.
Alizarin-blue W X (paste), 10 per cent.	Affected similarly to preceding dye.	Affected similarly to preceding dye.
Alizarin - blue D N W (paste), 10 per cent.	Loses 5 to 10 per cent.	Loses about 10 per cent. and becomes duller.
Alizarin-blue W R (paste), 10 per cent.	Is not so much altered as Alizarin-blue S W; hue unaffected.	Is rendered much paler and duller, similar to shade obtained with 1 per cent. of Alizarin-black S W, and 15 per cent. of Alizarin-blue S W.
Alizarin-blue W G (paste), 10 per cent.	Loses 20 to 25 per cent.	Much paler and greyer; shade resembles that obtained with 3 per cent. of Alizarin-blue S W, and 2 to 2.5 per cent. of Cerulein.

Name of Dye and Quantity Employed.	Effect of Treatment with Potassium Permanganate.	Effect of Treatment with Hydrogen Peroxide.
Alizarin - indigo - blue S M W (paste), 10 per cent.	Unaltered.	Rendered very slightly greener in hue.
Alizarin - indigo - blue S W (paste), 10 per cent.	Loses about 15 per cent.	Loses about 10 per cent. and becomes yellower and duller.
Gallein (paste), 10 per cent.	Loses about 15 per cent. and becomes greyer.	Loses 45 to 50 per cent. and becomes greyer.
Alizarin-blue R R, 10 per cent.	Is very little changed.	Is very little changed, rather brighter.
Alizarin - black-blue, 10 per cent.	Loses about 15 per cent.	Loses about 20 per cent.
Alizarin - cyanin 3 R extra (paste), 10 per cent.	Loses about 15 per cent.	Loses about 40 per cent. and becomes redder and duller.
A pale shade of indigo similarly treated.	Is reduced about 25 per cent., but is not altered in hue.	Is rendered only paler.

—E. B.

Note on the Application of Alizarin Yellows, 2 G and R. P. Werner. Bull. Soc. Ind. Mulhouse, 1892, 198—199.

See under IV., page 599.

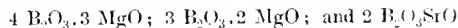
VII.—ACIDS, ALKALIS, AND SALTS.

The Metallic Borates. H. Le Chatelier. Compt. Rend. 1891, 113, 1034—1036.

THE author considers that the chemistry of the borates is in a very unsatisfactory condition, since one finds indicated in books no less than 11 proportions in which boric acid can combine with bases.

The only borates of which the formulae have been indisputably established are the two hydrates of boric acid $B_2O_3 \cdot H_2O$ ($BO(OH)_2$) and $B_2O_3 \cdot 3 H_2O$ ($B(OH)_3$).

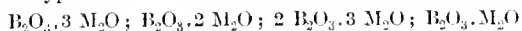
Acid borates containing more than one equivalent of acid to one of base do not exist, anhydrous borates to which such formulae have been attributed being mixtures. The substances—



are specially characterised as mixtures.

Hydrated acid borates all contain water which does not volatilise *in vacuo* at 100° C., or even in some cases at 150° C. This cannot be taken to be water of crystallisation, but must be considered as water of constitution, as in the case of the phosphates.

The only borates of which the formulae can now be considered established belong, therefore, to one of the four types—



—W. M. G.

PATENTS.

Improved Process or Means or Arrangements for the Manufacture of Carbonic Acid Gas. D. Rylands, Barnsley, Yorkshire. Eng. Pat. 9575, June 5, 1891.

BICARBONATE of soda or any other suitable material from which carbonic acid gas may be evolved by merely heating is subjected to the action of heat in a series of retorts. The evolved gas is either stored in gasometers, or pumped

into cylinders, or used directly. The residue is, of course, much more valuable commercially than is that usually obtained where the carbonic acid gas is generated by the action of an acid.—T. L. B.

Improvements in the Treatment of Waste Liquors from Metallurgical Processes to Obtain Sulphurous or Sulphuric Acid and Lime. A. T. Hall, Hull. Eng. Pat. 9947, June 11, 1891.

See under X., page 613.

Improvements in the Treatment of Waste Liquors from Metallurgical Processes to Obtain Sulphurous or Sulphuric Acid and Oxide of Iron. A. T. Hall, Hull. Eng. Pat. 9948, June 11, 1891.

See under X., page 613.

Improvements in the Manufacture of Potassium Carbonate. A. Dupré, Westminster, Middlesex. From F. Dupré, Stassfurt, Germany. Eng. Pat. 10,630, June 22, 1891.

163 parts of water together with 53 parts of sodium carbonate and 42 parts of sodium bicarbonate are heated together to 40° C., after which 50 parts of potassium sulphate are added every quarter of an hour for six or eight times, the temperature having been gradually raised to 70–75° C. Finally the whole is filtered rapidly; the filtrate on cooling deposits some potassium sulphate and sodium bicarbonate, leaving a solution of nearly pure potassium carbonate, which now merely requires evaporation. By using sodium carbonate alone instead of both carbonate and bicarbonate, the solution of potassium carbonate obtained is less pure. The potassium sodium sulphate obtained as residue in the first operation is, for the purpose of reconversion into potassium sulphate, treated with a solution of potassium chloride.—T. L. B.

A New or Improved Method or Process for the Production of Alkaline Cyanides. P. R. de Lambilly, Paris, France. Eng. Pat. 1032, January 19, 1892.

When ammonia gas is passed over a heated mixture of carbonate of sodium, or of potassium, or of barium, and finely powdered charcoal, the corresponding cyanide of the metal is obtained. The patentee works the process in two stages; first of all he passes ammonia over heated charcoal for the purpose of obtaining ammonium cyanide, and this is then passed over the mixture of sodium carbonate and charcoal after heating this to redness.—T. L. B.

An Improved Process for the Purification of Brine. C. G. Collins, Woodburgh, King's County, U.S.A. Eng. Pat. 4527, March 8, 1892.

The brine is treated simultaneously with oxygen and an electric current having an electro-motive force not exceeding 2½ volts. The impurities are then removed mechanically. A diagrammatic sketch is given.—T. L. B.

Method for Making Caustic Soda (Sodium Hydrate). J. C. Ody, Millbrook, near Southampton. Eng. Pat. 5125, March 19, 1892.

To a solution of calcium phosphate is added a solution of sulphate of soda. The clear solution of phosphate of soda obtained is boiled with caustic lime whereby phosphate of lime is precipitated and a solution of caustic soda obtained.—T. L. B.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

The Mirror and Plate-Glass Industry of Bohemia. Report of the U.S. Consul at Prague. Board of Trade J., July 1892, 9–13.

THE following account of the mirror and plate-glass industry of Bohemia is extracted from a recent report by the United States Consul at Prague:—

For over 200 years the mirror-glass industry has been established in Bohemia, just across the Bavarian frontier, this location being selected on account of the good, plentiful, and inexpensive supply of fuel guaranteed by the surrounding forests. In fact, it is claimed that the first impulse to the building of glass works was given by the owners of forests, who thereby sought to render their position more profitable.

In 1728 the Austrian Government started a mirror-glass factory at Neuhaus; but the enterprise was a failure, in spite of Governmental subventions, and was abandoned. The production of large mirrors in France and the perfection of silvering by the quicksilver process had the effect of stimulating the manufacture in Bohemia, and at the beginning of the nineteenth century mirrors with a surface of 3 square metres were turned out. The perfection of the casting process restricted the manufacture in the Bohemian glass works to the smaller sizes of blown or sheet glass.

To get an insight into the mirror-glass manufacture of Bohemia it is essential first of all to take account of the production of the crude or unwrought glass. Here a distinction must be made between the production by the blowing process and that by the casting or rolling process. Blown or sheet mirror-glass is made by seven firms in Bohemia, operating 20 glass furnaces, in which are 120 glass pots. One firm is engaged in the production of rolled glass, operating one furnace with 12 glass pots. In the refining process—i.e., grinding, smoothing, polishing, and silvering—there are 10 firms engaged. As already explained, the unwrought glass is blown or rolled, and mirror-glass is accordingly divided into sheet glass and rolled glass. The rolled glass is called crystal glass in commerce, and sheet glass sometimes thin mirror-glass. The reason for this lies in the fact that sheet glass has a thickness of only 5 millimetres, while rolled glass is often over 10 millimetres thick.

In both processes the glass mixture is melted in about the same manner, and the purest and best materials are used. The process in the factory from the moment when the glass is run out of the glass pots is something after the following description:—

The glass pots have to be refilled, and this is the work of the smelter. The various component materials—crystal sand, soda, calcite, charcoal, and powdered arsenic—are mixed in the proper proportions and placed in the empty glass pot, this filling being repeated after an interval of four or five hours. After the smelter has put in the second quantity, he heats the furnace to such a point that melting begins in 12 or 14 hours. When the mixture is melted, the smelter must see to it that it is clear and free from air bubbles, for which purpose he purifies the glass by subjecting it to a more intense heat. This purifying is accomplished generally in about eight hours. The glass being in a molten condition, the finishing process begins. When the glass is to be blown, a wait of 10 or 12 hours has to take place, until the liquid glass has become thick enough for the glass-blower to take it up on his blow pipe. On the other hand, when glass is to be rolled, the contents of the glass pot are poured on the casting table immediately after melting and rolled at once, the fluidity of the glass being an essential in this process.

In both the blowing and rolling processes of manufacturing crude mirror-glass, the glass is unwrought and imperfectly transparent. In order to even the rough surface, the grinding apparatus is used, and, after being properly ground, the polisher imparts the clear, shining surface to it. Both the grinding and the polishing of mirror-glass is done by machinery, while the smoothing is best done by hand; but even

the smoothing process is effected by means of machinery in the case of large-sized plates.

Grinding and Smoothing.—In the process of grinding, a large flat stone rests on a solidly constructed wooden base, and on the top of this stone a layer of burnt and sifted gypsum is placed, when is then converted into a pasty cement by adding water. This cement is spread evenly on the stone, and the glass is laid upon it and pressed firmly until it adheres to the gradually hardening gypsum. A somewhat smaller stone, called the upper stone, is similarly prepared, and another plate of glass laid upon it, when the two stones are brought together so that the glass surfaces touch each other. A twofold motion is given to the upper stone—about its own axis and in a circle from right to left. Sand and water are then poured between the two glass surfaces, and the grinding begins by setting the upper stone in motion, the power being supplied by machinery. The first grinding begins, and the surface of the glass gradually becomes smooth, the elevations in the glass being reduced by the sand. As the two plates of glass begin to show an even surface, finer sand is used, and the so-called second grinding takes place. After one side of the glass is ground, it is turned over and the reverse side submitted to the same operation. The sand used has seven different grains, from the coarsest to the finest. When both surfaces have been made even in the manner described, there is still too rough a surface to permit of successful polishing, and they must be subjected to the smoothing process. Here, again, one glass is laid upon the other, and a cement of continually increasing fineness used, the cement being applied to the moist and rough glass surface, and the surfaces carefully rubbed together by hand. After the smoothing process is finished the glass is carefully examined and all flawless pieces given to the polishers, while those containing flaws are cut up into small sizes.

Polishing.—Polishing is done by specially-constructed machinery, and is, properly speaking, an advanced stage of smoothing. It differs from the smoothing process in that the glass surfaces are not applied to each other, but a wooden or iron surface, covered with cloth, is substituted, and further, that a fine mixture of oxide of iron replaces the harder cement. The polisher fixes the glass by means of plaster or cement to a firm support, usually a flat stone, and moistens the cloth-covered rubbing implement, which receives a forward and backward motion by connexion with mechanical apparatus. The polishing implement is kept in motion until that portion of the glass over which it passes has obtained a high polish, when the glass is moved so as to expose another portion of its surface to the polisher. When the entire surface is polished, and it contains no flaws, it is ready for the silvering process. The large mirror-glasses are often put on the market, however, in the polished condition, especially the large rolled plates which are used for show windows.

In describing the foregoing different processes for preparing mirror-glass, it remains to be said that a so-called circular grinding apparatus has come into use lately in Bohemia, especially in the grinding of rolled glass. This apparatus is expensive, but it does the work at least five times as rapidly as by the other process. For rolled glass machinery is also used in the smoothing process, and a circular polishing apparatus has been introduced. This apparatus has been used in Bohemia only for rolled glass. After the polishing it is only necessary to put a face on the glass and it goes to the silverer, who gives the essential qualities of the mirror to it. In Bohemia both quicksilver and silver are used for this purpose. The quicksilver process is really the application of an amalgam of tin to the glass surface, the silver process the precipitation of nitrate of silver on the glass. The quicksilver process is being almost entirely replaced by the silver process in late years, both on account of the greater facility of the process and on account of the less injurious effect on the health of the workmen, so that almost all of the mirrors now are silvered ones.

The wages of glass-blowers, grinders, polishers, and smoothers in Bohemia are calculated by the piece,

according to its size. In the rolled-glass manufacture the workmen are paid monthly wages, the average monthly wages being 50 florins. As compared with other countries the wages paid are very low. The common day labourer averages 50 kreutzers a day in the winter and 60 kreutzers a day in the summer. A glass-blower can average from 200 to 250 florins a month under favourable conditions. In the glass refineries a workman earns from 20 to 50 florins per month according to his employment. Skilled workmen are paid from 1 to 1.50 florins per day, unless they work by the piece.—W. S.

PATENTS.

Improvements in the Method of Manufacturing Glass Bricks. H. D. FitzPatrick, Glasgow. From M. Schreiber and L. Oettinger, Berlin. Eng. Pat. 4525, March 8, 1891.

The glass bricks are intended to replace the glazed or enamelled bricks as at present manufactured. The glazed or enamelled bricks do not stand the effects of weather, moisture entering through cracks in the glaze and ultimately penetrating the body of the brick, with the result that the glazing breaks off. Moreover, the glazing being applied in a very thin coat is easily damaged, and it is impossible subsequently to repair such damaged bricks.

The new bricks are made of glass or the front part is made of glass backed by some other material. When wholly of glass, the bricks are made hollow but of such thickness as to be of sufficient strength. If it is desired to have a coloured or ornamental face to the brick it is made in a divided mould, the material for the front part being run in and pressed first, the material for the back part being run in afterwards but whilst the front part is still hot. The divided mould is also used when it is desired to make the front part of the brick of better quality of glass.

—V. C.

Improvements in the Manufacture of Glass. T. C. J. Thomas, London. Eng. Pat. 7988, May 9, 1891.

The inventor was granted a patent (12,076, 1886; this Journal, 1888, 35), for eliminating impurities in the molten grit by subjecting the material to the action of a blast of oxygen.

The present invention consists in heating the said blast of oxygen, or of using heated atmospheric air instead of oxygen. The latter is the cheaper method, though of course a larger volume of gas has to be used. The air or oxygen is heated by a hot blast stove or by an air regenerator.—V. C.

Improvements in the Manufacture of Tanks or Boxes and other Articles of Glass, and in Mechanism or Appliances to be used in the said Manufacture. J. Armstrong, West Bromwich. Eng. Pat. 10,454, June 19, 1891.

The present patent relates to improvements in the invention patented May 2, 1889, 7346.

According to the invention patented in 1889, tanks, &c. are made by fusing together the edges of five plates arranged in suitable positions. The new furnaces now employed are furnished with vertical and horizontal openings for the introduction of the heating appliances and pressing tools. A special swivelling mould has been introduced, by means of which the different sides of the tank or other article can be readily brought into position. For making cylindrical articles a roll or drum has been introduced. The drum is furnished with a gripper. One of the edges of the glass having been bound to the drum, a complete rotation given to the said drum forms the glass into a hollow cylinder. Lastly the blow-pipe used for fusing together the edges of the several glass sheets or plates carries with it a pressing roll, which, being applied immediately after the blow-pipe, joins together the heated and softened edges.—V. C.

Improvements in and Connected with Kilns for Annealing Plate Glass. W. W. Pilkington, St. Helens. Eng. Pat. 10,661, June 23, 1891.

THE object of this invention is to enable plates to be readily deposited in the kiln, to permit of them having a considerable period of repose before being moved into the cooling-off leer or tunnel, and to provide improved means of moving the plates through the leer. A chamber on wheels is provided to receive the plates on leaving the casting table in which they are conveyed to the compartments. Carriers are provided in the leers by which the plates are transferred from one compartment to another. These carriers may be constructed with two or more platforms.—V. C.

An Improved Method of Producing Marbled Glass. C. F. E. Grosse, Berlin. Eng. Pat. 7792, April 25, 1892.

HITHERTO marbled glass has only been produced in smelting, and the expense of this method has limited its application. In this invention, instead of colouring the whole mass of the glass, the surface only is coloured. Any colour may be used, but preferably an opaque colour. When the blower has brought the last charge to the pipe, and has worked the mass regularly, a finely-ground flux is either sieved on or blown on by means of a blower. The mass, now somewhat coned, is replaced in the furnace till the coloured flux has fused. By proper manipulation the colour can be made to assume the most varied forms.—V. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

PATENTS.

Improvements in Machines for making Bricks, Tiles, and Similar Articles from Plastic Clay or other Material. S. Jerrieres, Stroud. Eng. Pat. 9216, June 1, 1891.

THE improvement consists in making the severance of the stream of clay, as it issues from the brick-making machine, automatic instead of depending upon the attention of the labourer in charge. For this purpose two devices are described, the first consisting in mounting the cutting wires on a frame capable of being traversed horizontally and actuated by mechanism set in motion by the pressure of the end of the stream of clay on a stop at the end of the table on which it travels. In the case of the second, the cutting wires are not drawn through the stream of clay, but a definite length of the latter is cut off by the first wire, which alone makes the traversing motion referred to, and the bar of clay thus measured out is thrust against the wires which are stationary.—B. B.

Improvements in the Treatment of Stone, Brickwork, Mortar, Plaster, or Stucco, and the like, for Preventing Deterioration thereof. H. Aitken, Darroch. Eng. Pat. 11,209, July 1, 1891.

THE patentee is of opinion that the decay of stone, brickwork, plaster, stucco, and the like arises in great measure from the attacks of living organisms, and accordingly proposes to stop these ravages by treating the material to be preserved with some substance inimical to low forms of life. Such are mercuric chloride, potassium cyanide, carbolic acid, paraffin oil, vinegar, naphthalene, and carbonic oxide. These substances are introduced into the pores of the material to be protected in a manner to be determined by their nature and that of the building material, by

applying them in solution, with or without heat or pressure. If soluble or volatile, they may be prevented from escaping by coating the surface of the material to which they have been applied by some such substance as paraffin wax. In general, the patentee prefers to use mercuric chloride in aqueous solution, 1 part in 15 or 30 being suitable for walls, and 1 in 500 for cement or stucco. Colouring or odourising agents may be added to the preservatives to prevent their accidental consumption by human beings or animals.—B. B.

An Improved Composition containing Coal Tar, Applicable as a Preservative Composition or Cement for Building or other Purposes. H. Seiling, Ahlen, Germany. Eng. Pat. 14,948, September 4, 1891.

ONE kilo. of coal tar is mixed while hot with one quarter of a litre of sulphuric acid of sp. gr. 1.5, and the product mixed with one half to the whole of its weight of unburnt powdered gypsum. The composition is said to stick to wet surfaces, and to be useful for making walls and roofing damp proof.—B. B.

The Manufacture of an Improved Compound for Coating Walls or other Surfaces, and for Analogous Purposes. N. Norwood, Denmark Hill. Eng. Pat. 21,374, December 7, 1891.

THE patent relates to a composition similar to that described in Eng. Pat. 21,199 of 1891 (this Journal, 1892, 525), which consists essentially of a mixture of glue and plaster of Paris. In this case one hundredweight of whiting is mixed with 5 to 8 lb. of glue without the addition of water, and heated until the mass is rendered friable, when it may be reduced to powder. Water may be added in the course of preparation, if insufficient be present in the whiting and glue to effect the desired blending. Half a pound to a pound and a half of zinc sulphate may be added if required. The product, which may be coloured by any suitable means, is said to be usable with cold instead of hot water.—B. B.

Improvements in the Manufacture of Hydraulic Cement for Building Purposes. V. F. L. Smidth, Copenhagen, Denmark. Eng. Pat. 6745, April 8, 1892.

HYDRAULIC cement is mixed with sand, gravel, or ballast, and finely ground, constituting a mixture which the patentee calls "sand cement." This composition is said to form an efficient mortar when mixed with sand or other inert aggregate in the same manner as undiluted cement, the grinding causing the cement to be distributed very evenly throughout the mass, and thus coat the sand particles more perfectly. A dilution of as much as 16 parts of sand to one of cement is said to be attainable without unduly impairing the adhesive power of the cement.—B. B.

Improvements in the Construction of Kilns for Burning Limestone, Cement, and other similar Materials. J. Briggs, Clitheroe. Eng. Pat. 7308, April 16, 1892.

THE kiln consists of an inverted truncated cone with a domed roof, into which a conical hopper serves to convey the limestone or other material to be burnt, mixed with a small quantity of fuel. The bulk of the fuel is introduced by side openings provided with cast-iron covers. The burnt lime or cement is drawn off at the bottom by a door provided for that purpose. In the construction of the kiln a thickness of about 2 ft. of clay should be left behind the brickwork, the result being that this eventually forms a compact mass serving to support the walls of the kiln.—B. B.

Improvements in and in the Manufacture of Plaster for Building Purposes. W. P. Thompson, Liverpool. From L. O. Roeser-Müller and B. Deike, Munich, Germany. Eng. Pat. 7502, April 20, 1892.

A "porous plaster" for building purposes is formed by adding bicarbonate of soda alone or with a limited amount of dilute acid to ordinary plaster of Paris. The following is the prescription given. "For 1 cubic centimetre (*sic*) of porous plaster: 500 grms. gypsum + 700 to 750 grms. water, 23 grms. bicarbonate soda, 20 grms. sulphuric acid 5 per cent., 23 grms. bicarbonate soda, 15 grms. sulphuric acid 5 per cent. In place of the acids, equivalent quantities of salts (such as acid tartrates, acetate of alumina, &c.) may be employed." The composition is said to be light, 1 cubic metre weighing only 640 kilos., as against 1,230 kilos. for ordinary plaster of Paris also to be a bad conductor of heat and sound, and to be unaffected by dry rot even when it contains, as an alternative, wooden laths, osiers, rushes, and the like organic material.—B. B.

An Improvement in the Art of Making Mortar. E. T. Warner and J. F. Curry, Wilmington, U.S.A. Eng. Pat. 7850, April 26, 1892.

The method applies to ordinary and not to hydraulic mortar, and consists in the preparation of the lime by admixture with water, and if necessary sifting or straining and subsequent settling in a tank or reservoir until it assumes a putty-like smoothness, and mixing with sand in a mortar mixer. The mortar mixer may be of any ordinary construction, but that illustrated and described consists of a circular trough, rotated about a vertical axis by toothed gearing, and provided with two stirring shafts and a conical valve for permitting the discharge of the mortar from the bottom of the pan when mixture is complete. The chief claim is the thorough slaking of the lime and the production of a homogeneous paste therefrom.

—B. B.

X.—METALLURGY.

The Estimation of Slag in Wrought Iron. A. E. Barrows and T. Turner. Proc. Chem. Soc. 1892 [113], 122—123.

See under XXIII., page 636.

Temperatures Developed in Industrial Furnaces. H. Le Chatelier. Compt. Rend. 114, 470—473.

A SERIES of determinations of the temperatures developed in certain processes have been made by M. Le Chatelier employing his recently improved pyrometric methods. The scale of temperatures adopted was that of Violle, viz.:—

Melting points of			
Sulphur.	Gold.	Palladium.	Platinum.
148°	1,045°	1,500°	1,775°

The following results were obtained:—

Melting point of white Swedish pig-iron	1,135°
" " grey cast iron	1,220
" " ingot iron (carbon = 0.1 per cent.)	1,475
" " mild steel (carbon = 0.3 per cent.)	1,455
" " hard steel (carbon = 0.9 per cent.)	1,410

Temperature of the flame from a Bessemer "Robert" converter:—

At the "boil" period	1,330°
At the finish	1,580

Bessemer steel and slags (after pouring):—

Temperature of slag	1,580°
" of steel in the ladle	1,640
" of steel in the mould	1,580
" of solidification of the scale	1,340
" of reheating furnace	1,200
" of ingot under the hammer	1,080

Siemens-Martin furnace with charge of mild steel:—

Temperature of the gaseous fuel on leaving the producer	720°
" of the gaseous fuel on entering the regenerator	400
" of the gaseous fuel on leaving the regenerator	1,200
" of the air on leaving the regenerator	1,030
" of waste gases going to the chimney	300
" of furnace when the charge melts	1,420
" of furnace during refining	1,500
" of the tapped metal in the ladle at the beginning	1,580
" of the tapped metal in the ladle at the finish	1,490
" of the tapped metal in the mould	1,520

For ingot iron the temperatures are 50° higher, but the same difference exists between the temperature of the metal at the beginning and end of the tapping, indicating that the bath is hotter in the centre than at the sides. In the Siemens-Pernot furnaces the last portions of the tappings are the hottest.

Siemens crucible steel-melting furnace:—

Temperature of the space between the crucibles	1,600°
--	--------

Rotary puddling furnace:—

Temperature of the cast iron in the ladle	1,340°
" " " furnace	1,230
" of the bloom at the end of the operation	1,330

Blast furnace producing grey-pig for Bessemerising:—

Temperature of hearth in front of tuyere	1,930°
" of charge on tapping first portions	1,400
" of charge on tapping last portions	1,570

Crucible furnace for glass-making:—

Temperature of the furnace between crucibles	1,375°
" of the glass in the crucibles during firing	1,310
" of the glass in the crucibles during working	1,045
" of window glass during spreading	600

Siemens glass-melting furnace:—

Temperature of furnace	1,400°
" of melted glass	1,310
" of bottles during annealing	585

Siemens furnace for illuminating gas heated by a producer burning coke:—

Temperature of the furnace at the top	1,190°
" " " bottom	1,045
" of retort at close of distillation 1 m. from the top	875
" of retort at close of distillation 1.5 m. from the top	950
" of waste gases going to the chimney	680

Furnace for firing hard porcelain:—

Temperature at the finish	1,370
---------------------------	-------

Hard porcelains are fired at almost exactly the same temperature in different localities, as Sevres, Bayeux, &c.

Hoffmann furnace for red bricks:—

Temperature of firing	1,100°
-----------------------	--------

Electricity:—

Temperature of incandescent lamps	1,800°
-----------------------------------	--------

This determination was made on a lamp in ordinary working order. When hard pressed the temperature may exceed $2,100^{\circ}$.

The author concludes by drawing attention to the abnormal lowness of the temperatures given above, and suggests that the higher values generally received are affected by one or more of the following sources of error:—1st, The selection of the highest value from a number of determinations owing to the feeling that the temperature of a body should be proportional to its brilliancy and to the quantity of fuel consumed in heating it, which factors in reality, however, increase much more rapidly than the temperature. 2nd, The use of a pyrometric method with the assumption that the specific heat of iron is constant. 3rd, The fusion of platinum in gases charged with particles of molten metal, and the conversion of palladium into a spongy mass by a temporary oxidation or hydrogenation.—S. B. A. A.

A Non-oxidising Process of Annealing. H. P. Jones.
Eng. and Mining J. 1892, 53, 83.

THIS paper records experiments on a non-oxidising process for annealing iron and steel. The usual process of annealing consists in heating the metal to a red heat and then allowing it to cool slowly. During this operation the metal becomes oxidised and a scale is formed which is expensive to remove. The new process consists in heating the metal in a retort which is filled with illuminating gas and is in communication with a gas holder containing gas, by which means allowance is made for the expansion and contraction of the latter and for any slight leakage. The articles after treatment are perfectly bright, and articles which have been blued or oxidised can be rendered bright by this means. A further great advantage is that the process is entirely mechanical and requires no technical skill on the part of the operator.

In order to obtain an idea of the value of the process, specimens of metal produced by it were compared with others obtained by heating in the open fire, and cooling in ashes, and also with specimens which had been annealed in nitrogen, since it has been stated in connexion with non-oxidising annealing processes that "nitrogen should be perfectly harmless and efficient; hydrogen and hydrogen-bearing gases might be injurious; carbonic acid would oxidise the iron; and even carbonic oxide would oxidise it slightly, but perhaps so slightly that its effects would be wholly removed in drawing." (H. M. Howe, Metallurgy of Steel, 1891, p. 225.) The specimens heated in coal-gas and nitrogen respectively were placed in retorts which were heated in the same fire and for the same length of time. The experiments were made on steel wire turned down to diameter of 0.156 and 0.150 in., and the resulting specimens were compared by determining their elongation. The general results were that samples obtained with illuminating gas were practically as good as those with nitrogen, the percentage of elongation being generally slightly greater with nitrogen than with illuminating gas, so that if the value of the metal be taken as equal to the product of the percentage of elongation by breaking load, then the value would be slightly greater with nitrogen than with illuminating gas. Specimens annealed in the open fire gave elongations much below those of specimens annealed in either gas. Representing the efficiency of metal annealed in nitrogen as 100 then that obtained with illuminating gas is 95, and that of the ordinary process 86.—H. K. T.

The Uses and Applications of Aluminium. G. L. Addenbrooke. Jour. Soc. Arts, 40, 661—668.

THE author stated that the scope of this paper was limited to pure aluminium, or to the metal alloyed with a few per cents. only of other metals, and did not extend to so-called "aluminium bronzes" containing only a few per cents. of aluminium.

Three years ago the cost of the pure metal was about 60s. per lb., when the Deville-Castner process was put into operation, which was expected to produce it at about 20s. per lb. But the more recently introduced electrolytic

methods have rapidly brought the price down. A year ago the Pittsburg Reduction Co. announced that they were prepared to supply it at 4s. 2d. per lb., and at present the Aluminium Industry Co., of Neuhausen in Switzerland, supply it of 99 per cent. guaranteed purity at 2s. per lb., a cost *bulk for bulk* not much greater than that of copper. The two patented processes under which most of the aluminium at present produced is manufactured are those of Hall and Heroult, which are almost identical. In both cases alumina is dissolved in a flux of the fluorides of aluminium and sodium. The fused mass is placed in an iron furnace thickly lined with carbon, which forms the cathode of an electric circuit. A large block of carbon carried on an adjustable support so that it can be dipped into the cavity of the furnace forms the anode. Two or more of these furnaces are arranged in series, the anode of the first being connected with the cathode of the second, and so on.

In starting the plant the earbons are brought well down into the furnaces and the current from a dynamo is turned on. At first there is a good deal of resistance, but as the materials in the furnace get warm this decreases, and the anodes can be raised somewhat. Decomposition of the alumina takes place at about a full red heat, the oxygen partly unites with the carbon and is given off as carbonic oxide, and partly escapes free, while the aluminium sinks to the bottom and gradually accumulates. It is tapped off periodically into moulds, and more material added, so that the process is "continuous." Very little of the flux is spent in the operation, and the furnaces are not expensive.

The four chief items of cost are the cost of the electric energy, of the materials used, wages and superintendence, and interest, &c. on capital employed. In the Hall process 22 electric horse-power at a potential of 8 to 10 volts produce 1 lb. of aluminium per hour for about 56 lb. of coal, or, with coal at 10s. per ton, about 3d. for this item. The alumina costs about 30l. per ton, and yields about 50 per cent. of its weight of metal, or say 6d. per lb. for the aluminium produced. The plant with all buildings and accessories can be erected for 30l. per indicated horse-power available, which would represent about 6l. per annum to be spread over 300 lb. of aluminium per annum. Reckoning 20 per cent. for maintenance, interest, and profit, this represents 5d. per lb. We have thus for the three items specified 1s. 2d. per lb., so that adding the cost of labour and superintendence—which must vary greatly according to the scale of working—the present price of 2s. per lb. cannot leave much margin on the present small output, which for the four principal works is estimated at only 2,600 lb. per day. At the same time the present selling price is sufficiently near the remunerative level to prevent any great advance except by a reduction of output or an agreement among the manufacturers.]

To get further cheapness there must be a larger production and demand, which "must come within a moderate time." Future improvements are likely to be in the direction of cheaper alumina or other salt of aluminium, and more direct methods of applying heat, &c. in operating the furnaces, which now utilise only 25 per cent. of the energy produced.

The cast metal is now produced 99 per cent. pure, is rather harder than copper, and works like it, but is somewhat brittle instead of being extremely tough. An addition of 2 or 3 per cent. of silicon renders it harder and stronger, but decreases its malleability.

Admixture with iron altogether spoils it; a few per cents. of copper, zinc, tin, or nickel, while improving some of its qualities, injure others, and the alloys do not stand remelting well. In fact no simple alloy seems to produce what is wanted. The very white complex alloy made by the Phoenix Engineering Co. seems to promise much better results, being hard, fairly malleable, and improved by remelting up to a certain point. It seems likely to be useful for many purposes where a fair degree of strength and rigidity is needed, together with lightness and incorrodibility. The alloy with silver, and Professor Roberts-Austen's rose-pink gold alloy are for obvious reasons not likely to have any wide application.

Ingots of aluminium for rolling should be as pure as possible. They can be rolled down to $\frac{1}{1000}$ th of an inch

without annealing, when they are hard and springy, but can be readily softened by heating to a temperature of about 400°. The annealed sheets have a wide range of application, particularly for ornamentation and small vessels, as they can be readily stamped and spun.

Aluminium can be beaten into foil $\frac{1}{350,000}$ of an inch thick; this has already almost superseded silver foil, as it keeps its colour perfectly. Aluminium tubes solid-drawn by the Mannesmann process stand about one half the strain of steel tubes, i.e., a tube 1 in. diameter and 40 mm. thick stood a strain of 200 lb. before collapsing, the supports being 1 ft. apart.

Objects made of aluminium stand sea air and sea-water fairly well. The remarkable electrical conductivity of aluminium, about twice that of copper, weight for weight, may cause it hereafter to replace that metal for electric mains. The difficulties of soldering would seem to have largely disappeared.

In the discussion the Chairman (Professor Roberts-Austen) remarked that the reduction in the furnace was due to the combined effect of heat and dissociation, so that there was not much reason to expect an improved result from the direct application of heat in place of the electric current. He referred to the alloys of aluminium with the precious metals, and mentioned some peculiarities in the melting points of the alloys with gold, which pointed to the fact that the union of the metals was very peculiar.

Mr. S. G. Gordon said that the Mannesmann Company had made large quantities of aluminium tubes, and found no difficulty so long as the metal was pure.

Mr. B. H. Brongh had used surveying instruments of aluminium, but while much appreciating their lightness he did not find they would stand rough usage.

Mr. C. W. Parker (Messrs. Balfour and Co.) said their patented alloy of aluminium and tin was an excellent solder for articles made of aluminium, and would stand hammering.

Mr. Walter T. Reid had found articles of aluminium very readily corroded by sea-water and discoloured by the nitre compounds of certain explosives.

Mr. Addenbrooke, in reply, said he thought the materials in the furnace might be advantageously heated before turning on the electric current. The electrical resistance of perfectly pure aluminium had not been accurately determined, but it must be far less than copper. For surveying instruments the aluminium should be in the form of a hard alloy. It was better to solder without the use of a flux, and with an aluminium bit.—J. H. C.

Progress of Steel-making in Austria-Hungary. G. Brisson. Gén. Civil. Jan. 23, 1892, and Bull. Soc. d'Encouragement pour l'Ind. Nat. 1892, 53—55.

THE principal iron ore deposits of Austria-Hungary and the leading metallurgical establishments are briefly noticed.

The high-grade ores of Styria in the Alps and of Morawitz, Sognaska, and Gyalar, in the Carpathians, contain little phosphorus, and are often rich in manganese, so that the "acid" Bessemer process is applicable, and has in fact long been established.

The more phosphoric ores of Wueic, near Kladno in Bohemia, though very advantageously situated in many respects, have only come into use much more recently with the adoption of the basic "Martin" process.

M. Knipfleser, Professor of Metallurgy in the School of Mines of Leoben (Styria) gives dates as follows:—

First working of the Bessemer converter (acid)	1863
First working of the Martin hearth (acid)	1869
First working of the Bessemer converter (basic)	1879
First working of the Martin hearth (basic)	1886

Thus Austria-Hungary was among the first to use the acid process, but very late in adopting the basic process.

A detailed statement of the production by the various processes for the past five years is given as follows:—

Year.	Converter.			Martin Hearth.			General Total.
	Acid.	Basic.	Total.	Acid.	Basic.	Total.	
1886	111,122	105,830	216,951	29,062	13,914	43,004	259,957
1887	114,783	118,379	233,162	22,508	43,522	66,030	299,192
1888	149,220	139,127	288,347	28,672	75,794	104,466	392,813
1889	133,091	141,416	274,507	35,921	104,174	140,095	414,602
1890	149,660	138,021	287,681	33,304	178,015	211,319	499,000

The two forms of the acid process and the basic Bessemer process show but little increase, while the basic Martin process has advanced with extreme rapidity. The author remarks that it is no longer employed merely to obtain "good products" from phosphoric ores; but that it is now applied to yield "excellent products" from ores already good.—J. H. C.

The Passive State of Iron and Steel. Part III. Thos. Andrews. Proc. Royal Soc. 49, 481—488.

For Part II. of this research (abstract), see this Journal 1892, 527. Part III. now follows, and the article is concluded.

SERIES V., SET 1.—Relative Passivity of Wrought-iron and various Steel Bars, and the Influence of Chemical Composition and Physical Structure on their Passive State in cold Nitric Acid.

THE author is not aware that any previous experiments have hitherto been made showing the relative passivity of the various kinds of steel compared with wrought iron, or the influence of the chemical composition and physical structure of such metals on their passive condition in nitric acid.

The passive state of iron or steel may have hitherto been regarded by many as a sort of fixed property pertaining to iron and steel alike, when immersed in cold, strong nitric acid. The following experiments were made to investigate if the passivity was of an universally static character, or whether it varied with the chemical composition and general physical structure of the metal, and, if so, to what extent. For convenience, this part of the investigation was divided into two parts, one portion of the observations, Set 1, being made on drawn rods of metals of known chemical composition and structure, and the other, Set 2, of experiments constituting a study of the relative passivity of various steel and iron plates of known but varied composition, &c. The experiments of Set 1 were made on bars of the various steels selected from the author's standard samples. The bars were cold drawn through a wire, and were therefore different in physical structure to the rolled plates used in the second series of the experiments. An idea of their general properties will be obtained on reference to Part II., Tables IV. and V. (this Journal, 1892, 529). A polished bar, $8\frac{1}{4}$ in. long, 0.310 in. diameter, of the steel to be tested was placed in the wooden stand W (Fig. 1), along with a polished wrought-iron bar of equal size, and the pair were then immersed in $1\frac{1}{4}$ fluid ounce of nitric acid 1.42 sp. gr., contained in the U-tube, the bars being in circuit with the galvanometer. The immersion was continued for the periods stated, and with the electrochemical results given on Table VI.

The wrought-iron bars used in each experiment were cut from one longer polished rod, so as to afford a fair comparison of the relative passivity of the various steels, compared with the wrought iron, and also with each other. The results are the average of numerous experiments in each case.

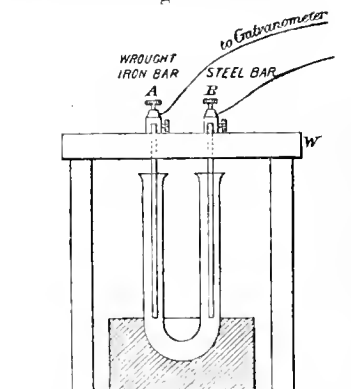
TABLE VI.

Current between polished "passive" wrought-iron and steel bars in cold nitric acid 1.42 sp. gr. Electrochemical position of the wrought-iron positive, except where otherwise marked N (negative). E.M.F. in volts						
Time from Commencement of Experiment.	Column 1.	Column 2.	Column 3.	Column 4.		
	Soft Cast Steel with Wrought Iron.	Hard Cast Steel with Wrought Iron.	Soft Bessemer Steel with Wrought Iron.	Tungsten Steel with Wrought Iron.		
	Set No. 1.	Set No. 2.	Set No. 3.	Set No. 4.	Set No. 5.	Set No. 6.
Seconds						
0	0.000	..	..	..	..	..
30	0.013	0.022 N	0.004 N	0.017	0.016	0.070 N
Minutes						
1	0.005	0.022 N	0.016 N	0.022	0.007	0.074 N
3	0.005 N	0.022 N	0.020 N	0.030	0.024	0.073 N
5	0.007 N	0.028 N	0.023 N	0.034	0.032	0.071 N
10	0.011 N	0.026 N	0.022 N	0.034	0.034	0.070 N
20	0.012 N	0.025 N	0.020 N	0.031	0.034	0.065 N
30	0.013 N	0.023 N	0.023 N	0.028	0.032	0.061 N
40	0.013 N	0.019 N	0.020 N	0.024	0.029	0.060 N
50	0.013 N	0.017 N	0.019 N	0.023	0.026	0.059 N
Hours						
1	0.013 N	0.014 N	0.019 N	0.020	0.024	0.056 N
1½	0.012 N	0.011 N	0.020 N	0.017	0.019	0.055 N
2	0.011 N	0.008 N	0.020 N	0.014	0.016	0.054 N
2½	0.007 N	0.005 N	0.019 N	0.012	0.013	0.052 N
3	0.004 N	0.001 N	0.018 N	0.012	0.013	0.052 N
3½	0.002 N	0.000	0.018 N	0.011	0.013	0.051 N
3½	0.000	0.001	0.017 N	0.011	0.013	0.050 N
4	0.002	0.004	0.016 N	0.011	0.012	0.049 N
5	0.006	0.007	0.013 N	0.011	0.011	0.049 N
7	0.016	0.012	0.006 N	0.011	0.011	0.048 N
12	0.037	0.018	0.006	0.012	0.011	0.048 N
18	0.052	0.026	0.017	0.013	0.012	0.047 N
20	0.058	0.030	0.023	0.013	0.013	0.047 N
22	0.064	0.033	0.028	0.014	0.015	0.048 N
24	0.070	0.036	0.033	..	0.016	0.065 N
26	0.078	..	0.035	..	..	..
29	0.085	..	0.042	..	..	..
30	0.088	..	0.047	..	..	..
38	0.098	..	0.058	..	..	..
40	0.107	..	0.060	..	..	..
43	..	..	0.065	..	..	..
45	..	..	0.071	..	..	..
47	..	..	0.090	..	..	..

SERIES V., SET 2.—Relative Passivity of Wrought-iron and Various Steel Plates in cold Nitric Acid, sp. gr. 1.42.

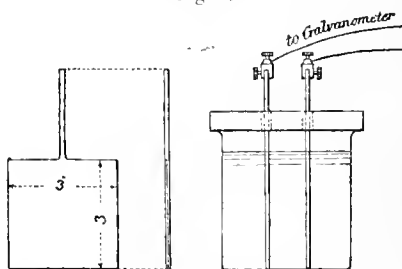
In the following series of observations, the metals experimented upon consisted of plates of rolled wrought iron, rolled steels made by the Bessemer, Siemens-Martin, or crucible cast steel processes, and they were of the chemical

Fig. 1.



composition given on Table VII. Each plate was 3 in. square by $\frac{1}{8}$ in. thick = total area of exposure, 19.5 sq. in. including edges, brightly polished all over, and had a long thin strip left on the top side (see Fig. 2) for convenience

Fig. 2.



of attaching to the galvanometer connexions. The whole of the wrought-iron plates, used as elements with the various steel plates, were cut from one larger wrought-iron plate and were thus practically of uniform composition, thus ensuring an accurate comparison of the relative passivity of the wrought iron compared with the different types of steels, and at the same time indicating relatively the influence of varied composition and structure on the passivity of the different classes of steel under observation. In each experiment, a polished wrought-iron plate and a polished steel plate were firmly placed in two small holes drilled through a thick plate-glass cover; the cover holding the two plates were then carefully placed closely over a porcelain vessel containing 15 fluid ounces of nitric acid, sp. gr. 1.42, the plates being fully immersed in the acid, and the protruding shanks of the bars connected in circuit with the galvanometer. The electro-chemical effects observed were then taken in the usual manner, and the results are given on Table VIII.

At the conclusion of each experiment on Table VIII., the nitric acid, though quite colourless at first, was found to be of a yellowish-brown colour. A small deposit of fine black carbonaceous-looking matter was noticed at the bottom of the tank surrounding the wrought-iron bar in each set of these experiments.

The hard Siemens-Martin steel plate and the wrought-iron plate, instantly after withdrawal from the acid, showed nearly their original bright polish, with the exception of a few fine streaks or markings on the wrought-iron plate, indicating that the latter metal had been rather more acted upon than the steel plate, the hard Siemens-Martin steel plate presenting a slightly dull-greyish aspect. Somewhat similar results were observed on withdrawing the soft cast steel, hard cast steel, soft Bessemer steel, and hard Bessemer steel series of plates from the nitric acid.

The hard cast steel plate when taken out showed a dull lustre much removed from its original bright polish, but there were no other signs of its having been acted upon. The wrought-iron plate connected with it was bright on withdrawal from the liquid, and but very slightly marked.

TABLE VII.
CHEMICAL ANALYSIS OF THE WROUGHT-IRON AND STEEL PLATES USED IN THE EXPERIMENTS.

Description.	Combined Carbon.	Silicon.	Sulphur.	Phosphorus.	Manganese.	Iron (by difference).	Total.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Wrought iron (Wortley best scrap) ..	None	0.392	0.034	0.270	0.194	99.110	100.000
Soft cast steel	0.460	0.074	0.025	0.210	0.184	99.047	100.000
Hard cast steel	1.407*	0.121	0.056	0.080	0.360	97.976	100.000
Soft Bessemer steel	0.150	0.015	0.111	0.034	0.540	99.120	100.000
Hard Bessemer steel.....	0.510	0.068	0.113	0.087	0.153	98.039	100.000
Soft Siemens steel	0.170	0.071	0.117	0.077	0.627	98.938	100.000
Hard Siemens steel	0.720	0.080	0.102	0.143	1.230	97.746	100.000

* By combustion. The terms "soft" and "hard" relate only to difference of percentage of combined carbon, and not to their having undergone annealing or hardening processes.

TABLE VIII.

Time from commencement of Experiment.	Current between bright "passive" wrought-iron and steel plates in cold nitric acid, 1.42 sp. gr. Electrochemical position of the wrought-iron positive, except where otherwise marked N (negative). E.M.F. in Volt.					
	Soft Cast Steel, with Wrought Iron.	Hard Cast Steel, with Wrought Iron.	Soft Bessemer Steel, with Wrought Iron.	Hard Bessemer Steel, with Wrought Iron.	Soft Siemens Steel, with Wrought Iron.	Hard Siemens Steel, with Wrought Iron.
Minutes						
1	0.020	0.071	0.017 N	0.076	0.031	0.065
5	0.032	0.074	0.005	0.079	0.017	0.064
15	0.038	0.073	0.013	0.083	0.024	0.061
30	0.040	0.067	0.012	0.008	0.038	0.064
40	0.048	0.062	0.012	0.107	0.048	0.064
50	0.049	0.059	0.011	0.104	0.053	0.064
Hours						
1	0.047	0.055	0.011	0.103	0.053	0.064
2	0.047	0.061	0.007	0.109	0.034	0.062
3	0.048	0.060	0.000	0.103	0.013	0.061
4	0.047	0.060	0.013	0.098	0.065	0.065
5	0.048	0.058	0.019	0.121	0.007 N	0.060
6	0.050	0.052	0.007 N	0.106	0.022 N	0.056
8	0.038	0.053	0.011 N	0.104	0.037 N	0.059
9	0.040	0.054	0.011 N	0.107	0.031 N	0.058
15	0.053	0.061	0.021 N	0.086	0.017 N	0.055
18	0.060	0.055	0.050 N	0.077	0.008 N	0.056
20	0.050	0.054	0.038 N	0.077	0.007 N	0.058
22	0.040	0.060	0.028 N	0.079	0.007 N	0.061
24	0.038	0.060	0.023 N	0.077	0.007 N	0.064
26	0.046	0.064	0.017 N	0.065	..	0.064
28	0.049	0.065	0.013 N	0.061	..	0.062
30	0.050	0.073	0.017 N	0.061	..	0.066
32	0.049	0.071	0.028 N	0.061	..	0.070
40	0.052	0.067	0.016 N	0.064	..	0.084
45	0.050	0.077	0.015 N	0.070	..	0.090
50	0.046	0.077	0.018 N	0.070	..	0.088
54	0.046	0.077	0.017 N	0.071	..	0.086
56	..	0.078	0.016 N	0.071	..	..
66	..	0.078	0.017 N	..	..	..
72	..	0.067	..	..	..	..

General Remarks.

A brief *résumé* of some of the principal results and conclusions arrived at by the author up to the present time may now be given.

Firstly.—The experimental observations of Part I., Series I. (this Journal, 1890, 951), indicate that the influence of magnetisation on the passive state of steel rods in cold nitric acid, sp. gr. 1.42, is not very great, but it was detectable with the delicate galvanometer and by the sensitive electro-chemical method pursued by the author in the investigation.

The effect of magnetisation is more marked in warm nitric acid, and when the iron is in a powdered state, as shown in the independent and separate experiments of Messrs. Nichols and Franklin on passive powdered iron in warm nitric acid, previously alluded to in Part I., by whom it was shown that the temperature of transition from the passive to the active state was very materially lowered by powerful magnetism; their experiments also indicate that the passive state of powdered iron cannot be fully overcome, even under strong magnetic influence, until a temperature of about 51° C. is reached.

Secondly.—The author's experiments of Part I., Series II., at higher temperatures, confirm those of Part I., and further tend to demonstrate the influence of magnetisation in somewhat lessening the passivity of steel, showing that even previous to the critical temperature point of transition from the passive to the active state, magnetised steel bars were rather less passive in warm nitric acid than unmagnetised ones.

Thirdly.—The results in Part II., Series III. (this Journal, 1892, 527—529) show that the passivity of both unmagnetised wrought iron and unmagnetised steel in nitric acid sp. gr. 1.42 is considerably and proportionately reduced as the temperature of the acid increases, until the temperature point of transition from the passive to the active state is reached at a temperature of about 195° F., and it was also found that the wrought iron was less passive in the warm nitric acid than cast steel.

Fourthly.—The results of the observations of Part II., Series IV., indicate that Schenker-Kestner was to some extent in error in regarding the passivity of iron as not dependent on the greater or less degree of saturation of the acid. The author's experiments herein recorded have shown that the passivity of the metals employed, viz., wrought iron, soft cast steel, hard cast steel, soft Bessemer steel, and tungsten steel, was very materially increased with the concentration of the nitric acid, and it was also observed that wrought iron was much less passive in the nitric acid of less concentration than most of the steels, the soft Bessemer steel being found about equal in passivity to the wrought iron under the conditions of experimentation. A reference to Table III. shows that a considerable amount of E.M.F. was developed between the different metals in every instance, which is a circumstance of much interest in connexion with the passive state of iron and steel.

Fifthly.—The results obtained in Part III., Series V. and VI., on the relative passivity of wrought iron and the various steels, soft cast steel, hard cast steel, soft Bessemer steel, hard Bessemer steel, soft Siemens steel and hard Siemens steel, are of an important character, showing, by the delicate electro-chemical method employed, the powerful influence of difference in chemical composition and physical structure, &c., on the passive state of the metals. Generally throughout this series of experiments it will be observed that the wrought iron was electro-positive to the steels with a considerable E.M.F., amounting in some cases to as high as one-tenth to one-seventh of a volt, the wrought iron being thus shown to be less passive than the steels. In the experiments on the wrought-iron and various steel bars on Table VI., which in course of their manufacture were drawn cold through a worle, and were hence in a different molecular condition to the plates (which were rolled hot) experimented upon in Table VIII., it will be noticed that, in several instances with soft cast steel and hard cast steel, the wrought iron did not assume the electro-positive position until two or three hours after immersion in the nitric acid. Subsequently the iron assumed its normal position, and became during the long remaining period of the observations electro-positive to the steels, with a considerable and increasing E.M.F., showing that the wrought iron was becoming gradually very much less passive than the steels. In the case of the soft Bessemer and soft Siemens plates, Table VIII., we have also a similar instance of these peculiar and temporary interchanges and variations of relative passivity which are not easily accounted for. In the case of the tungsten steel, Table VI., the wrought iron was steadily in the electro-negative position, hence in the latter instance showing the wrought iron to be permanently more passive than the tungsten steel.

A reference to the experiments on the wrought iron and various steel plates, on Table VIII., shows that the E.M.F. between the passive wrought iron and the various soft steels, which contained less percentage of combined carbon, in circuit in cold nitric acid sp. gr. 1.42, was very considerably less than the E.M.F. under similar conditions between the wrought-iron plates and the different hard steels having a higher percentage of combined carbon. The latter results, therefore, demonstrate the interesting circumstance that steels of a higher percentage of combined carbon are more passive than those of a lower percentage of combined carbon. It will be observed that the wrought iron was also electro-positive to most of the steels, whether of a higher or lower percentage of combined carbon, which shows that wrought iron may be regarded as generally less passive than steels.—J. C. C.

PATENTS.

Improvements in the Manufacture of Iron and Steel, having Reference to the Utilisation of Blast Furnace and other Slags in Conjunction with Finely Divided Oxides of Iron. W. Hutchinson and F. W. Harbord, Wolverhampton. Eng. Pat. 2747, February 16, 1891.

THE inventors prepare a self-fluxing ore by incorporating "Blue Billy," hammer or roll scale, powdery ores or oxide of manganese with molten blast furnace slags in suitable proportions. The slags from the furnace or converter are either run into a bogey, and a calculated quantity of the powdery oxide rabbled in, or the oxides, if in large quantities, may be heated on the bed of a furnace and the slags added. A manganiferous iron can thus be obtained by utilising cupola slags, ferro-, and spiegel furnace slags, &c.

A Cleveland slag for example containing—

	Per Cent.
Silica.....	27.6
Alumina.....	22.2
Lime.....	40.1
Magnesia.....	7.6
Other constituents.....	2.5

when mixed with an equal weight of scale or "Blue Billy" containing 70 per cent. of metallic iron will give the following approximate analysis:—

	Per Cent.
Silica.....	14.0
Alumina.....	11.0
Lime.....	20.0
Magnesia.....	3.8
Oxide of iron.....	49.0

a valuable self-fluxing ore.—S. B. A. A.

Improvements in Apparatus and Appliances for the Rapid Determination of Carbon in Steel. A. Tropenas, Sheffield, and A. E. Wells, Rotherham. Eng. Pat. 2785, February 16, 1891.

See under XXIII., page 636.

Improvements in Obtaining Gold, Silver, and Copper from Ores. A. French, Stirling, and W. Stewart, Lenzie. Eng. Pat. 3278, February 24, 1891.

THIS process consists in furnacing the ores at a red heat with small percentages of "nitre cake" (bisulphate of soda), and common salt, leaching, and then treating by ordinary methods. It is especially adapted for extracting the precious metals from ores containing pyrrhotite and other refractory sulphides, and it is applicable to ores containing arsenic, antimony, tellurium, zinc, &c.

An ore containing $2\frac{1}{2}$ to 6 per cent. of copper, some gold and silver, and over 10 per cent. of sulphur, would first be calcined, then pulverised and mixed with 2 to 3 per cent. of nitre cake, and 1 to 2 per cent. of common salt, heated for about an hour with a limited supply of air in a reverberatory furnace at a red heat and leached.

An ore containing little or no copper, but principally gold and silver, would be mixed with $1\frac{1}{2}$ to $2\frac{1}{2}$ per cent. nitre cake, and $1\frac{1}{2}$ to $2\frac{1}{2}$ per cent. of common salt, and heated for 40 to 70 minutes.—S. B. A. A.

Improvements in Processes and Appliances for the Manufacture of Iron and Steel. J. von Ehrenwerth, Leoben, Austria. Eng. Pat. 4384, March 11, 1891.

THESE improvements relate to an open-hearth reduction process previously described by the inventor (Eng. Pat. 4386 of 1890; this Journal, 1890, 811) and consist in the introduction of a preliminary reducing operation in furnaces of special construction, resulting in the formation of spongy iron, which is afterwards smelted in a highly carburised iron bath according to the method of the previous patent. Drawings and descriptions are given of five varieties of vertical furnaces adapted respectively for the treatment of granular or sandy ore, large ore or blocks, and for the production of hot or cold iron sponge or of fluid iron (double shaft furnace). They are all entirely or partially heated by gaseous fuel and they possess, in common, the feature that the waste gases resulting from the reduction are utilised by their combination with a special supply of air, for heating the ore before reduction, or for heating the retorts or regenerators.—S. B. A. A.

New or Improved Machinery for use in Galvanising Wrought or Cast Iron and Steel Pipes, Bars, and Hoops, and for other like Purposes. T. Jones, Nether-ton. Eng. Pat. 5234, March 24, 1891.

THIS invention consists of an appliance for removing steel pipes, bars, &c., from the galvanising bath and for plunging them into a water tank. A gripper fitted on its carriage is moved by an endless band on an inclined platform, the lower end of which is situated immediately over the end of the zinc bath. When the tube has been drawn on to the platform the motion of the endless band is reversed and the gripper loses its hold on the pipe, which accordingly

falls through a slot in the inclined platform into a tank of water underneath. For the details of the mechanism, the drawings and description in the specification must be consulted.—S. B. A. A.

Improved Solder for Joining together Aluminium Pieces or Pieces of Aluminium with other Metals. G. Wegner, Berlin, Germany. Eng. Pat. 6038, March 29, 1892.

THE solder consists of 165 parts lead, 100 of English tin, and 9 of zinc. If the colour of this is objectionable, for this lead may be substituted about 100 parts of aluminium. In either case the joint will bear hammering.

The aluminium pieces are first thoroughly cleaned, but without files, polishing powder, soldering spirit, or sal-ammoniac. They may then be warmed and the alloy is placed upon the surface and a copper or forged iron soldering bit applied, which effects at once the solution of the alloy, so that the tinned surfaces have now a smooth firmly-attached coating which can only be removed by heat. This coating may be of any convenient thickness, but it is noted that the soldering bit should only be used at a red heat.—J. H. C.

Improved Processes for the Treatment of Silicated Nickel Ores and Pyritic Ores of Nickel and Copper, or Nickel, Copper, and Cobalt. H. L. Herrenschmidt, Rouen, France. Eng. Pat. 7585, May 1, 1891.

THIS is a process for the treatment of silicated nickel ores and pyritic ores of nickel and copper with or without cobalt. The ores are first treated by known metallurgical processes so as to obtain mattes containing 30 per cent. of copper and 10–20 per cent. of nickel, the remaining constituents being iron and sulphur. They are then carefully roasted so as to convert the nickel and cobalt into sulphates as completely as possible and the iron into oxide; and the product is then lixiviated so as to obtain a liquor of a density of about 12° B. The sulphates are next converted into chlorides by the addition of calcium chloride and the iron removed by the addition of precipitated hydrate or carbonate of copper. Or calcium carbonate may be added and the liquid then boiled, when the iron and some of the copper are precipitated.

In order to separate the nickel and copper in the pure solution thus obtained, a portion of the liquor is precipitated with milk of lime, the calcium chloride formed being reserved for the first part of the process. The mixed precipitate of nickel and copper hydrate so obtained is now cautiously added to the rest of the liquor, with the result that copper is precipitated in the place of nickel, which dissolves, so that a pure solution of nickel is ultimately obtained. The precipitate is similarly treated with fresh quantities of liquor until it consists only of copper, any nickel and copper liquor which is left over being precipitated with lime and used as before.

Another method is to chloridise a portion only of the liquor, which is then precipitated with lime and added systematically to the rest of the liquor as before. Or the chloridising may be entirely omitted if sodium hydrate or carbonate are used as precipitants instead of lime.

If the ore contains cobalt the same processes are used, with the result that a solution of nickel and cobalt is obtained on the one hand and precipitated copper hydrate on the other. A mixture of air and chlorine is now blown through a portion of the nickel and cobalt solution and a mixed precipitate of nickel and cobalt peroxide is obtained. This precipitate is next heated with the rest of the liquor when the nickel of the precipitate is gradually replaced by cobalt, so that the two metals can be separated by a systematic treatment as before.—H. K. T.

Improvements in Manufacturing Nickel Alloys. L. Mond, Northwich. Eng. Pat. 8083, May 11, 1891.

THIS invention is an extension of the method described in Eng. Pat. 12,626 of 1890 (this Journal, 1891, 774) to the manufacture of nickel alloys. It consists in passing nickel carbonic oxide gas diluted with indifferent gases into

the molten metals with which it is desired to alloy the nickel. In practice it is most advantageous to make direct use of the mixture of gases obtained in the extraction of nickel from its ores according to the method of the patent mentioned.—S. B. A. A.

Improvements in the Manufacture of Tin and Terne Plates. J. H. Rogers, Llanelly. Eng. Pat. 9342, June 2, 1891.

THE object of the invention is to expedite the annealing of the plates, to reduce labour, and to save fuel. By preference three furnaces are used, arranged in the arc of a circle. During working one furnace is heated by gas which enters with air at one end, whilst the products of combustion are led away to the chimney at the other end. The air for supporting the combustion having been previously led through the furnace last heated is thereby raised to a high temperature, and the heated products of combustion are led through the third furnace before passing to the chimney, so heating that and thus economising fuel.

—J. H. C.

An Improved Furnace for the Treatment of Refractory Ores. C. J. Fauvel, London. Eng. Pat. 9708, June 8, 1891.

THE powdered ores are automatically fed into the top of a peculiarly constructed muffle or oxidising tower constructed of brick and fitted internally with a series of inclined fire-clay slabs. The muffle tower is heated by a furnace and series of flues in such a way as to keep the products of combustion always out of contact with the ore. A separate air-heater is provided to aid the roasting of the ore, which becomes completely "sweet-roasted" while falling from one inclined slab to another. It is finally discharged in a constant stream through a pipe which dips into rapidly running cold water. The sulphurous vapours and the dust particles are carried off through flues and gradually deposited or condensed in a series of condensing chambers cooled by circulation of cold water through metal tanks. Supplementary furnaces and air-heating chambers are provided near the outlet when necessary to maintain a sufficient draught.—J. H. C.

Improvements in the Treatment of Waste Liquors from Metallurgical Processes to obtain Sulphurous or Sulphuric Acid and Zinc. A. T. Hall, Hull. Eng. Pat. 9947, June 11, 1891.

A SOLUTION obtained by boiling alkali waste with lime is added to the waste liquor of copper precipitation processes, which contain salts of iron and zinc, and particularly chlorides. The black precipitate of sulphides of iron and zinc which is formed is roasted. The sulphurous acid given off may be employed in the manufacture of sulphuric acid, and the residue in the furnace is smelted to obtain metallic zinc. Soda ash or other alkaline material may be substituted for the solution of alkali waste.

The greater part of the iron should be precipitated first by means of lime in the ordinary way.—J. H. C.

Improvements in the Treatment of Waste Liquors from Metallurgical Processes to obtain Sulphurous or Sulphuric Acid and Oxide of Iron. A. T. Hall, Hull. Eng. Pat. 9948, June 11, 1891.

THE waste chloride of iron or sulphide of iron liquors from tin-plate or galvanising works are precipitated with a solution or cream obtained by boiling alkali waste with about one-tenth of its weight of lime. An excess of the reagent is to be avoided. Soda ash or other alkaline material may be substituted. The resulting black precipitate contains sulphide of iron, which is roasted, and the sulphurous acid given off used for making sulphuric acid in the usual way. The residue will be mainly oxide of iron, if no excess of precipitant has been used.—J. H. C.

Improvements relating to the Manufacture of Metal Fibre and to Apparatus therefor. A. Torkington, Rotherham. Eng. Pat. 10,728, June 23, 1891.

ACCORDING to this invention metal fibre is manufactured by allowing the molten metal to flow out through a number of fine apertures, and cooling the fallen metal by a draught of air. A suitable apparatus consists of a tank (in which the metal is raised to a temperature above its melting point), connected with a side tube in which the metal can rise. The side tube is closed below by a perforated cap.

—S. B. A. A.

A Process for the Extraction of Tin from Tin Slags or Tin Refuse by Founders' Ashes, Copper Salts, Carbonaceous Matter, and Fluorspar or other suitable Fluxes. F. H. Mason, London. Eng. Pat. 10,984, June 27, 1891.

THE crushed tin slag is mixed with (1), founders' ashes or other easily reducible cupreous substance containing about three times as much copper as the tin present; (2), anthracite in quantity sufficient to reduce the whole of the tin and copper present; and (3) fluorspar, lime, or other suitable fluxes.

This mixture is smelted in a low blast or in a reverberatory furnace, and the alloy obtained is poled as may be necessary, so as to remove any iron or other impurity and leave only a tin-copper alloy known as bronze.—J. H. C.

Improvements in the Utilisation of Tin-Plate Scrap. F. W. Harbord and W. Hutchinson, jun., Wolverhampton. Eng. Pat. 11,190, July 1, 1891.

THE tin-plate scrap is melted, preferably in a large cupola furnace, with from 30 per cent. to 50 per cent. of cast or pig iron; roll-scale, puddlers' tap cinder, or other suitable oxides and silicates of iron, or manganiferous ores or low-grade spiegel being added as required, and as much limestone as necessary to make a basic slag. The resulting metal is tapped into pig-beds or chills. By the use of flues and dust chambers, or condensing chambers and scrubbers, the greater part of the volatilised tin and lead oxides is intercepted, and may be subsequently utilised by sifting, treatment with dilute hydrochloric acid, and subsequent smelting into a tin-lead alloy.

Old galvanised scrap may be treated in the same way, and the zinc oxide similarly recovered from the flue dust.

—J. H. C.

A Process for Extraction of Metals from Ores and Minerals containing them. J. Turton, London. Eng. Pat. 11,208, July 1, 1891.

THE ores are powdered, roasted if necessary, and treated with a strong solution of nitrate of potash or soda, common salt, and sulphuric acid, whereby the metals are dissolved.

To the clear solution zinc or other precipitant is added, whereby many of the metals, including gold if it is present, are precipitated in the form of a powder which can be treated in any known manner. If there be silver in the mineral, it will be found in the residue in the form of chloride.

—J. H. C.

Improvements in the Construction and Working of Smelting and Melting Furnaces. L. Reuleaux, Liège. Eng. Pat. 11,247, July 2, 1891.

THIS is an arrangement for blowing in fuel and in some instances powdered ore through the tuyeres of cupola furnaces, with simultaneous charging of ores and fluxes or metals and fuel in the ordinary way.

The fuel to be charged through the tuyeres is tipped into a hopper, and thence pushed forward by a rotating shaft provided with arms or teeth, and so caused to fall into a revolving distributor resembling a bucket wheel, whose object is to regulate the descent of the fuel and to prevent an undue escape of gases. The fuel is then guided by a suitable conduit into the branch blast pipe belonging to a

lower range of tuyeres, and is thence blown into the crucible of the furnace through the tuyeres. A second series of tuyeres, arranged at a slightly higher level, or some other suitable arrangement of independent tuyeres, is provided through which air alone is blown in so as to prevent choking.

An arrangement for supplying compressed air in some of the buckets of the distributors, so as to prevent loss of blast, is also provided and described.—J. H. C.

Improvements in or Additions to Apparatus used for Galvanising Sheets and Plates of Iron. T. Jones, Dudley. Eng. Pat. 11,759, July 10, 1891.

THIS is a contrivance for scraping the surface of the plate as it leaves the bath, so as to remove the superfluous coating and to render that which remains more uniform.—J. H. C.

Improvements in Apparatus for producing Ferroferrous and Ferric Oxides. A. Crossley, Pontypool. Eng. Pat. 12,813, July 28, 1891.

INSTEAD of the series of trays mentioned in Pat. 8914, 1890 (see this Journal, 1891, 472) the author now prefers to use a series of inclined tubes, which revolve at a suitable rate, and down which the material to be oxidised passes. The upper end of each tube is placed immediately below the lower end of the one next above it, and the lower one is inclined at the same angle in the opposite direction, but in the same plane, as the one above. The material thus passes automatically down each of the series of tubes. The tubes are placed in a furnace.—J. W. L.

Improvements in and appertaining to Basic Lined Furnaces. J. H. Darby, Brymbo. Eng. Pat. 13,906, August 18, 1891.

IN furnaces with basic or neutral hearths and siliceous brick sides, roof, and ends, the splashing of the slag and basic dust fluxes away the acid portions of the furnace lining, and reduces the life of the furnace. According to the present invention this may be partially remedied in open hearth steel furnaces by leaving a space of 2 or 3 in. between the acid bricks composing the side walls of the furnace (the parts most rapidly corroded) and the metal casing, and ramming this space up with ground chrome ore and tar, magnesia and tar, or any other suitable material capable of withstanding the action of the basic slag, &c. It will be found that when the inside casing of bricks is fluxed away, the layer of refractory material will have become dense and hard, and will protect the metal casing from the heat for a long time. Other furnaces may be treated in a similar manner.—S. B. A. A.

Improvements in the Reduction of Ores. J. T. King, Liverpool. From T. S. Blair, jun., Alleghany, U.S.A. Eng. Pat. 15,830, October 7, 1890.

THIS is an improved direct-reduction process, adapted to the treatment of sesquioxides and magnetic oxide of iron, for the production of a sponge which may be utilised in the open-hearth process. The success of direct reducing processes is in general dependent on (a) the mechanical condition of the ore as to permeability; (b) the temperature, rate of supply, pressure, and reducing power of the gases used; (c) the duration of the process. For satisfactory working the ore should not be wet or pasty, nor contain lumps more than 2 in. in diameter; it should be charged into a reducing chamber previously heated to a red heat, the charge being, if necessary, introduced in several instalments with short intervals between for heating up. The temperature of the mass and of the gas supply should be a fairly bright red heat, and the pressure and volume of gas supplied should be sufficient to cause a current of gas to flow through every part of the ore at the rate of 7½ ft. per

second. If the escaping gases can be utilised as fuel the supply of gas may be increased with advantage. Ordinary producer-gas made from bituminous coal is a sufficiently energetic reducing agent, and will, under the conditions mentioned, perfectly reduce a charge of limonite in 40 minutes to 1 hour, open red hematite in 10 to 15 per cent. longer time, according to the texture of the ore; massive hematite in $1\frac{1}{2}$ to $1\frac{3}{4}$ hours, and magnetite in $1\frac{1}{2}$ to 2 hours.

If lime or limestone be mixed with the fuel in the gas producer, cyanogen will be generated in the lower part of the producer, and will increase the reducing power of the resulting gas.

Three forms of furnaces for different products, and a contrivance for removing the sponge from the furnace without oxidation are described and illustrated. The latter consists of a cast-iron cylinder with perforated base, in which the reduction is conducted, and which can be bodily removed from the furnace and cooled by passing a current of cold gas through its interior.—S. B. A. A.

Improved Method or Means of Desulphurising Castings or Alloys of certain Metals. P. Rossignaux, Paris. Eng. Pat. 4173, October 23, 1891.

THE process is applicable to castings or alloys of iron, nickel, cobalt, and copper containing any two or more of these metals combined together; it enables the percentage of sulphur in castings, i.e., in alloys containing carbon, silicon, and sulphur, to be reduced to 0.01 per cent.

It consists in introducing into these castings a certain quantity of metallic manganese, aluminium, magnesium, and sodium; these four metals, having a greater affinity for sulphur than iron, nickel, cobalt, and copper, attract the sulphur and form a slag composed largely of metals and sulphur, which collects on the surface of the molten metal.

The quantity of reagent is calculated so that the total amount of sulphur may be changed into sulphate of manganese, sulphate of alumina, sulphate of magnesia or sulphate of sodium, a slight excess of the reagent being always employed.

The reagent is added to the molten metal in a reverberatory furnace or in a Bessemer converter, and agitated with it. When the slag has collected it is drawn off, and the purified metal is run off separately.—J. H. C.

Improvements in Metallurgical Furnaces and Ovens. F. G. Bates, Philadelphia, U.S.A. Eng. Pat. 18,766, October 29, 1891.

IN this specification the construction of a furnace with a number of novel features is described and illustrated. The following are a few of its characteristics. It has two fire-places at or near the front corners of the heating chamber, and two outlets provided with dampers at or near the rear corners, so that the products of combustion are first caused to converge towards the centre of the furnace and then to diverge towards its extremities; the movements of the gases are further controlled by two side exits. There is a third fire-place at a lower level from which the products of combustion circulate under the bed of the furnace, and are then discharged over the side fireplaces. For other details the specification must be consulted.—S. B. A. A.

Improvement in Furnaces. E. Kerr, Pittsburgh, U.S.A. Eng. Pat. 19,464, November 10, 1891.

THIS improvement relates more particularly to the construction of cupola furnaces for melting masses of metal by the agency of gaseous fuel. The improved furnace is constricted internally at a point rather more than half-way down its length, and is thus divided into two chambers, an upper melting chamber bounded below by a circular ledge and communicating by the constricted opening with a lower chamber or crucible. Gaseous fuel and air are supplied from concentric pipes at the summit of the melting chamber, and it is arranged that complete combustion shall

take place at the top of this chamber. The metal is stacked on the ledge in the melting chamber, and as it melts it flows down into the crucible. The gases likewise pass downwards into the crucible and out through suitable ports into the stack.

A modification is described in which a number of fire chambers or gas producers adjoin and communicate with the melting chamber, which may further have a special air supply to ensure perfect combustion.—S. B. A. A.

A Novel System of Regenerative Gas Furnace for the Reduction of Zinc Ores. E. Dor, Ampsin, Belgium. Eng. Pat. 22,694, December 29, 1891.

ACCORDING to the present invention, duplicate kilns, built back to back and communicating with each other by a passage below the retorts, are arranged with four regenerative chambers at each end at the ground level. Gas and air are introduced through ordinary Siemens sumps into a series of channels under the furnaces, and then into two pairs of regenerators from which the gas and air pass by two openings into a chamber in the upper part of one of the furnaces. Combustion commences at this point; the gases now descend over the retorts and through the common opening into the second furnace where they pass upwards over the retorts and out through two openings above into the regenerators, and by another system of channels into a conduit connected with the chimney. When the currents of gas and air are reversed, these pass through the heated channels previously traversed by the waste gases, but the connections are so arranged that the direction of the current of burning gases within the furnaces suffers no change.—S. B. A. A.

Improvements in the Casting and Tempering of Pure Copper. T. D. Bottome, Hoosick, N.Y., U.S.A. Eng. Pat. 2214, February 5, 1892.

THIS invention aims at producing tempered copper castings free from the imperfections of ordinary copper castings, by adding while in a state of fusion about one-thousandth part of sodium. For small quantities of copper ten pounds or under, the copper is melted in a crucible under a cover of common salt. A drilled carbon rod charged with sodium is then quickly pushed to the bottom of the crucible, and the copper is thoroughly stirred with the same rod. The copper is then poured in the ordinary way. Instead of pure sodium an alloy of sodium and copper may be used, which is prepared by grinding precipitated powdered copper in an iron mortar with sodium.

For larger quantities a mixture of equal parts of common salt, bicarbonate of soda, and powdered anthracite is prepared: some of this is put into the crucible, then the copper is added and is covered with some more of the mixture. The pot is then covered, and when the copper is melted it is stirred with a carbon rod for a minute or so, after which it is ready for casting. Over-heating is to be avoided, and it should not be poured at too high a temperature.

If the castings are not sufficiently hard when taken from the mould, they should be re-heated quickly to redness, and then placed in hot graphite dust to cool.—J. H. C.

Improvements in Metal Alloys. J. B. Alzugaray, London. Eng. Pat. 2361, February 9, 1892.

THE alloys are produced by fusing together aluminium and antimony in the proportions required, or by fusing the compounds of these metals with or without the admixture of carbon. The aluminium may be added to the molten antimony or *vice versa*.

One alloy obtained by melting antimony and stirring with a rod of aluminium, or *vice versa*, contains about 18.37 per cent. of aluminium and 81.63 per cent. of antimony, and is when fully formed absolutely infusible at the highest temperatures obtainable in Perrot's furnace.—J. H. C.

Improvements in a Compound for Carburising Metals. S. H. Brown, Boston, U.S.A. Eng. Pat. 6704, April 7, 1892.

The "carburising compound" consists of 87 per cent. of bone carbon, 8 per cent. calcined lime, 4 per cent. soda ash, one-half per cent. sal-ammoniac, and one-half per cent. tungstic acid. Cyanide of silver may be substituted for the tungstic acid with equally good results. For 100 lb. of metal about 33 lb. of the mixture is generally employed. The ingredients are placed with the iron to be carburised in a retort, the carbon, lime, and tungstic acid being placed in the hottest part of the retort, while the sal-ammoniac is placed near the door. After a short heating to drive off the air the retort is hermetically sealed. When the metal is properly carburised it is removed from the retort and plunged into water or other suitable bath.—J. H. C.

Improvements in and connected with Crucible Furnaces. E. A. Meichsner, Chemnitz, Germany. Eng. Pat. 8299, May 3, 1892.

A RECTANGULAR reverberatory chamber or muffle is placed over the grate of a furnace in such a way that the products of combustion may all pass into it by means of apertures in the roof of the combustion chamber.

The metal to be treated, such as iron and charcoal, for conversion into steel, is packed in a rectangular crucible or chest, which is then exposed for a sufficient time in the reverberatory chamber.

Sight holes are provided in the walls of the reverberatory chamber, and opposite to one of these is an aperture in the crucible through which a tube is inserted for ascertaining the degree of heat. Dampers are used when necessary for controlling the heat.—J. H. C.

A Method of Decorating Metal Articles with other Metals deposited thereon. B. Krantz and H. Zeissler, London. Eng. Pat. 8122, May 12, 1891.

ACCORDING to this invention the metal article is first coated with bitumen, as in zinc engraving, and the design is printed thereon direct from a photographic negative, or it is transferred in the ordinary way on to the bitumen coating, which is then developed by turpentine. The article is then placed in an etching bath composed as follows by measure: nitric acid, 2 parts; concentrated sulphuric acid, 1 part; pure water, 3 parts. When etched the article is taken out, well washed in water to remove all traces of acid, and quickly dried in a warm place and put in a depositing bath composed as follows by weight: cream of tartar, 12 parts; carbonate of copper, 1 part; water, 24 parts. The bath for other metals is made by replacing copper with the desired metal; thus chloride of gold or silver in the case of these metals, pure nickel for nickel, or the usual electro plating solutions.—G. H. R.

Improvements in Extracting Metals and other Substances from Ores or Minerals. H. Niewerth, Remscheid, Germany. Eng. Pat. 9219, June 1, 1891.

THE invention applies particularly to the metals of the alkalis and alkaline earths, and to such metalloids as silicon. The method adopted is the continuous application of frictional or induced electricity and heat to suitably prepared materials out of contact with air.—J. H. C.

Improvements in or relating to the Negative Elements (Positive Electrodes in charging Secondary Cells) of Voltaic Batteries. D. G. FitzGerald, London. Eng. Pat. 9629, June 6, 1891.

THE object of this invention is to increase the efficient working condition of the metallic supports of such elements, and to obtain greater economy in the working of the battery by obviating local action in the elements. This is effected by coating the grid, or support, of lead, or lead alloy, with gold or with platinum, or with platinum superposed upon gold, which coating is preferably effected by electro-deposition. The gilding solution preferred is one that can be used cold, such as a solution of about six parts by weight of cyanide of potassium in 160 parts of water, which should contain less than one part by weight of gold as cyanide. This solution can readily be made by the battery process; Roseleur's cold gilding solution also gives good results. The best coating is obtained, however, by using a bath containing 8 to 12 oz. of cyanide of potassium and 1 oz. of gold to the gallon of water at a temperature of from 140° to 150° F.—G. H. R.

Improvements in or connected with Negative Elements (Positive Electrodes in charging Secondary Cells) of Voltaic Batteries. D. G. FitzGerald, London. Eng. Pat. 9628, June 6, 1891.

ACCORDING to this invention lead strips coated with gold or platinum by electro-deposition are used instead of the gold or platinum contact pieces hitherto employed with lithanode plates. The gilding bath is prepared as follows:—16 parts by weight of cyanide of potassium are dissolved in 160 parts of water, raised to a temperature of 140° F. and electrolysed between a fine gold anode of large surface, and a cathode of small surface which may be of gold or any other metal, such as copper, which is not attacked by the cyanide solution. The electrolysis is continued until about one part of gold has been dissolved; the weight of metal in solution being found by subtracting from the weight lost by the anode the weight of gold recovered at the cathode. The temperature of the bath should not be below 140° F. For the deposition of platinum the bath preferred is made by dissolving platinum chloride in a strong solution of potassium cyanide. With this bath a platinum anode of large surface should be used.—G. H. R.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Process for the Separation of Copper, Nickel, and Silver from Mattes or Alloys containing the same, and the Treatment of the Residues resulting therefrom. J. Strap, Paris, France. Eng. Pat. 4396, March 11, 1891.

MATTES containing nickel, copper, and silver are cast into plates and constitute the anode of an electrolytic bath, the cathode being formed of a thin sheet of copper. The bath contains 150 to 250 grms. of copper sulphate per litre of water according to the quantity of matter treated, and 5 per cent. of its volume of sulphuric acid. A current of 25 to 30 ampères is passed for a cathode having 1 square metre of surface, the E.M.F. being $\frac{1}{2}$ volt. Under these conditions the nickel passes into solution as sulphate, and remains in that condition; the copper is gradually deposited on the cathode and the silver and foreign matters form a muddy deposit at the bottom of the bath. When there is no more sulphate of copper in the bath, the solution of nickel sulphate is either crystallised out or the nickel is recovered by electrolysis.—S. B. A. A.

Improvements in Galvanic Batteries. C. N. Souther, Chicago, U.S.A. Eng. Pat. 18,097, March 23, 1891.

THE improvement consists in using a zinc carbon couple, the carbon being placed in the porous pot which is filled with copper sulphate solution kept saturated by means of added crystals of copper sulphate. The outer jar contains water, in which zinc stands.—G. H. R.

Improvements in the Production of Copper Tubes by Electrolysis. A. Watt, Balham, Surrey. Eng. Pat. 9652, June 8, 1891.

ACCORDING to this invention the copper is deposited on rotating mandrels composed preferably of type metal, or some similar alloy of low melting point. The mandrels are immersed in the bath and the deposit is subjected to the friction of a fixed travelling brush or rubber while the mandrel is revolving.—G. H. R.

Apparatus for Supplying Depolarising or other Liquids to a Series of Electric Batteries. V. Jeanty, Paris, France. Eng. Pat. 9689, June 8, 1891.

THE apparatus is composed of a main closed vessel containing the liquid to be supplied to the series of batteries, and of a distributing open vessel placed beneath the former and connected therewith by a first pipe through which the liquid descends from the upper to the lower vessel, and by a second pipe which determines the flow of the liquid intermittently. Through the bottom of the distributing vessel are fitted short pipes by each of which the liquid is distributed to the several elements of the battery placed below. The liquid contained in the upper vessel is conveyed intermittently to the distributing vessel from which it overflows through the short pipes to the respective elements. The liquid conveyed to the separate elements is discharged at the bottom by means of a vertical pipe, and the fresh liquid having a greater relative density settles at the bottom, whilst the exhausted liquid rises to the top and goes to waste by an overflow pipe.—G. H. R.

An Improvement in Galvanic Batteries. W. J. Engledue, Byfleet, Surrey. Eng. Pat. 9803, June 9, 1891.

THE battery is provided with a cover which can be clamped liquid-tight by means of an india-rubber ring or other suitable washer, so that the battery may be inverted without the electrolyte escaping; and only so much exciting fluid is filled in as will cause a part, but not the whole, of the electrodes to be immersed. When the light begins to fall off the battery is inverted, thereby bringing the whole of the electrodes into action and restoring the current. The battery is specially intended for miner's and other portable lamps.—G. H. R.

Improvements in the Treatment or Purification of Graphite to Render it Suitable for Industrial Purposes. W. Lutz, Leipzig, Saxony. Eng. Pat. 9922, June 11, 1891.

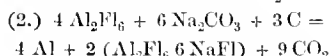
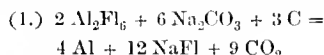
THE graphite, either finely or coarsely powdered, is moistened with concentrated nitric or sulphuric acids, or with both, or with a solution of "oxygenous" salts (salts containing oxygen) and then immediately calcined; or it is heated for some time with an acid solution of a bichromate or a permanganate, then separated and calcined; or it is mixed with potassium chlorate and nitric acid, warmed, and then washed and calcined, or fourthly, the graphite is heated for some time with concentrated nitric or sulphuric acid, then separated and calcined.

These processes are recommended as being much shorter than those usually employed and productive of similarly good results.—J. W. L.

An Improved Process for the Electrolytic Production of Aluminium. L. Grabau, Hanover, Germany. Eng. Pat. 10,090, June 13, 1891.

THE difficulties of manufacture due to the presence of silicon and iron are avoided by using as the material for electrolysis a mixture of aluminium fluoride with soda, or other basic substance which can be easily obtained free from these impurities. Cryolite is fused by the agency of the current, and to this is added during electrolysis a mixture of aluminium fluoride and soda in definite proportions according to the quantity of aluminium to be separated.

The proportion between aluminium fluoride and soda may be such that besides aluminium, sodium fluoride, or chiefly cryolite ($\text{Al}_2\text{F}_6 \cdot 6 \text{NaF}$) is formed. Any proportion lying between these two extreme cases, which may be represented by the following formulae, may be employed:—



Potash may be substituted for soda if the corresponding potassium compounds are used. The positive electrode must be carbon, the negative may be a metal such as aluminium.—G. H. R.

An Improvement in Voltaic Batteries. P. Jabloehkoff, Paris, France. Eng. Pat. 10,082, June 13, 1891.

IN carrying out this invention advantage is taken of the power of absorbing oxygen from the atmosphere possessed by carbon and other porous bodies, for oxidising the nitrous vapours produced in the working of cells containing nitric acid. One electrode is a more or less porous carbon vessel closed at the bottom, filled with fragments of coke, or preferably of peat charcoal, and closed at the top by a porous lid. Around the lower part of this vessel and some distance from its sides is placed the other electrode, which consists of several thicknesses of zinc or iron plate, and extends to about one-third the height of the carbon vessel. The whole is enclosed in a basket or bag having a thick lining of spongy material, such as peat, and is placed in a jar charged with a solution of nitrate of soda or potash. Nitric acid, diluted so that it does not fume, is poured into the inner vessel. When the cell is working the alkaline nitrate is decomposed, while the nitric acid evolves nitrous fumes which in rising through the upper part of the carbonaceous material meet oxygen condensed there from the atmosphere and become reconverted into nitric acid which descends, the acid being thus continuously regenerated.—G. H. R.

Improvements in and Relating to the Manufacture of Plates for Electric Accumulators. C. Rousseau, Paris, France. Eng. Pat. 11,004, June 27, 1891.

THE invention consists in constructing plates by compressing a paste composed of the oxide of carbonate, or some salt of lead, into and on either side of a frame cut out of a lead plate. The paste is mixed with a solution of chloride of sodium, and hair or other suitable filament cut into lengths of about one centimetre is added for the purpose of binding it.—G. H. R.

Improvements in Thermo-Electric Batteries. P. Giraud, Chantilly, France. Eng. Pat. 11,060, June 30, 1891.

ACCORDING to this invention each element is formed of an alloy the composition of which is varied according to the size of the element, so that the electro-motive force may remain the same without the internal resistance being increased. The following are the three sizes of the electrodes which may be most advantageously employed to suit different cases:—

A. Small size:—Length, 0·07 m.; width, 0·02 m.; height, 0·02 m.

B. Medium size:—Length, 0·07 m.; width, 0·02 m.; height, 0·03 m.

C. Large size:—Length, 0·03 m.; width, 0·03 m.; height, 0·05 m.

And the composition of the alloy to suit these three sizes is respectively:—

COMPOSITION A.	
	Parts by Weight.
Antimony	1,450
Zinc	900
Cadmium	50
Pure copper	80
Tin	40
Silicon	3

COMPOSITION B.

	Parts by Weight.
Antimony.....	440
Zinc.....	780
Cadmium.....	60
Pure copper.....	30
Tin.....	15
Silicon.....	2

COMPOSITION C.

	Parts by Weight.
Antimony.....	1830
Zinc.....	960
Cadmium.....	65
Silicon.....	2

The other electrode of each element is preferably composed of blades or plates of tinned iron or of pure nickel; they may, however, be made of iron iridiumised, platinised, or nickelled on its surface, or of ferro-aluminium, and the two electrodes are united by an autogenous joint formed by casting the alloy.

The extremities to be heated are protected by metal cups cemented to them by a pulp made preferably of silicate of soda and asbestos powder, though silicate of potash may be used. The different rows of sockets are separated from one another, and the wall of the heating apparatus by asbestos washers united to them by the same cement.

—G. H. R.

Improvements in and Relating to Galvanic Batteries.

G. G. M. Hardingham, London. From J. R. Hard and H. Connett, New York, U.S.A. Eng. Pat. 11,560, July 7, 1891.

This invention relates to dry batteries of the open circuit class, the object being to provide the battery cell with a gas outlet for the purpose of relieving it from excessive internal pressure while providing against the escape of the electrolyte. The cell is provided with a stopper containing an outlet for gas which is provided with a valve opening outwardly. The invention is described with special reference to the silver chloride cell.—G. H. R.

Improvements relating to the Coating of Articles with a New Metallic Alloy by Electro-deposition.

The London Metallurgical Company, Limited, and S. O. Cowper-Coles, London. Eng. Pat. 13,460, August 8, 1891.

THE electrolytic bath is prepared by dissolving cyanide of zinc in cyanide of potassium in the proportions requisite to form a double salt, and adding a small excess of cyanide of potassium. To this solution is added a small quantity of the double cyanide of potassium and silver. The anode used is composed of a zinc-silver alloy of approximately the same composition as that which it is desired to deposit. The percentage of zinc may be varied from 25 to 90 per cent., and the bath may be used hot or cold.—G. H. R.

Improved Exciting Fluid for Galvanic Zinc Carbon Batteries, and Method of Recovering Useful Products from the Spent Fluids of such Batteries.

M. Muthel, Berlin, Germany. Eng. Pat. 19,617, November 12, 1891.

THE improved exciting fluid is composed of chromic acid and bisulphate of ammonium, which when spent contains sulphate of zinc and chrome ammonium alum. The spent liquor is electrolysed between carbon or lead anodes to free it from zinc, whilst keeping it neutral by the addition of ammonia; the fluid containing ammonia, chrome, alum, and ammonium bisulphate is then evaporated, and the residue calcined, whereby the ammonia is driven off and chromic oxide is obtained as a valuable by-product. The ammonia can be utilised for neutralising the chrome lye formed in a subsequent electrolysis. The exciting fluid may be modified by the addition of free phosphoric acid or acid phosphates,

in which case all the chrome and zinc can be readily precipitated out of the spent fluid as phosphoric acid compounds by neutralising the fluid by means of ammonia. The addition of chloride of iron increases the depolarising power of the solution.—G. H. R.

An Improved Process for the Purification of Brine.

C. G. Collins, Woodsburgh, King's County, U.S.A. Eng. Pat. 4527, March 8, 1892.

See under VII., page 604.

Improvements in Incandescent Electric Lamps.

F. S. Smith, Pittsburgh, U.S.A. Eng. Pat. 6083, March 29, 1892.

THE object of this invention is to reduce the cost of the lamps by substituting iron for the platinum leading in wires generally employed. As a sufficiently close joint cannot be produced by fitting the wires into openings previously formed in the glass, it is necessary that the glass be formed about or moulded upon the wires by fusing it. This can be done in a glass blower's flame, but great care must be exercised to guard against excessive heat, and exposing the iron to the direct action of the flame, or the consequent oxidation spoils the joint. The joint may be made perfectly air-tight by coating the points where the wires enter the glass with a cement formed of one part by weight litharge, two parts red lead, five parts of the carbonate of lead, all thoroughly mixed and worked into thick paste with boiled linseed oil.—G. H. R.

Improvements in and relating to Secondary Batteries or Accumulators.

H. H. Lake, London. From W. Sleichner and G. A. Mosher, Troy, U.S.A. Eng. Pat. 6112, March 29, 1892.

THE electrodes consist of rods of conducting material which lie in a series of troughs supported on rectangular frames, both troughs and frames being made of insulating materials. The rods pass through the side of the frame, and are connected together by a single rod. The troughs are filled with red lead, electrolytic lead, or other active material, and the troughs so filled with the connecting rods, form the electrodes.—G. H. R.

Improvements in Means and Apparatus for Separating

Gold, Silver, and other Metals from their Ores. G. J. Atkins, London. Eng. Pat. 7069, April 12, 1892.

THIS invention relates to an improvement in the apparatus described by the same author in Eng. Pat. 12,295, of 1886 (this Journal, 1888, 126). In this apparatus crushed or pulverised ore is subjected to electrolytic action in the anode compartment of an electrolytic apparatus in such a way that the ore is retarded in its descent through the compartment, so as to keep the particles of ore in motion and in contact with the anode pole in the electrolytic solution for a sufficient time to allow the chemical action, such as oxidation, chlorination, &c., to take place. The crushed ore is then subjected to the action of mercury in an amalgamating apparatus which is either connected directly with the electrolytic compartment or may be separate from it. The cathode is formed of a cylindrical vessel of copper or other suitable material, which is made in two halves which are bolted together by flanges, so that ready access may be had to the anode pole contained therein. The anode pole consists of a broad-bladed screw composed of carbon, lead, peroxide of lead, or any other suitable material which is a conductor of electricity, but it is not soluble in the electrolyte employed. It is preferably constructed in the manner described in a patent granted to the author in 1889, Eng. Pat. 10,961 (this Journal, 1890, 742).—G. H. R.

Improvements in Generating Electricity and Producing Air in a Luminous State, and in Apparatus therefor.
T. Duffy, San Francisco, U.S.A. Eng. Pat. 7253, April 14, 1892.

THE inventor describes a method of obtaining light for illuminating purposes by forcing or blowing air through or between vibrating tongues or strips of magnetised metal, and confining and carrying away through transparent conductors the air which it is claimed has been rendered luminous by its passage through the vibratory strips.

—G. H. R.

Improvements in the Art of Producing Metallic Zinc.
P. C. Choate, New York, U.S.A. Eng. Pat. 7378, April 19, 1892.

THE zinc and other equally volatile constituents are separated from the ore by decomposition and volatilisation in the presence of free oxygen, thereby obtaining a condensed oxidised zinc fume. This fume is subjected to a moderate heat in order to expel its soluble constituents more volatile than zinc. The remaining product is then treated with an acid solvent of the zinc in which lead is insoluble, such as dilute sulphuric acid, and finally metallic zinc is obtained from the solution thus formed by means of electrolysis.

—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Process for the Removal of the Lint from Cotton-Seed.
W. L. Dudley, J. Analyt. and Appl. Chem. 6 [3], 1892.

THE "sea-island" or "long-staple" cotton (*Gossypium Barbadosense*) and the Egyptian cotton have naked seed, while the "upland" or "short-staple" cotton (*G. Herbaceum*) of the United States has seed encased in a mass of fibre firmly adherent to the seed-coat.

The seed crushed in England for the extraction of the oil is largely the Egyptian, but in the United States the great source of the oil is the "upland" seed, as the "sea-island" cotton grows over a very limited area. In consequence of this hairy envelope which surrounds the American cotton-seed, decortication is necessary previous to the expression of the oil. The Egyptian and "sea-island" seed need only be crushed, heated, and pressed.

Besides the expense of decorticating the American seed, much "meat" is lost by becoming entangled in the hulls and failing to separate; on this account the oil-yield is lower by several gallons per ton than that from the naked seed, and the yield of "cake" is less as it contains no hulls. The American seed will not stand storage nor shipment well (especially export), as moisture absorbed by the fibrous envelope will enable fermentation to set in.

The process for the treatment of American seed is briefly as follows:—It is (1) run through "linters," which remove as much as possible the cotton which has been left on the seed by the gin; (2) decorticated by a machine which cuts the seed-coat, whereupon the "meat" and the "hulls" fall apart; (3) separated by passing through an inclined revolving screen having meshes, which allow the "meat" to fall through, while the "hulls" are retained and roll out at the lower end; or by means of an air blast; (4) the "meat" is heated and pressed. The hulls are burned, and the ash, rich in potash, has a market value.

All mechanical methods which have been devised to strip the seed of its fibre, have proved unsuccessful, either from imperfect performance or lack of speed.

The chemical process described below was devised some time since (U.S. Pat. 344,951) by the author and N. W. Perry. It has never been tried commercially, but its success is perfect on a small scale.

The seeds after linting are subjected to the action of N_2O_3 and SO_2 , either in the order named or mixed together, enough air accompanying them to "regenerate" the NO . This is probably best accomplished by causing the seed to descend a chute slowly, through which a current of N_2O_3 is ascending, and then to enter a chute where SO_2 and air are ascending; or they may descend through a chute having an ascending current of N_2O_3 , SO_2 , and air. After a few seconds' exposure to these gases under proper conditions, the fibre on the seed will have changed very little in appearance, but its structure is so completely destroyed that the slightest friction causes it fall to an impalpable powder. The seeds are left perfectly smooth and show no signs of corrosion. They have a slight acid reaction on the outside, but the acid is speedily removed by washing. The seed-coat is very hard and is impervious to the gases. No trace of acid has ever been discovered in the interior. The seeds germinate very quickly if planted. The acidity may also be removed by blowing lime-dust on the seed as soon as it comes from the "cleaner" which removes the disintegrated fibre; or it may be carried by a conveyer through lime water and then through a dryer. The seed is now ready to be crushed and pressed, or it may be shipped and stored.—W. S.

Changes in Lubricating Oils and their Adulterants on keeping for a long time. Dr. Holde. Mitth. d. Königl. techn. Versuchsanst., Berlin, 1892. 10 [2], 85—90.

THE author has subjected a number of vegetable and mineral oils to the action of air for several months, and he has afterwards determined: (1.) The viscosity according to Engler, at 20° C. (2.) Alterations of specific gravity. (3.) Changes in acidity. (4.) The changes indicated by altered iodine numbers. He thus discovered:—

(1.) That the outflow (viscosity) had considerably changed in vegetable oils, but had not changed much in the case of mineral oils.

(2.) The specific gravity of vegetable oils had increased more in proportion than was the case with mineral oils.

(3.) Notwithstanding the considerable amount of oxygen absorbed by vegetable oils, the increase of acidity had not been noticeable. Volatile organic acids are supposed to have been formed.

(4.) The iodine numbers had considerably decreased, which fact shows that under the influence of oxygen the non-saturated compounds of oleic acid, &c. with glycerol have been transformed into saturated compounds.—P. D.

Examination of Vegetable Lubricating Oils specially regarding Qualitative Tests. Holde. Mitth. Königl. techn. Versuchsanst., Berlin, 1891, 294.

See under XXIII., page 637.

A New Unsaturated Fatty Acid of the Series, $C_nH_{2n-1}O_2$.
A. Arnaud. Compt. Rend. 114, 79—80.

THE author has discovered in the seeds of a *Guatemalan Pteranmia*, or *Tariri*, belonging to the family of the *Simarubae*, the glyceride of a new fatty acid, $C_{18}H_{33}O_2$, for which he proposes the name tariric acid. Its composition has been proved by elementary analysis of the acid itself and of its potassium and silver salts, and, what is more convincing, by the analysis of the potassium salt of the dibrominated acid, and of the tetrabrominated acid. Tariric acid absorbs therefore four atoms of bromine, and is isomeric with stearolic acid, which Overbeck prepared from oleic acid. The melting point of the new acid is 50.5° C.—J. L.

Degras. R. Ruhsam. *Jahresb. der Deutsch. Gerberschule zu Freiberg i. S.* 1891—1892, 3, 3—17 (this Journal, 1891, 557, 1013).

See under XXIII., page 639.

PATENTS.

An Improved Compound for Cleansing Purposes. R. J. Jordan, Deal, Kent. Eng. Pat. 10,516, June 20, 1891.

The composition of the patented cleansing compound is 5 lb. of chalk, 2 soda, $\frac{1}{2}$ fat, and from $\frac{1}{4}$ to $\frac{1}{3}$ oz. of oxalic acid.—J. L.

Improvement in the Treatment and Purification of Soap Makers' Spent Lye for Extracting Glycerin therefrom. O. C. Hagemann, London. Eng. Pat. 11,889, July 13, 1891.

This invention, part of which has been communicated to the patentee by E. K. Mitting, Chicago, U.S.A., consists in the use of calcium chloride for purifying spent lyes.—J. L.

Improvements in Apparatus for Smelting Tallow. H. Pfütznern, Connwitz-Leipzig, Germany. Eng. Pat. 13,189, August 4, 1891.

The patented apparatus consists in a jacketed stationary drum, in the centre of which a moveable shaft is fixed. This shaft bears a number of hollow stirrers or fingers communicating with the shaft in such a way that hot water may be passed through the shaft and the stirrers. The pieces of fat are fed into the drum by means of a worm. The molten tallow passes a sieve in the bottom of the apparatus, and may be withdrawn by means of a tap.—J. L.

A New and Improved Liquid Polish for Cleaning Brass, Steel, and all Kinds of Metal. J. King, Kingston-upon-Hull. Eng. Pat. 3571, February 23, 1892.

The invention consists in mixing together the following substances for the purposes named:— $\frac{1}{2}$ oz. Castile soap, $\frac{1}{2}$ oz. silversmith's rouge, $\frac{1}{2}$ oz. lamp black, 1 oz. flour emery powder, 7 oz. rotten stone, $\frac{7}{8}$ of a gill turpentine, $\frac{1}{2}$ pint paraffin oil, $\frac{1}{4}$ of a gill methylated spirit, $1\frac{1}{2}$ oz. cream of tartar.—J. L.

Improvements in Soap or Washing Powder. R. Steward, Liverpool. Eng. Pat. 7581, April 1, 1892.

The patent is claimed for a mixture of 32 parts of tallow or other greases, 10 resin, 4 caustic soda, 24 water, 5 mineral oil, 25 soda ash.—J. L.

Improvements in the Method of Extracting Stearine and Oleine from Tallow, and Apparatus therefor. E. J. J. B. Benoit and J. Soler y Vila, Paris, France. Eng. Pat. 6955, April 11, 1892.

The patentees melt the tallow in a wooden lead-lined vat, provided with a perforated steam coil, and add to the molten mass 1—3 per cent. powdered oxide (*sic*) of manganese. The tallow is run off into a second vat to be treated there with 0.2—0.5 per cent. of cream of tartar. Finally the tallow is run into a third vat, which is kept at a temperature of about 30° C. in a hot chamber. The bottom of this vat is pierced with holes, which are closed by rods. Adjustable screws in the bottom of the vat enable these rods to be so lifted that the olein separated from the crystalline stearin may be run off.—J. L.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

PATENTS.

Improvements in the Manufacture of White Lead. R. W. White, Camberwell, Surrey. Eng. Pat. 6683, April 18, 1891.

This is an invention by which it is intended to give any white lead deficient in covering power, as those obtained by precipitation processes generally are, such body and covering power as are found in white lead of the best quality. For this purpose white lead is suspended in a weak solution of lead acetate, and this mixture, at as high a temperature as possible, is passed again and again over surfaces of lead, air or any other oxidising medium being at the same time admitted, until experience or analysis shows the white lead to contain the true proportion of chemical constituents. The apparatus in which this operation is to be performed cannot be understood without the drawings.—C. O. W.

An Improved Manufacture of Material applicable as a Blacking, and for other Purposes. F. Ragon, Paris. Eng. Pat. 8480, May 16, 1891.

The invention relates to a compound forming a base where-with, by the addition of suitable colouring matter, blacking and other similar products may be manufactured. The compound is composed of the following ingredients:—Tallow, 1 part; ordinary pine rosin, 9; carbonate of soda, 6; water, 6. The tallow and rosin are first melted together in a boiling pan, then the soda and water are added whilst diligently stirring. The compound so obtained may also be used as a soap, wax substitute, or linseed oil substitute.

—C. O. W.

Improvement in the Manufacture of Paints and Varnishes, and in the Treatment of Materials in connection therewith. H. Taylor, London. Eng. Pat. 3142, February 17, 1892.

The invention consists in the treatment of rosins, pitches, bitumens, or gums in a melted state with from 5 to 10 per cent. of fresh slaked lime.—C. O. W.

Improvements in Painting Creosoted Poles, and other Articles. J. Hughes, Manchester. Eng. Pat. 5139, March 16, 1892.

TELEGRAPH and telephone poles and similar articles which have been previously treated with creosote, are coated with a solution of half a pound of shellac, and one to two ounces of camphor in a gallon of methylated spirit. When dry the poles are painted with a paint which must be mixed without oil, the pigment being preferably mixed with gold size and turpentine.—C. O. W.

Improvements in the Manufacture of White Lead and in Apparatus therefor. W. H. James, London. Eng. Pat. 5287, March 17, 1892.

In carrying out this invention a mixture is prepared first containing 65 per cent. lead carbonate, and 35 per cent. hydroxide of lead, by mixing one part of litharge with from one to one-and-a-half parts of water, and with from one-tenth to one per cent. by weight of acetic acid, estimated as glacial. This mixture is well agitated and carbonic acid injected into it at a temperature of from 170° to 210° F. The white lead mixture so obtained, together with the mother-liquor or with the addition of water is slowly agitated, so as to allow the coarser particles to settle, when the supernatant liquor containing the finely divided white lead is separated from the coarser particles, filtered and dried at a temperature of about 190° to 210° F.

The carbonic acid gas used when derived from lime kilns is purified by treatment with chlorine and subsequent washing in a scrubber. Or carbonic acid gas dissolved in water under pressure may be used. The apparatus for carbonating consists of a horizontal copper cylinder, fitted with rotating beaters and an external trough connected with the interior of the cylinder by means of perforations arranged at such an angle that the carbonic acid enters the cylinder and flows in the same direction as the revolving magma. A pump is used to force the gas into the cylinder. For the filtration, iron filter-presses and hydro-extractors are used, covered with sheet lead. The drying chambers are provided with superposed endless bands, travelling in opposite directions, so that the white lead being dried falls from band to band.—C. O. W.

A Process for Waterproofing all kinds of Skins, and Rendering them more Durable. F. Riegert, St. Joseph, Mo., U.S.A. Eng. Pat. 5689, March 23, 1892.

See under XIV., page 324.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Index of Plants capable of yielding Tanning Materials: A prize essay. F. E. Mafat. Report on this Essay. R. Geigy. Bull. Soc. Ind. de Mulhouse, 1892, 128—193.

Alguobilla. The pods of different species of *Prosopis*, containing 60—65 per cent. of tannin; imported from South America, particularly Chili.—Leguminosæ.

Arnica (*Arnica montana*, Linn.). This grows wild in Switzerland and Germany; its roots and flowers contain a tannin.—Composite.

Absinthe (*Artemisia absinthum*), originally an Eastern plant, has long been grown in Europe; its leaves contain a tannin.—Composite.

“Armoise” (Wormwood; *Artemisia vulgaris*, Linn.). Wild in Europe; its leaves contain a tannin.—Composite.

Alder (*Betula albus*, Linn.). In Europe *Alnus glutinosa* and *Alnus firma*, and in Japan *Alnus firma*, are indigenous. The bark, leaves, and fruit contain 13—15 per cent. of tannin; the 36 per cent. given by some authorities may be doubted. The Japanese alder contains 25 per cent. of tannin and colours the leather but little; the European alder is used in Russia and gives a deep colour.—Betulaceæ.

Aloes. Different species of *Aquilaria*; abundant in Eastern Asia. The tannins of these plants impart a peculiar odour and a greenish-brown colour to the leather.—Leguminosæ (sic).

Aristolochia (*Aristolochia rotunda*, Linn.). Those species which produce serpentine root are Virginian; the others flourish in central France. The roots contain a tannin.—Aristolochiæ.

“Arbousier” (*Arbutus unedo*) grows in Europe; its leaves are used for tanning in Asia-Minor and contain as much as 36.4 per cent. of tannin.—Ericaceæ.

“Airelle-myrtille” (*Vaccinium myrtillus*, Linn.). This plant, more commonly known as bilberry, is abundant in France, Germany, and England. Its tannin is rapid in its action and 3.5 kilos. of the dried and ground plant will make 1 kilo. of sole leather in a short time. The plant is best pruned like sumac, the leaves are not affected by moisture when gathered, which cannot be said of oak bark.—Ericaceæ.

Alcornoque (*Bowdichia virgilioides*, Humboldt), is South American; the root, wood, bark, and leaves contain tannin.—Leguminosæ.

Acacia. Various species of acacia yield the fruit or pods known as balibalah, cassia grains (“graine de cassier”), bablah, neb-neb, and Indian pods (“gousses de l'Inde”). Bablahs were first imported into Europe in 1830 as a mordant; the percentage of tannin in them is from 25—32, according to species. The exporting countries are India, Egypt, Nubia, Syria, Arabia, Senegal, and Mauritius. Acacia extract contains a strong free acid, a tannin analogous to that of nut galls, and a large quantity of a calcium salt.—Leguminosæ.

Artichoke (*Cynara scolymus*, Linn.); leaves and stem are astringent.—Composite.

Aya-pana. This is from three species of *Eupatorium*, viz: *ayapana*, *dalea*, and *aromatizans*, growing in Brazil, Jamaica, and Cuba respectively; the leaves are rich in tannin.—Composite.

Apricot (*Prunus armeniaca*, Linn.) contains tannin in leaves and bark.—Rosaceæ.

Almond (*Amygdalus communis*, Linn.) is indigenous in Africa, and cultivated in the middle of France, Italy, and Spain. Its leaves are astringent.—Rosaceæ.

Agremonia eupatoria, Linn. has astringent leaves and flowers; it is wild in most European countries.—Rosaceæ.

Andromeda. Several species grow in Lapland and North America, where they are known as “sour-tree.” The wood contains 4—8 per cent. and the leaves 10 per cent. of tannin.—Ericaceæ.

Andira. Several species yield bark containing 8—10 per cent. of tannin; they flourish in South America, Brazil, Guiana, Santa-Fé-de-Bogotá, Antilles, Cuba, Haiti, Jamaica, and Surinam.—Leguminosæ.

Mahogany (*Cedrela odorata*, Linn.) yields bark containing tannin.—Cédrelacée.

Birch contains a tannin in wood, bark, and leaves which colours iron salts green. Davy gives 1.675 per cent. as the tannin contents, Villon, 3 per cent., Fraas, 5.32 per cent.—Betulaceæ.

Bennet (*Geum urbanum*, Linn.) is wild in Central and Southern Europe; its roots, leaves, and flowers are astringent, and according to Tromsdorff contain 42 per cent. of tannin free from gallic acid; others, however, give 4 per cent. in the whole plant.—Rosaceæ.

“Bois jaune” (*Morus tinctoria*, Linn.), Old Fustic, contains moritanic acid, which colours ferric salts green.—Moraceæ.

Bistort (*Polygonum bistorta*) contains in its roots, stem, flowers, and leaves “bistortannic acid” and a yellow colouring matter assimilable by hides; it haunts the marshy land of Southern France.—Polygonaceæ.

“Behen rouge” (*Stutice latifolia*, Smith) grows in Persia, the Caucasus, &c. Its roots are used in Southern Russia as tan for skins, to which it imparts a dull, ochreous, red colour.—Plumbaginaceæ.

Buranhem (*Chrysophyllum glycyphloeum*, Cararetti) furnishes the bark known as monesia or mohica, and grows in Brazil, where an extract is exported for therapeutical purposes; Payen gives 7.5 as the percentage of tannin found in one sample. The tannin of this bark colours leather deep brown.—Sapotaceæ.

Briars (*Erica arborea*, &c.) of which there are about 400 species, grow chiefly in Southern Africa, and contain tannin.—Ericaceæ.

Star-Anise (*Illicium anisatum*, Linn.) from India, China, and the Philippine Islands, contains tannin in its fruit.—Magnoliaceæ.

“Bois doux” (*Inga vera*, &c.) is a tree of Mexico, Guadeloupe, and the Indies, where it is known as cooroo-coopully; its wood and bark are tanniferous.—Leguminosæ.

Bauhinia (*Bauhinia variegata*) grows in the Antilles and Central America; its wood and bark contain tannin.—Leguminosæ.

Bearberry (*Arbutus uva-ursi*, Linn.) grows in France, Italy, Spain, and Russia, and contain 14 per cent. of tannin in its leaves, according to some authorities, and 36.4 per cent. according to others.—Ericaceæ.

Box (*Buxus sempervirens*) contains a mean of 6 per cent. tannin in wood and bark.—Euphorbiaceæ.

Bamboo (*Bambusa arundinacea*, Retz) is Indian and Chinese, and is used in those countries for tanning skins.—Gramineae.

Banoul (*Croton moluccanum*, Linn.) originally came from the Moluccas, and is now in Ceylon, Réunion, and Madagascar; in Tahiti it is used as a tan-stuff.—Euphorbiaceae.

"*Bois de nulle*" (*Mimusops balata*) grows in South America; it colours leather red.—Sapotaceae.

"*Bois de jir*" (*Sideroxylon cinereum*) is used for tanning in Peru; it imparts a red colour to the leather.—Sapotaceae.

Oak (*Quercus*). There are 70–80 species of oak, comprising 275 varieties, about half of which inhabit the old world and half the new world. The hard oak dominates in Europe, and of its two varieties *Quercus pedunculata* and *Quercus sessiliflora*, the latter has the bark which is richer in quercitannic acid. Of other oaks, the following are given:—*Q. tanca*, 8 per cent. of tannin in its bark; *Q. cerris* (hairy-cupped oak), 10 per cent. of tannin in bark; *Q. ilex* (evergreen oak), 10 per cent. of tannin in bark; *Q. suber* (cork oak), 10 per cent. of tannin in bark; *Q. ballota*, 10 per cent. of tannin in bark; *Q. mirbecki*, 12 per cent. of tannin in bark; *Q. coccifera* (kermes oak), 15 per cent. of tannin in bark; *Q. agrifolia* (valonia), 8 per cent. of tannin in bark; *Q. infectoria*; *Q. glomerata* (Russian oak). The above are African and European. Of American oaks may be mentioned:—*Q. alba* (white oak), 7.85 per cent. of tannin in bark; *Q. tinctoria* (black oak), 6.47 per cent. of tannin in bark; *Q. rubra* (red oak), 5.55 per cent. of tannin in bark; *Q. coccinea* (scarlet oak), 7.78 per cent. of tannin in bark. It may be generally stated that oak bark contains from 7 to 18 per cent. of quercitannic acid, while the wood and leaves contain 5–7 per cent. A table showing the percentage of tannin in different parts of the anatomy of oaks is given.—Cupuliferae.

Chestnut (*Castanea vesca*), abundant in southern Europe and North America; the wood contains 68 per cent. of water when felled, 43 per cent. three months after felling, the bark being left on, and 35 per cent. five months after sawing and stripping. The wood and bark contain from 4 to 12 per cent. of tannin (castaneatannic acid).—Cupuliferae.

Hornbeam (*Carpinus betulus*, Linn.) is European and North American; the wood, bark, and leaves contain 2.084 per cent. of tannin.—Cupuliferae.

Cornelian cherry (*Cornus mascula*, dogwood) grows in Europe, especially France; its bark, leaves, and fruit contain 19.9 per cent. of tannin according to Cassineourt, and 8–9 per cent. in the bark according to some other analysts.—Cornaceae.

Hazel (*Corylus avellana*, Linn.) contains in wood, bark, and leaves 2.916 per cent. of tannin.—Cupuliferae.

Hemlock (*Conium maculatum*) contains tannin in its leaves.—Umbelliferae.

Carob (*Ceratonia siliqua*, Linn.) grows in Spain, Italy, France, Algiers, and Egypt. Its fruit (St. John's bread) contains 50–55 per cent. of tannin.—Leguminosae.

Cistus creticus grows in Spain, Crete, and Candia, and has astringent leaves.—Cistaceae.

Bignonia copala, or *Caroba*, is grown in South America, and is used as a tanning agent under the name Jacaranda; the tannin resides in its bark and leaves.—Bignoniaceae.

Carob of Judaea (*Pistacia terebinthos*, Linn.) grows in the Levant, and gives rise to horn-shaped galls which contain 25 per cent. of tannin, and are called "caroubes."—Anacardiaceae.

Cypress (*Cupressus sempervirens*, Linn.) contains tannin in bark and cones.—Coniferae.

"*Contrayerva*" (*Dorstenia brasiliensis*) is Peruvian and has astringent roots.—Moraceae.

Conocarpus arborea and *C. racemosa*. West Indies and Brazil; its bark and fruit contain tannin. Its indigenous name is "mangle."—Combretaceae.

Catechu. The brownish red catechu of Bengal is the exudation from the *Acacia catechu*. The Bombay brown catechu is from the *Areca catechu*—the areca palm. Gambier is the extract from the leaves of *Uncaria gambier*.

To Bengal catechu have been ascribed of tannin 54.5 per cent. (Davy), 38.2 per cent. (Renard), and 48 per cent. (Villon). To Bombay catechu, 48.5 per cent. (Davy), 54.4 per cent. (Renard), and 55 per cent. (Villon). To gambier, 58 per cent. (Davy), 33–40 per cent. (Renard), and 65.79 per cent. (Villon). Catechutannic acid (mimotannic acid) colours iron salts green.

Cinnamon (*Laurus cinnamomum*, &c.) The several species of this plant contain tannin.—Lauraceae.

Centaury (*Erythraea centaurium*), common in Europe, is astringent.—Gentianaceae.

Coffee (*Coffea arabica* and *C. mauritana*) contains caffen-tannic acid which colours iron salts green.—Rubiaceae.

Cherry. Wild cherry (*Cerasus avium*, Linn.) is indigenous in Europe and contains 10 per cent. of tannin in its bark. The other varieties also contain tannin.—Rosaceae.

Service tree (*Pyrus sorbus* and *P. domestica*) contains tannin in wood, bark, leaves, and fruit.—Rosaceae.

Canavie (*Rumex hymenocarpum*, Linn.) grows wild in the marshy lands of the south-east of the United States; its bulbs contain 20–24 per cent. of tannin. Most other varieties of rumex also contain tannin.—Polygonaceae.

Paraguay acacia (*Curnpay*) of South America contains 16–20 per cent. of "europatannic" acid.—Leguminosae.

Curapa yields a light, rebbish, coarse-grained wood, and its bark contains 4–8 per cent. of tannin. It is found in Guiana.—Cedreleaceae.

Toothwort (*Plumbago europaea*, Linn.) contains tannin in its roots.—Plumbaginaceae.

Diei-diei (*Cesalpinia coriaria*) chiefly from Mexico and Venezuela contains ellagitannic acid to the extent of 30–45 per cent.; it imparts a reddish-brown colour to leather.—Leguminosae.

Dog-rose (*Rosa canina*, Linn.) has astringent leaves and fruit.—Rosaceae.

Maple.—The many varieties of this plant contain tannin; 16 per cent. is given by Renard for the tannin in wood and bark, but only 2.28 per cent. as an average by Davy.—Aceraceae.

Eucalyptus (*Eucalyptus resinifera*) is used in New Caledonia, where it grows, as a tanning agent; the tannin in its leaves is estimated at 10–12 per cent.—Leguminosae.

Ebony (*Diospyros*). The bark of some species contains 16–18 per cent. of tannin and is used in Peru, Brazil, and Japan for tanning.—Ebenaceae.

Fustic, young (*Rhus cotinus*, Linn.) grows in Southern Europe, and contains a tannin which colours iron salts olive green.—Terebinthaceae.

Spiraea (*S. filipendula*, Linn.) has astringent flowers and roots.—Rosaceae.

Fern. The varieties of *Filix mas* contain a tannin which colours iron salts green and is called "filixitannic acid."—Filices.

Strawberry (*Fragaria vesca*, Linn.) The flowers and roots are astringent.—Rosaceae.

Ash (*Fraxinus excelsior*, Linn.) contain 3.324 per cent. of tannin in wood, bark, leaves, and sap, according to Davy.—Oleaceae.

Pomegranate (*Punica granatum*). The bark of this tree was used by the ancients as a tanning agent under the name "malicorium"; Davy attributes 18.8 per cent. of tannin to it. The shell of the fruit contains 22–25 per cent. of tannin, and is used for tanning in Japan; the wild pomegranate contains 46 per cent. of tannin.—Granataeae.

Budica buera (combretaceae), *Globularia alpinum* (wild seenna), *Tracrium* (labiate), *Psidium pomiferum* (myrtaceae), *Caryophyllus aromaticus* (the clove tree—Myrtaceae), and *Geranium* are astringent plants containing tannin.

Madder root (*Rubia tinctorum*) contains rubitannic acid and *Galium verum* (cheese rennet) contains gallotannic acid.—Rubiaceae.

"*Gonakie*" (*Acacia undansonii*), or red gum, yields very tanniferous fruit, which is used as a tannage in West Africa.—Leguminosae.

"*Gonzalo alocs*" (*Astronium fraxinifolium*) is used as a tannage in South America, and called "gateodo" or cat-wood.—Terebinthaceae.

Beach (*Fagus sylvatica*, Linn.) contains 2 per cent. of tannin; its bark is used in Persia for tannage.—*Cupulifera*.

Hop (*Humulus lupulus*, Linn.—*Cannabaceae*) contains 1 per cent. of tannin.

"*Irette*" (*labiata*), *ipeccacuanha* (*rubiacae*), *jacaranda* (*bignoneae*),—used in South America for tanning; and *blackthorn* (*rhamnus*,—*Rhamnaceae*) are tanniferous. The last named contains "ziziphotannic acid" in its bark, which is used for tannage in Persia. *Khaya* (*cedrelaceae*) contains "khayatannic acid."

Kino is the dried exudation or extract of several plants of which the principal are:—*Pterocarpus erinaceus* (Africa), *Butea frondosa* and *B. superba* (N. India), *Pterocarpus marsupium* (India), *coccoloba wifera* (Jamaica), and *Rhizophora mangle* or mangrove (Mexico), whose leaves contain 18–20 per cent. of tannin; the first four are leguminosae. *Kino* contains 45–55 per cent. of "coco-tannic acid."

Mastic (*Pistacia lentiscus*, Linn.)—The leaves and bark contain 10–12 per cent. of tannin; used for tanning buffalo skins in certain countries.—*Terebinthaceae*.

Marrubium vulgare, common horehound, is astringent.—*Labiatae*.

Mango (*Mangifera indica*,—*Terebinthaceae*) contains tannin in bark and leaves (20–22 per cent.).

Mulberry (*Morus nigra*).—The bark of some species is used in Persia as a tannage.—*Moraceae*.

Myrtle (*Myrtus communis*, Linn.—*Myrtaceae*) has astringent bark, berries, and leaves. *Celtis australis* (*Ulmaceae*) contains 6 per cent. of tannin in its wood. *St. John's wort* (*Hypericum perforatum*, Linn.—*Hypericaceae*) has astringent flowers. *Malpighia altissima*, Antilles cherry, has tanniferous bark which is used as tannage at Guadeloupe.

Mimosa.—The *mimoseae* include a great many varieties of acacia; the most valuable bark is from Tasmania; the Australian produce contains 25 per cent. (*A. cyanophylla*)—45 per cent. (*A. pycnantha*) of tannin; *A. sentis* (6.32 per cent.) and *A. bivercata* (30.40 per cent.) are from New South Wales.

Myrabolans, the fruits of several species of *Terminalia* (*combretaceae*); their contents of tannin are variously given, 18.2 per cent. and 52 per cent. being the extremes; Loewe asserts the invariable presence of ellagic acid ($C_{12}H_{10}O_6$).

Galls are classified as European and Asiatic; of the latter there are Levant galls and Aleppo galls. The Levant galls contain 77.42 per cent. of gallotannic acid (Müller); the Aleppo galls contain 60–66 per cent. (Fehling). Villon gives the following for Aleppo and Levant galls:—Black, 37–41 per cent.; green, 53–60 per cent.; white, 50–65 per cent. For Smyrna galls he gives:—Black, 33–37 per cent.; green, 53–60 per cent.; white, 60–63 per cent. Renard gives 33–60 per cent. as a mean of all three kinds. Mierzinsky gives 60–66 per cent. as a mean. Of European galls those of Morea and Istria are the best, and have some 40 per cent. of gallotannic acid; Italian and Hungarian galls follow, and those of Germany and France are least important. French galls contain 9–10 per cent. of tannin; German galls, according to Villon, contain 18–19 per cent. of soluble and 13–14 per cent. of insoluble tannin. Chinese and Japanese galls are from plants belonging to the terebinthaceae, viz., *Rhus semialata* in China and *Dyostilium racemosum* in Japan; 69 per cent. is the mean of the many versions which have been given of the tannin in Chinese galls. Hungarian galls or "knoppert" are from oaks, and contain from 20 to 35 per cent. of tannin. Bassorah galls are from an oak and contain 57 per cent. of gallotannic acid according to Kathreiner, Eltner, and others. Renard gives 27 per cent. and Villon 30 per cent., of which 3 per cent. is difficultly soluble. Bokbara galls are from the Indian tamarisk (*terebinthaceae*); their percentage of tannin has been variously given from 26 per cent. to 50 per cent. Carob of Judea, see above.

Water-lily (*Nymphaea alba*, *N. lutea*). The roots contain tannin according to Morin, who called it "nuphartannic acid."—*Nymphaeaceae*.

Walnut (*Juglans regia*, *Juglandaceae*), *medlar* (*Mespilus germanica*, *Rosaceae*), and *areca-nut* (*Areca catechu*, Linn.—*Palmaceae*), which is used in Japan for tanning, are all tanniferous.

Elm (*Ulmus campestris*) contains 1.9 per cent. of tannin in its bark according to Davy and, 7–8 per cent. according to Villon.—*Moraceae*.

Nettles (*Urtica urens*, *Urticaceae*) and *olive* (*Olea europaea*, *Oleaceae*) are tanniferous.

Osier (*Salix viminalis*) contains 7–10 per cent. of tannin in its bark, which is largely used in Northern Russia.—*Salicaceae*.

Orange and *citron* barks are used in Persia for tannage. *Osgriss* leaves (*Osgriss compressa*) contain 17 per cent. of tannin, called by Villon "osgristannic acid."

Onager (*Eurotia biennis*, *Onagraceae*) and *Australian yellow-wood* (*Oslega xanthoxyla*, *Cedrelaceae*) are tanniferous, the latter being used in the Transvaal. Of the various species of *poplar* (*Populus*, *Salicaceae*) the Italian contains 3–3.125 per cent. of "salicitannic acid;" the bark of the shaking poplar contains 5.80 per cent. of tannin in spring (Müller).

Plantain (*Plantago*) is tanniferous, and *pyrethrum* (*Pyrethrum autheumis*, Linn. *Compositae*), which is wild in Persia, Africa, &c., contains 0.55 per cent. of tannin in its roots. *Prunus spinosa* (*rosaceae*) is wild in France, and contains 3.33 per cent. of tannin. *Rumex acutus*, (Linn. *Polygonaceae*), *potentilla* (*rosaceae*), *periwinkle* (*Vinea major*, *Apocynaceae*), *persicaria* (*polygonaceae*), *cult's fool* (*Gnaphalium dioicum*, Linn. *Scneoideae*), *lion's foot* (*Alchimilla vulgaris*, Linn. *Rosaceae*), *Potierum sanguisorba*, Linn. (*Rosaceae*), *Equisetum hyemale* (rough horsetail, *Equisetaceae*), and *Lichen pulmonarius*, Linn. (*Lichenes*) are minor tanniferous plants.

Persea gratissima or *Laurus persea* (*lauraceae*), the alligator pear of S. America, and *plane* (*platinaceae*) yield bark, and *cocoa-nut palm* (*Cocos nucifera*, *Palmaceae*) yields wood, which are used as tannage in the native countries of the respective trees.

Quebracho (*Aspidospermum quebracho*) (*terebinthaceae*) comes from nearly all the Eastern States of South America (source of aspidospermine): red quebracho contains 16–22 per cent. of "aspidospermianic acid," while white quebracho only contains 10–11 per cent. The author points out the advantages and disadvantages of quebracho (*quebrachocolorado*) as a tanning agent. At the Paris Exhibition of 1867 leather tanned with quebracho was shown for the first time in Europe, and in 1874–75 the utility of this wood became recognised in France. In whatever form quebracho wood is to be used exposure to air should be avoided as much as possible; a sample which had a titre of 20 per cent. of tannin when freshly cut was found to contain only 16 per cent. after six months' storage.

Quillaia bark (*rosaceae*) is from Peru and Chili, and is used in Germany for making an extract (for Saponin).

Cinchona (*rubiacae*). Of this there are five varieties, namely: Grey, red, yellow, white, and false. The tannin of the bark is called "cinchotannic acid."

Red rhatany (*Krameria triandra*, *Polygalaceae*) grows in Argentina, Brazil, Chili, and Alsace; its bark contains "rhataniatannic acid." The dried extract is difficultly distinguished from kino; the bark, however, contains 42.5 per cent. of tannin while kino averages 50 per cent.

Rhubarb (*Rheum palmatum*, Linn. *Polygonaceae*) contains 9 per cent. of tannin in its roots; *Blackberry* (*rubus fruticosus*, *Rosaceae*) contains about 7 per cent. of tannin in its flowers and leaves; *Rose* (*rosaceae*) and *Rosemary* (*Rosmarinus officinalis*, *Labiatae*) are tanniferous.

Pine. Under this heading the author includes the genus *Abies*, *Pinus* and *Larix* of the *coniferae*. The bark of *Pinus picea* (Linn.) contains 6–7 per cent. of "tannocrotop-tannic acid." *Pinus canadensis* (Linn.) is the bemlock (white spruce) so much used as tannage in the United States; the bark contains 8–10 per cent. of tannin. The bark of *Pinus abies* (Linn.) contains 7–8 per cent. of tannin. Villon found 25 per cent. of tannin in the inner bark of *Pinus alpestris*, 3 or 4 per cent. in the outer bark, and 7 per cent. in the cones. A table of percentages of

tannin in pine of different ages, &c. is shown, and as a mean of all pines the author gives 8.25 per cent. of "pinitannic acid."

Larch (*Larix europæa*) bark contains 1.66 per cent. of tannin according to Davy, and 5.8 per cent. in springtime according to Müller. There is no tannin in the wood of any of the coniferae.

Scilla maritima (sea onion. Liliaceæ) contains 20—25 per cent. of tannin in its bulb (squills).

Sorghum vulgare is tanniferous.

Sumac is from several species of *rhus* (terebinthaceæ), of which *Rhus coriaria* is the chief; the others are given in detail by the author, but complete lists of this common tanning agent are fairly numerous (compare Procter's Test-Book of Tanning). A table shows that the percentage of tannin in various sumacs is from 10—28.2 per cent.

Tormentilla reptans and *T. erecta* (Rosaceæ), wild in the Alps and Pyrenees and employed as tannage in the Faroe Islands, where they produce a red leather. They contain tannin in the flowers and roots to the extent of 31 per cent. according to Renard ("tormentillo-tannic acid") and of 17 per cent. according to others.

Paraguay tea or *maté* (*Ilex paraguensis*. Rutaceæ) contains 7 per cent. of "yervamaté-tannic acid." *China tea* (*Thea chinensis*. Ternstroemiaceæ) has been much analysed; the mean may be given as 26.85 per cent. of tannin in green tea and 26.12 per cent. in black tea.

Willow. The various species of *salix* (salicaceæ) contain tannin in the bark and leaves; in the former it varies greatly, 1.4 per cent. and 16 per cent. being given in a table. The author urges that more attention be paid to willow bark by tanners; in Russia it has long been used.

Mountain ash (*Pyrus aucuparia*. Rosaceæ) contains 5—7 per cent. of tannin in its bark, 3.5 per cent. in its wood, and some also in its leaves and fruit.

Simarouba amara (Rutaceæ) is used in Guiana, Cayenne, and Venezuela for tannage; *Sabal serrulata* or *Calamus draco* (Palmaeæ) contains 15 per cent. of tannin (Villon); *Tamarindus indica*, Linn. (leguminosæ) is used as tannage in Venezuela; *Cassia auriculata* or *Turwar* (Leguminosæ) is employed in India.

Weinmannia macrostachia (Verbenaceæ), a tropical plant known as red tan, common lime (*Tiliu europæa*. Tiliaceæ), *madow sweet* (*Spiræa ulmaria*. Rosaceæ), *Verbena officinalis*, or *vervain* (Verbenaceæ), and *veronica* (Scrophulariaceæ), are all tanniferous plants of well-known habitat.

Valonia, *Quercus agrifolia*, *Q. valonea* (Cupuliferæ). These well-known acorn-cups contain from 25 to 45 per cent. of tannin. The main varieties are *Chamadra*, 33.4 per cent., *Chamadina*, 35.4 per cent. and upwards, *Rabdistia*, 30 per cent., and *Chondra* 27 per cent. Powdered valonia is poorer in tannin than the cups, because before grinding they do not completely separate bark and wood chips. A table gives the percentages of tannin according to different authorities.

In addition to the above index the author gives a list of 30 kinds of bark, six kinds of wood, and four plants which are tanniferous, but have not been used; they are nearly all of tropical growth.

In conclusion, emphasis is laid on the necessity for considering the quality of the tannin with reference to its influence on the finished leather, as well as its available quantity, in a tan-stuff before employing it as a tannage.

The report on this essay deals particularly with a portion of it which is not here published. The essayist proposes to utilise the waste of the industries which use wood for cellulose production in Alsace by making tanning extracts from it. The reporter points out that the cost of transport and the low tannin value of such waste renders its employment as fuel far more profitable.—A. G. B.

PATENTS.

Improved Means for Preserving a Solution of Tannin and keeping it from Fermenting or changing into Gallic Acid. W. Crowther and J. Crowther, Dewsbury, Yorkshire. Eng. Pat. 9624, June 6, 1891.

THE objects defined in the title are effected by keeping the tannin liquor at or about 40° F. The source of cold is any refrigerating machine, and the conductor is a brine solution circulating through coils of pipes in the vessels or tanks containing the liquor. The invention is applicable to any of the trades or manufactures in which decoctions of tannin are employed, but especially to the dyeing of cotton and other vegetable fibres, and wool. An advantage of the process is that in dyeing mixed fabrics the wool does not absorb the tannin at this temperature to anything like the same extent to which it does so at higher temperatures; thus more tannin is available for the cotton, and the metallic salts used in the subsequent operation do not affect the wool, which is consequently softer to the touch.

—A. G. B.

A Method of and Means for rendering Leather and Leather Goods Waterproof and more Durable. F. Riegert, St. Joseph, Missouri, U.S.A. Eng. Pat. 5687, March 23, 1892.

FIVE parts of yellow wax are melted, at a temperature of about 85°—90° C., in a vessel which can be closed. Two parts of turpentine, benzine, or other spirit are then added and the temperature maintained until the wax is dissolved. The leather is immersed in this solution for 10 or 15 minutes, according to the thickness of the leather, and then subjected to pressure or blows.—A. G. B.

A Process for Waterproofing all kinds of Skins and Rendering them more Durable. F. Riegert, St. Joseph, Mo., U.S.A. Eng. Pat. 5689, March 23, 1892.

THE skin is spread on a metal plate, kept at a temperature of 40°—50° C., and to its "inner surface" is applied a solution of india-rubber in "benzine," such as is known in France as "gomme du bresil"; this is well rubbed in and is followed by a dressing of "dubbing, grease, or oil of any suitable description" similarly applied. The skin is then allowed to dry for a short time and finally rubbed with soap-powder. Skins that are rough on the inner side must be scraped or rubbed "so as to allow the india-rubber to penetrate the pores more readily."—A. G. B.

Improvements in and in Apparatus for the Treatment of Liquid Gelatin or Glue for the ultimate Production of Plates or Sheets of such. W. P. Thompson. From F. A. Wolff, Heilbronn, Wurtemberg, Germany. Eng. Pat. 6416, April 2, 1892.

THE hot liquid gelatin flows from a reservoir on to an endless band of oil-cloth the edges of which are slightly turned up so as to form a channel. The band is slowly moved forward by revolving pulleys over a series of guide rollers, which keep it perfectly horizontal, and on its return journey it is twice turned, similarly to a crossed belt, in order that the gelatin may remain on the top surface; it is prevented from returning by the guide rollers. This band is enclosed in a box through channels in which cold air is drawn or blown in such a manner that the gelatin may have a thorough draught of air passing over its surface. A scraper strips the gelatin from this band on to another endless revolving band on which the gelatin is cut up into pieces of the required size by a revolving knife. The pieces fall on to the drying frames, which also form an endless revolving band. The whole apparatus is illustrated in the specification. The thickness of the sheets is regulated by the rate of flow of the gelatin on to the band. The time necessary for turning out the pieces ready for drying depends on their thickness; 10—20 minutes is said to be sufficient.—A. G. B.

Degras. R. Ruhsam. Jahresh. der Deutsch. Gerberschule zu Freiberg i. S., 1891—1892, 3, 3—17. (This Journal, 1891, 557, 1013.)

See under XXIII., page 639.

An Improved Process of Tanning Hides for making Kid-leather. W. Zahn, Newark, Essex, New Jersey. Eng. Pat. 7072, April 12, 1892.

100 LB. of well-prepared hides are immersed in a solution composed of 5 lb. of bichromate of potash and 2 lb. of common salt dissolved in 5 gals. of water, to which are added $2\frac{1}{2}$ lb. of commercial hydrochloric acid. The hides remain in this solution until they appear to be well soaked, which generally means 3—5 hours, and are then pressed. They are next treated with sulphuretted hydrogen, "either alone or in conjunction with other compounds," as gas or in solution. If the sulphuretted hydrogen be applied as gas, the hides or skins are suspended in a chamber, or series of chambers, through which the gas is passed, the finish of the process being indicated by the change of the yellow colour to bluish green. If it be applied in solution the skins are immersed in a bath composed of 2 lb. of "yellow sulphuret of potash of commerce" dissolved in 12 gals. of water; to this bath 4 lb. of dilute sulphuric acid (1 : 5) and, after a time, another pound of sulphuret of potash are slowly added. Alum may be used in this bath if desired.—A. G. B.

Improved Manufacture of Substitute for Leather. A. J. Boulton, London. From A. E. Ebert, Dresden-Alstadt, Saxony. Eng. Pat. 7698, April 23, 1892.

THE material to be manufactured, which should preferably be hair-felt containing a small proportion of wool and free from soluble matter, is singed by a hot-iron plate to remove short hairs and immersed for 10 to 20 minutes, according to thickness, in a vessel containing the molten impregnating material and kept hot over a low fire. The pieces of felt must be thoroughly dried before immersion and are best handled on a wire frame. The impregnating bath is prepared as follows:—"One part of ozokerite or cerasin (mineral wax) is melted, and to this are added two parts of melted beef or mutton dripping. This mixture is diluted by the addition of from 6 to 8 parts of varnish, so that it acquires the consistency of a salve or pomade, whereupon 2 or 3 parts of oxide of iron are added"; the addition of about $\frac{1}{4}$ per cent. of oxide of manganese is sometimes advantageous. "This mixture is now mixed with 5 parts of asphalt." Resin oil may be added to increase the fluidity of the bath if required, and turpentine oil has also been found to be advantageous at times. After immersion the pieces of felt are spread on a plate and the excess of liquid pressed out by a roller. The sheets are then pressed between sheets of metal covered with German or Frankfort black and moistened with water to prevent adhesion. Calendering between rollers, varnishing with asphalt varnish, and burnishing with brushes conclude the manufacture of this leather substitute.—A. G. B.

Improvements in and Relating to Tanning Hides and Skins. H. H. Lake, London. From Durio Brothers, Turin, Italy. Eng. Pat. 8169, May 4, 1892.

THEORY and custom have heretofore forbidden the use of tannin liquors of a very high degree of concentration, 3°—4° B. having been the maximum limit allowed. According to the patentee, it is this that has rendered nugatory the attempts which have been made to hasten the tanning process by drumming or fulling. This invention combines the use of a rotating drum with that of strong tannin liquors. The drum, or fuller, preferred is a cask $6\frac{1}{2}$ ft. inner diameter and $6\frac{1}{2}$ ft. length, capable of rotating on its own axis; these dimensions will serve for about 10 to 12 cwt. of hides or skins. The cask is filled to within $\frac{3}{4}$ in. of the rotatory axis with a tannin liquor of about 6 $\frac{1}{2}$ ° B., made from any good extract; the hides or skins ("which need not undergo any special preliminary preparation, except the ordinary unhairing, fleshing, and puring, known by the name of river work") are introduced, and the cask closed and rotated at about 10 revolutions per minute. From time to time the rotation is stopped for proofing the liquor, which is brought back according to requirement not only to the initial density but to a slightly higher density

by the addition of fresh extract; in this way the liquor will be ready for a new batch of hides when the first is tanned. Filtration after five or six operations, is, however, recommended. "From 2 to 4 hours are sufficient" for the tanning of small hides or skins, such as, for example, those of sheep and the like, and from 20 to 30 hours are not exceeded for the heavy and very thick bull or ox hides"; the time varies by reason of the quality of the hides. When the proofing shows that no more tannin is being absorbed, the hides are removed to another drum and tumbled in "water with tannin liquor" to wash away deposits which are likely to have been produced in the strong liquors.—A. G. B.

XV.—MANURES, Etc.

The Results of Chemical Manuring. Chemical Trade J., 1892, 11, 2.

A SERIES of experiments have been made during the past 10 years by the East Suffolk Chamber of Agriculture, with a view to gaining some reliable evidence as to the advisability of manuring grass lands in accordance with the prevailing customs. The trials were made at Saxmundham on poor heavy land, with a clay subsoil. The manures tried were the following:—

Manure.	Quantity per Acre.	Cost per Acre.
Compound manure, containing potash, phosphates, nitrogen, and magnesia.	Lb. 424	s. d. 25 6
Pure dissolved bones	496	33 0
Superphosphate	1,044 Cwt.	33 0
Gypsum	32	32 0

The following table shows the results for 1891, for 10 years, and the excess over unmanured plots on the average of 10 years of all the experiments:—

Manure.	1891.	Average of 10 Years 1882—91.		
	Yield per Acre.	Yield per Acre.	Excess over Unmanured Plot.	Value of Excess.
	Lb.	Lb.	Lb.	£ s. d.
Compound manure	4,312	4,277	1,263	2 5 0
Pure dissolved bones	3,418	3,608	594	1 1 0
No manure	3,225	3,014	..	..
Superphosphates	2,880	3,387	375	0 13 0
Gypsum	3,106	3,198	184	0 6 6

It will thus be seen that the compound manure was the only one which paid for its use. This compound was made in the following proportions:—

Lb.	
Superphosphate (containing 13·5 per cent. soluble H_3PO_4)	106
Muriate of potash	33
Nitrate of soda	26
Sulphate of ammonia	10
Sulphate of magnesium	53
Gypsum	106

This composition gives 14·5 lb. of ammonia, 48·5 lb. of potash, and 14·5 lb. of phosphoric acid per acre. It will be noticed also that this mixture is largely composed

of those chemical manures which in themselves were apparent failures, showing that the fault does not lie with the manures so much as with the want of judgment in their application. In order to assure the reliability of these tests, extensive meteorological observations were also made so as to witness the effect of the weather upon the crops obtained. The net profit in the case of the compound manure, after allowing for the cost of the same, amounts to 1*l.* per acre.

XVI.—SUGAR, STARCH, GUM, Etc.

On the Formation of Dextrins. P. Petit. Compt. Rend. 1892, 114, 76—79.

THE dextrins which are prepared by Payen's process (heating starch moistened with a small quantity of nitric acid, to 100°—110° C.) almost invariably reduce Fehling's solution.

The author undertook to examine the influence of time and of the quantity of acid employed, on starch in Payen's process at a temperature of 125° C. The resulting product might contain unattacked starch, glucose, and dextrin, and an estimation of these substances could be based on the following facts which had been ascertained by using known quantities of starch, glucose, and of a non-reducing dextrin. 1st. Water at 40°—50° C. fully extracts glucose and dextrin, and the starch collected on a weighed filter is recovered completely. 2nd. The rotatory power of the solution is equal to the sum of the rotatory powers of the glucose and of the dextrin. 3rd. On fermenting the solution, sterilising it, and adding yeast, it is found that the decrease of rotatory power exactly corresponds to the quantity of glucose used. The solution does not further reduce any Fehling's solution. The author's results are given in the following table, in which the quantity of substance reducing Fehling's solution is expressed in percentages of glucose calculated on the dextrin:—

Per-centage of Acid.	Time during which the Starch was heated.				Unaltered Starch per 1 gram. of Dextrin.
	1 Hour.	2 Hours.	3 Hours.	4 Hours.	
0.2	3.9	5.06	3.6	2.8	0.003
0.3	7.2	5.3	3.6	3.0	0.002
0.5	7.3	6.07	4.2	3.1	0.001
0.8	8.06	6.3	4.5	4.0	Traces
2.0	9.5	7.1	5.4	4.5	Traces

From these results the following conclusions are arrived at. For the same quantity of acid the reducing power decreases when the time of heating increases; whilst for the same length of period of heating the reducing power increases with the amount of acid used. Other experiments showed that for the same amount of acid the reducing power decreased the quicker the higher the temperature rose, and further that this reducing power decreased more rapidly when, for the same quantity of acid and the same length of time, the temperature rose more. These observations explain why some commercial products of dextrin are practically non-reducing; for the manufacturers heat the starch for 60 to 70 hours.

The variations of the rotatory power give analogous results.

The examination of the dextrins by fermenting them showed that all dextrins prepared by Payen's process contain, besides small quantities of glucose, a quantity of a non-fermentable substance which reduces Fehling's solution. The author conjectures that this substance is a product of the oxidation of the starch by nitric acid and has the properties of an aldehyde.—J. L.

Vegetation of the Vine. L. Roos and E. Thomas. Compt. Rend. 1892, 114, 593.

See under XVII., page 627.

PATENTS.

Improvements in the Treatment of Saccharine Solutions which have been Boiled to the Granular State. J. C. Mewburn, London. From "The Maschinenfabrik Grevenbroich," Grevenbroich, Germany. Eng. Pat. 8516, May 19, 1891.

INSTEAD of using the syrup (and smaller crystals) which pass through the centrifugal machine for boiling into inferior products as heretofore, it is run into the vacuum pan at the end of the next granulation. The mixture so obtained is cooled and crystallised either in barrels, vessels, or vats provided with agitators; the surplus syrup after the subsidence of its fine crystals or crystal meal is drawn off, and is subsequently boiled as second product.—A. R. L.

Improvements in Apparatus for and a Method of Manufacturing Sugar. R. Brokhoff, Aix-la-Chapelle, Germany. Eng. Pat. 6160, March 30, 1892.

THIS invention relates more especially to improvements in apparatus of the kind described in the specification of the Patents No. 13,084, Sept. 10, 1888 (this Journal, 1889, 810) and No. 7517, May 4, 1889 (this Journal 1890, 529). Instead of an elevated vessel for the clearing or refining liquor, a pump is used in conjunction with an air vessel and valve to keep the pressure constant. Instead of the usual round mould basket a removable octagonal mould basket is used.

—A. L. S.

XVII.—BREWING, WINES, SPIRITS, Etc.

On the Use of Hydrofluoric Acid and Fluorides in Distilleries as proposed by Effront. Report by Camille Vincent. Bul. Soc. d'Encouragement Ind. Nat. 6 [72], 642—645.

THE transformation of starchy matters into alcohol is, as is well known, only a partial one and as a rule only 80 per cent. of the available starch is used up; about 3 per cent. escape the saccharification altogether; moreover, during the fermentation of the worts various organic acids and other products are formed.

Pasteur has established the fact that in every normal alcoholic fermentation about 7 per cent. of the fermentable matter yields glycerol and succinic acid, or serves to reproduce yeast; it therefore follows that about 15 per cent. of the available starch is lost to the distiller, as it is partly changed by the lactic and butyric ferments, or else is found in the fermented products in the form of dextrin, because the diastase has been more or less coagulated by the said organic acids.

The injurious ferments do not limit their action to the weakening of the diastase and the destruction of a portion of the maltose; they also affect the vitality of the yeast, and therefore cause a great loss of alcohol. To counteract the effect of these ferments by conducting the mashing at a somewhat high temperature the endeavour has been made to paralyse their action, but the desired result has not been obtained because the temperature had to be raised so high that the diastase suffered complete alteration.

It has also been attempted to stop abnormal fermentation by the use of mineral acids, but without avail.

M. Effront has for some time paid particular attention to the action of hydrofluoric acid and soluble fluorides on the worts, and has obtained such satisfactory results that the process based upon this action has already come into practical use.

Effront's researches demonstrate the energetic action of hydrofluoric acid on the injurious ferments.

The author has for instance found that in a wort subjected to lactic fermentation, 0.200 grm. of hydrochloric acid or 0.300 grm. of sulphuric acid per 100 cc., is required to completely stop the further growth of the ferment, whilst an addition of only 0.025 grm. of hydrofluoric acid suffices. Even an addition of only 0.003 grm. of this acid reduces the production of the lactic acid to one-fourth, while about 0.060 grm. of hydrochloric acid is required for the same purpose. Similar results have been obtained with the butyric ferment.

0.012 grm. of the acid added to 100 cc. of an infusion of malt did not, apparently, stop the action of the diastase, although considerably paralysing the lactic and butyric ferments.

Effront has also discovered that the use of hydrofluoric acid allows of the mashing being carried on at a much lower temperature than is ordinarily necessary (50°–60° C.) At that temperature the production of maltose is supposed to be at its maximum. But the product obtained is evidently only expressed by the difference between the starchy matter rendered soluble by the action of the diastase and the portion changed by the lactic and butyric ferments. Now, by paralysing these ferments, Effront is enabled to carry on the mashing at a much lower temperature (30° C.), and he has succeeded in converting 96 per cent. of the available starch into maltose.

He has also observed that yeast cultivated in presence of hydrofluoric acid or ammonium fluoride, is more active than the usual article. It is evident from these facts that the proportion of malt and yeast may be reduced without diminishing the *rendement* of the alcohol.

The mashing and fermentation processes proposed by Effront have been practically tested in the distillery of Messrs. Maquet and Clément, and have resulted in a remarkable increase in the production of alcohol.

Numerous works in Bavaria, Italy, and Spain have also adopted the new process.—L. de K.

A New Enzyme. Glucose. R. Géduld. *Wochenschrift für Brauerie*, 8, 620.

1. GLUCOSE exists in ungerminated grain, partly in a soluble and partly in an insoluble form. It also exists in germinated grain in an insoluble form. 2. Glucose does not liquefy starch paste, and only slightly acts on soluble starch. 3. Digested at 50° C., with the different dextrans, it converts them all into dextrose. Whether intermediate dextrans are formed has not yet with certainty been determined. 4. Glucose acts most vigorously on maltose which it converts into dextrose.—A. L. S.

On the Volatilisation of Alcohol during Fermentation. E. Riss. *Zeits. für Spiritusind.* 14, 148.

THE author has investigated the loss of alcohol during the primary fermentation, and he finds that this loss amounts to about 1 per cent. on the product. No doubt the loss of alcohol from storage casks is still greater.—A. L. S.

Iso-maltose and its Importance in Brewing. C. J. Lintner. *Zeits. ges. Brauw.* 1892, 15, 6.

ISO-MALTOSE is prepared by the action of diastase on malt at 72° C. for four hours. After removing the excess of maltose a syrup remains, from which pure iso-maltose, quite free from dextrin, is precipitated in a flocculent form on treatment with absolute alcohol. The product begins to fuse together at 65° C. and at 85° C. it carbonises partially; at 200° C. it melts completely, undergoing further decomposition. It has a sweet taste and a rotatory power $[\alpha]_D^{20} = 139^\circ$, that of maltose being 140.4° . Its reducing power is about 84 per cent. of that of maltose; diastase converts it completely into maltose. The author is of opinion that the aroma emitted in kiln-drying is essentially due to the

presence of iso-maltose and points out that this aroma is most marked under conditions favourable to the production of iso-maltose. Iso-maltose is an important constituent of beer and forms 25–30 per cent of beer extract. The decoction method is especially favourable for producing beer rich in iso-maltose, as this is formed in quantity at a temperature of 65°–70° C. and in presence of not too great an excess of diastase. A dextrin having a rotatory power $[\alpha]_D^{20} = 200^\circ$ is formed together with maltose and iso-maltose in the decomposition of starch by diastase, which three products only are obtained in all cases. Hence in the opinion of the author the amyloins or malto-dextrins obtained by Brown and Morris (this Journal, 1891, 265,) may be mixtures of iso-maltose and this dextrin and not simple bodies (this Journal, 1890, 533).—C. A. K.

The Use of Hydrofluoric Acid and its Salts in the Distillation of Alcohol. L. N. Schishkoff. *Journ. of Russ. Chem. Soc.* 1892, 24, 137.

EXPERIMENTS have proved that the use of compositions containing hydrofluoric acid and fluorides in due proportions give extraordinary results in the manufacture of spirit, and considerably cheapen its production. It is also possible to obtain spirit of a much better quality. The author ascribes to the fluorides antiseptic properties, in consequence of which the formation of a too large quantity of butyric and acetic bacteria is preventable. By the use of 6 grms. of hydrofluoric acid of 30 per cent. strength to one hectolitre of must, a very slow but steady fermenting operation is secured.—P. D.

Determination of the Extractive Matters in Brandy. *Zeits. für Spiritusind.* 14, 215.

See under XXII., page 638.

The Fermentation of Arabinose by Bacillus ethacetiens. P. F. Frankland and J. MacGregor. *Proc. Chem. Soc.* 1892 [114], 132.

THE products are qualitatively the same as were obtained in the fermentations of glycerol by the same organism, consisting of ethyl alcohol, acetic acid, carbon dioxide, hydrogen, and traces of succinic acid, together with another acid not identified. When, however, the fermentation is conducted in a space closed by a mercury seal instead of cotton wool, a notable proportion of formic acid also occurs amongst the products. When the fermentation is conducted in a closed space, the products are formed approximately in the proportions $3\text{ C}_2\text{H}_6\text{O} : 3\text{ C}_2\text{H}_4\text{O}_2 : 4\text{ CH}_2\text{O}_2$.

In the fermentations conducted in flasks plugged only with cotton wool, on the other hand the alcohol and acetic acid were in the proportion $2\text{ C}_2\text{H}_6\text{O} : 3\text{ C}_2\text{H}_4\text{O}_2$. It appears therefore that in the fermentation of arabinose by *Bacillus ethacetiens* the proportion of acetic acid to alcohol is greater than in that of dextrose, and still greater than in that of mannitol and glycerol, but less than in that of glyceric acid.—W. S.

Vegetation of the Vine. L. Roos and E. Thomas. *Compt. Rend.* 1892, 114, 593.

FROM a study of the changes which take place in the vine *Aramon*, between the periods of flowering and maturity the authors arrive at the following conclusions:—(1.) During the first ten or twelve weeks of vegetation a saccharose is present in the leaves, the stem, and even in the grape, contrary to the opinion of Petit. (2.) This saccharose disappears from these parts during the fourth month of vegetation, and they then contain a mixture of sugars consisting largely of dextrose. (3.) The increase in the quantity of sugar in absolute value does not correspond with a diminution of acidity, as is the case with regard to the percentage value; it is not, therefore, correct in every case to say that the acidity diminishes in proportion as the

plant advances to maturity. (4.) The diminution of acidity, in absolute value, takes place at the time when the levulose in the fruit is rapidly increasing in quantity; at this period also the polarimetric rotation begins to pass to the left until, at the time of maturity, it is practically the same as that of invert sugar.—F. S. K.

The Hydrolytic Functions of Yeast. Part I. J. O'Sullivan.
Proc. Chem. Soc. 1892 [113], 124—125.

It is generally stated, on the authority of Berthelot, that the water in which yeast has been washed possesses, like yeast itself, the power of hydrolysing cane sugar, and that the active substance can be precipitated from the solution by means of alcohol. In the present communication it is shown that *healthy* yeast yields none of its invertase to water in which it is washed; and that when it is placed in contact with sugar, hydrolysis is effected solely under the immediate influence of the plasma of the cell, no invertase leaving the cell while hydrolysis is taking place.

After describing his mode of obtaining a healthy yeast, the author gives an account of the difficulty met with in removing the cells from the liquid in which they were suspended; although bright liquids, free from organisms, were obtained by adding aluminium hydrate, finings, or gypsum, before filtering, such substances were found to retard the activity of the invertase, and therefore could not be used. Ultimately the object was obtained by shaking up the yeast and water with filter-paper pulp before filtering.

A detailed account is given of experiments carried out under various conditions, which show that water which had been in contact with highly active yeast for various times had no hydrolytic power, although on the condition of a mere trace of invertase, the solution at once became active. The author, therefore, concludes that the resolution of cane sugar under the influence of yeast is entirely due to zymic hydrolysis.—W. S.

PATENTS.

Improvements in the Method of and in Apparatus for Drying and Evaporating, suitable for Use in Breweries, Distilleries, Sugar and Starch Manufactories, and in other Industries. H. Hencke, Darmstadt, Germany.
Eng. Pat. 6587, April 16, 1891.

A NUMBER of different machines are described, consisting of rotating cylinders and combinations of several of these. They are heated by hot air or steam. The specification is accompanied by a number of drawings and a detailed description of the apparatus.—A. L. S.

An Improved Means and Method of Closure for the Regulation of Gaseous Pressure. E. J. Mills and C. J. Ellis, Glasgow.
Eng. Pat. 9187, June 1, 1891.

See under 1., page 595.

Improvements in the Process of and Apparatus for Effecting the Extraction of Hops with the Simultaneous Production of a Fine Extract. W. P. Thompson, Liverpool.
From J. F. Theurer, Milwaukee, Wisconsin, U.S.A.
Eng. Pat. 9763, June 9, 1891.

THE hops to be used in the brewing are boiled with a small quantity of wort in a closed vessel furnished with stirrers. The wort is run off through a perforated false bottom into a cooling vessel and the residual hops boiled in the copper with the remainder of the wort.—A. L. S.

An Improved Method of and Means for Manufacturing Beer and Ale. P. M. Justice, London.
From A. W. Billings, New York, U.S.A.
Eng. Pat. 10,135, June 15, 1891.

THIS invention aims at the employment of raw grain in conjunction with malt for preparing the wort. The mash tub used is cylindrical and provided with stirrers and jacketed, so that the contents may be either heated or cooled.

The mashing is performed as follows:—Water at 120° F. having been led into the tub, the ground raw grain with from 1 to 25 per cent. of malt is added. The temperature is gradually raised to 146° F., the material being kept well stirred, and after 15—20 minutes is rapidly raised to 200° F., at which point it is kept until the grain is thoroughly gelatinised. The mixture is then cooled to 160° F., and the remainder of the malt added. The discharge valve is then opened and the mash rapidly discharged into the filtering tub, from which after standing 30—40 minutes, it is drawn off in the usual manner.—A. L. S.

New or Improved Means for the Preservation of Hops.
M. A. Adams and C. S. Meecham, Maidstone, Kent.
Eng. Pat. 11,123, June 30, 1891.

THE hops are packed in metal cylinders or other suitable vessels, which can be hermetically closed.

After the hops have remained the proper time in these vessels, the air is removed by a current of carbonic acid, sulphurous acid or other suitable gas or vapour, and the cases are sealed up.—A. L. S.

Improvements in Brewing. A. Umbeck, Barmen, Rhenish Prussia, Germany.
Eng. Pat. 18,511, October 27, 1891.

ACCORDING to the inventor a large quantity of starch is left in the spent grain, as produced by the usual method of brewing. In order to dissolve this starch, the mash is boiled with common salt. To prevent the loss of the volatile ingredients of hops during the boiling process, the inventor recommends that the hops be first distilled and the distillate be added to the cooled wort.—A. L. S.

Improvements in Relation to the Production of Colour Malt. C. Hof, London.
From L. Rühsmann, Bamberg, Germany.
Eng. Pat. 23,649, November 27, 1891.

THE malt is soaked in water, and after 25 to 30 hours is placed in a closed cylinder or roaster and heated to 60°—70° C. for 2 hours; the temperature is then raised to 95°—100°, whereby the roasting is effected.

It is claimed that the coloured malt thus produced yields a better extract than that prepared in the usual way.
—A. L. S.

Improvements in the Process of Manufacturing Beer, Ale, Wine, Cider, or the like. W. P. Thompson, Liverpool, Manchester, and London.
From C. F. Lawton, Rochester, New York State, U.S.A.
Eng. Pat. 3010, February 16, 1892.

AIR is passed through the fermenting liquor; this is to kill all the ferment germs which may be present, except yeast and the acetic ferment. If the acetic ferment increases to any extent, the current of air is replaced by a mixture of carbon monoxide and nitrogen obtained by the partial combustion of coke. The effect of the passage of this mixture through the fermenting liquor is to kill the acetic ferment, whilst it leaves the yeast unharmed. This treatment is said to give a beer of great stability and with a minimum of labour.—A. L. S.

Improvements in the Method of and Apparatus for Manufacturing Beer, Ale, Wine, Cider, or the like. W. P. Thompson, Liverpool, Manchester, and London. From C. F. Lawton, Rochester, New York State, U.S.A. Eng. Pat. 3011, February 16, 1892.

THE hot boiled wort is collected in a closed vat and cooled by injecting into it sterilised air. Yeast is added when the wort has been cooled to the proper temperature. During the progress of the fermentation air is injected from time to time. There is an arrangement for skimming the harm as it rises to the surface. A detailed description of the apparatus is given in the specification.—A. L. S.

Improvements in the Manufacture of Beer. A. J. Boulton, London. From The Pfandler Vacuum Fermentation Company, Rochester, New York, U.S.A. Eng. Pat. 4682, March 9, 1892.

THIS invention relates to the production of lager beer. The primary and secondary fermentation are both conducted in closed vats, from which the gaseous products are removed as fast as they are produced; thus the whole of the fermentation takes place in a complete or partial vacuum. If required, a little air is injected at the bottom of the vat.

By this means the time for the manufacture of lager beer is said to be very much shortened.—A. L. S.

Improvements in the Manufacture of Beer. A. J. Boulton, London. From The Pfandler Vacuum Fermentation Company, Rochester, New York, U.S.A. Eng. Pat. 4688, March 9, 1892.

THIS invention relates to the treatment of the beer subsequent to the ripening stage, which has been manufactured according to the above company's process.

The carbonic acid pumped out of the fermenting vessels is stored in a gasholder, and the finished beer after filtration is saturated with the gas and led into cask by a special apparatus described in detail in the specification.—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A).—CHEMISTRY OF FOODS.

PATENTS.

Improvements in Apparatus for Closing Vessels for the Preservation of Alimentary and other Substances. G. Bathgate, London. Eng. Pat. 6266, April 13, 1891.

IN this specification improved forms of apparatus for corking or stoppering bottles or jars, combined with a vacuum pump for simultaneously exhausting them, are described. The bottle or jar is inserted by its neck into an aperture provided at the lower portion of the stoppering chamber, and the union is rendered air-tight by suitable packing, e.g., the neck of the vessel may be surrounded by an india-rubber cushion. (See below.) The stoppering chamber is connected by an aperture with the chamber of an air-pump. The stoppering rod and the piston rod of the air-pump are interdependent, and both are controlled by an irregular cog-wheel, which is manipulated by a lever. On pulling the lever forward the piston rod is raised, the vacuum chamber, and thence also the stoppering chamber, being exhausted. The cogs on the wheel are so arranged that on continuing to pull the lever they act upon a set of cogs on the stoppering rod so that the latter is depressed and the cork or stopper inserted. In certain cases the above-mentioned

cog-wheel also controls the plug of a three-way cock, connecting the stoppering chamber with the vacuum chamber and also with the atmosphere; it is so arranged that when the cork or stopper is inserted the plug of the cock has been turned into such a position that the stoppering chamber is in communication with the atmosphere, thereby rendering it easier to remove the bottle. An air-filter of antiseptic material may also be used in the passage leading from the stoppering chamber to the atmosphere. The three-way cock may be automatically operated as follows:—Upon an extended part of the plug of the cock a cam path is formed in which a projecting screw, secured in a bearing carried by a rod, engages. The rod is then operated by the cog-wheel so that the teeth which produce its movement are independent of those producing the movements of the stoppering and piston rods. For screw-stoppered bottles, a crown wheel is used in conjunction with the cog-wheel to impart the necessary rotatory motion. In order to hermetically seal the joint between the neck of the vessel to be stoppered and the stoppering chamber, and to admit a vessel whose head is of greater dimensions than its neck, an elastic cushion divided preferably into four parts may be used.—A. R. L.

Improvements in and relating to Means and Appliances for Testing and Recording the Characteristics or Properties of Flour and Dough. J. Hogarth, Kirkealdy. Eng. Pat. 6784, April 20, 1891.

THE inventor describes at some length various improvements upon and relating to the appliances used in his system of testing and recording the properties of flour and dough described in a former patent (Eng. Pat. 16,389, October 17, 1889). For details of this invention the original specification must be consulted.—J. C. C.

Improvements in the Treatment of Common Salt intended to be used for Curing Food, such as Meat, Game, Fish, and Poultry. A. Collingridge. From V. Coinet and A. Jones, Paris. Eng. Pat. 10,415, June 19, 1891.

THE process consists essentially in passing the vapours obtained from the destructive distillation of peat or wood into a chamber containing salt until the latter is thoroughly impregnated with them. If no apparatus is at hand for the distillation of wood, 5—15 per cent. of commercial pyro-ligneous acid is added to the salt. The latter may be employed forthwith for the curing process, which it is claimed is thus perfected in a much shorter space of time.

—J. W. L.

An Improvement in the Manufacture of Wheaten Flour. J. Amos, Waverley, New South Wales. Eng. Pat. 10,601, June 22, 1891.

THE roller milling method of manufacturing wheaten flour, which is displacing the older stone process, has certain disadvantages as compared with the latter. In the first place, the separated bran-flour contains much gluten, but being of inferior quality it cannot be mixed with the "straight grade" flour. Secondly, as the germ is merely flattened during grinding, only a very minute portion of it finds its way into the finished flour. In this way, therefore, the purest product is deprived of a portion of those substances on which its flavour and baking qualities depend. Another point is that the period of maturing—between grinding and dressing—which it is customary to allow in the case of stone flour, but which is omitted in the case of roller milling flour, contributes distinctly to the superiority of the former. The present invention is intended to overcome these faults, and at the same time avoid the troublesome and expensive process of maturing the bulk of the flour. It consists in separating, at an early stage of the manufacture, the germs and the products rich in gluten (bran flour) either together or separately, and "ageing" the same. For this purpose flour is added, and in order to hasten the

extraction of the oil and flavouring matter from the germs the mixture may be heated, but not above 158°F . The mixture is afterwards packed into sacks and allowed to cool and mature. The "aged" product is finally carefully dressed and purified and mixed with "straight grade" flour in order to improve the same. It is claimed that by this process it is necessary to store only 5—10 per cent. of the output of a mill to improve the whole product practically to the same extent as it was improved under the old process by the storage of the whole product.—H. T. P.

A New or Improved Device to be used when Boiling Milk.

H. D. Fitzpatrick, Glasgow. From E. Teschner, Berlin, Germany. Eng. Pat. 2565, February 10, 1892.

A hollow frustum of a cone, the wide end of which is cut out to a wave-like form, is introduced, the wide end downwards, into the milk to be boiled, a smaller frustum of more acute angle being placed over the top of the first. As soon as the boiling point is reached that portion of the milk contained within the larger frustum rises, the tapered form of the latter forcing it to the top whence it bubbles over the rim of the smaller frustum and is returned to the main portion before this attains a high level. It is claimed that as the milk is spread into a thin film, it is deprived of air, thus rendering it more digestible, and enabling it to be kept longer; also that the milk is prevented from boiling over.

—A. R. L.

Improvements in or Applicable to Apparatus for Sterilising Milk and other Fluids.

G. F. Redfern, London. From G. H. Neubass, J. F. H. Gronwald, and F. H. C. Oehlmann. Eng. Pat. 3170, February 22, 1892.

This is an arrangement for exhausting the gases from, and rendering homogeneous, milk and other fluids, and is to be combined with an ordinary sterilising apparatus or with an improved apparatus. For details of this invention the original specification must be consulted.—J. C. C.

Improvements in Apparatus for Purifying, Sterilising, and Filtering Water, and Rendering the same fit for Potable Purposes.

S. L. West, Washington, U.S.A. Eng. Pat. 5589, March 22, 1892.

This invention consists in a drinking water distributing system or sterilised water service apparatus applied to the ordinary water supply and heating system in common use. By means of this apparatus all water passing through the system is heated to 212°F , cooled, and filtered. For details of the apparatus the original specification must be consulted.—J. C. C.

Improvements in or Relating to the Preservation of Meat and Fatty Matters.

J. Falcimagne, Paris, France. Eng. Pat. 5725, March 23, 1892.

This is a method based on the transformation of carbonate of lime or soda into sulphite under the influence of sulphurous acid fumes produced by burning sulphur. A special apparatus is described in detail in the specification, in which the fumes from burning sulphur are drawn through a layer of alkaline carbonate into a chamber containing the meats, &c.—J. C. C.

An Improvement in the Manufacture of Malt Bread, Biscuits, Confectionery, and other Articles of Diet.

W. Crawford, London. Eng. Pat. 6811, April 9, 1892.

In order to produce bread, confectionery, &c., of a "highly digestible and nutritive nature," the inventor employs the following ingredients:—2 lb. of flour, 2 lb. of wheat meal, $\frac{1}{4}$ lb. of fine maize meal, $\frac{1}{4}$ lb. of rice flour, 5 oz. of extract of malt, $\frac{3}{4}$ oz. of compressed yeast, $\frac{3}{4}$ oz. of salt, 2 $\frac{1}{2}$ pints of water, and $\frac{1}{2}$ pint of lime water. The yeast and malt extract are dissolved in the water previously heated to

90°F ., the wheat meal, maize meal, and rice flour are then stirred in and the mixture is allowed to ferment for two hours in a warm place. The lime water and salt are then added and dough is made with the remaining flour. The dough is allowed to "prove" for half an hour; it is then moulded in any desired way, proved for another 20 minutes and finally baked in an oven not too hot. If desired, all wheat meal or all flour may be employed, and the quantity of malt extract may be varied; otherwise the above instructions must be adhered to.—H. T. P.

(B.)—SANITARY CHEMISTRY.

PATENTS.

Improvements in the Treatment of Sewage, and in Obtaining certain useful Products thereby.

A. Hossack and H. C. Bull, London. Eng. Pat. 10,563, June 20, 1891.

In carrying out this process, town sewage is mixed by means of suitable apparatus with sufficient milk of lime to saturate the water in the sewage. At the same time a quantity of finely pulverised slack coal is added to the mass in order to accelerate the precipitation of the sludge. The mixture is allowed to settle in shallow tanks, the supernatant liquid is run off, and the sludge is then placed in deep tanks so that the remaining water may separate as completely as possible. The liquid separating at this stage is mixed with lime and employed in treating a fresh portion of sewage. The sludge is moulded into blocks which are dried and used for the production of illuminating gas, tar, ammonia, &c. The residue of carbon obtained may be used for the manufacture of water-gas, whilst the ash finally remaining may be employed as a fertiliser. The liquid obtained in the first operation is treated with a current of carbonic acid gas. The resulting precipitate of calcium carbonate may be used in glass-making, &c., or river mud may be added to the liquid during the treatment with carbonic acid. In this case, the sludge of mud and chalk forms a valuable stock for the manufacture of Portland cement. Finally, if desired, the liquid, after precipitation of the lime, may be filtered through peat-charcoal, prepared preferably from peat-litter, which will remove any remaining injurious substances. The charcoal may afterwards be mixed with the before-mentioned sludge and worked up for illuminating gas.—H. T. P.

Improvements in Apparatus for Drawing off Liquid from Sewage Tanks.

F. Bird, London. Eng. Pat. 10,865, June 25, 1891.

This invention consists in a valve and mechanism whereby the rise or fall of a pivoted floating draw-off tube is caused to open or close a throttle valve suddenly, by the aid of tumbler weights which are acted upon by arms attached to the draw-off tube.—J. C. C.

Improvements in the Treatment of Sewage Sludge.

W. E. Agency, Dublin. Eng. Pat. 10,929, June 26, 1891.

The liquor is first allowed to settle, the clear liquor is then purified by manganate or permanganate of potash or soda in such a manner that the manganese is recovered as oxyhydrate; this is added to the sludge in small quantities and exposed to the air in thin layers; the oxyhydrate is reduced by the micro-organisms to manganous hydrate which in turn absorbs oxygen and returns to oxyhydrate, acting as a carrier of oxygen for the micro-organism, and preventing the formation of putrefaction products, and offensive odours in consequence.—J. C. C.

Improvements in Apparatus for Treating Sewage.

W. H. Munns, London. From A. F. Black, Malden, Massachusetts, U.S.A. Eng. Pat. 12,025, July 15, 1891.

According to this process, the sewage water to be treated is discharged over a distributing grill, beneath which are

arranged a number of superimposed horizontal sieve-belts made of wire gauze, the whole being surrounded by a metal outer case. A trough-like shape is imparted to the belts by making them travel over convex pulleys. The sewage passes successively in the form of spray through the grill, and the belts which sift out the coarser suspended particles, the liquid being at the same time exposed to the purifying action of a blast of air entering at the lower part of the outer case. The foul gases given off by the sewage are exhausted from the apparatus by means of a fan and rendered innocuous by being passed through a furnace; whilst the solid particles adhering to the belts are brushed off the latter by means of rotating brushes fixed at one end of the outer case, and discharged through suitable chutes into a drying reservoir. The liquid portion of the sewage finally falls on a tram of filtering cars, each containing sand spread on a perforated bottom. The cars run continuously on a circular track, a segment of which passes underneath the sieve-belts, whilst the remainder of the track traverses a depositing field, from which the filtered sewage may be conveyed to a river, &c.—H. T. P.

(C).—DISINFECTANTS.

PATENTS.

Improved Manufacture of Disinfecting Powder. T. H. Williams, Derby. Eng. Pat. 9491, June 4, 1891.

BARLEY which has been used for brewing purposes, after being dried, is ground in an edge-runner mill or other suitable apparatus, and then mixed by the aid of the same mill with 10—20 per cent. of carbolic acid so as to form a practically dry powder. Sanitas, eucalyptus, creosote, or other such substances may be used in place of carbolic acid.

—J. C. C.

Improved Manufacture of Disinfecting Powder. T. H. Williams, Derby. Eng. Pat. 9492, June 4, 1891.

HORS which have been used for brewing purposes, after being dried, are ground in an edge-runner mill or other suitable apparatus, and then mixed by the aid of the same mill with 10—20 per cent. of carbolic acid so as to form a practically dry powder. Sanitas, eucalyptus, creosote or other such substance may be used in place of carbolic acid.

—J. C. C.

Improvements in Apparatus for Use in Disinfecting by Means of Antiseptic Liquids. C. Herscher, Paris, France. Eng. Pat. 2549, February 9, 1892.

This invention relates to an apparatus for distributing an antiseptic liquid in the form of a fine spray, for the purpose of disinfecting clothes, furniture, the walls of houses, ships, &c. It consists of a cylindrical closed vessel mounted vertically on wheels or on a truck for the sake of portability. A horizontal partition divides the cylinder into two compartments which communicate by means of a short pipe. The lower compartment is fitted with an inlet funnel and an outlet tap and is intended to hold the antiseptic liquid. The upper chamber is provided with an air-pump by means of which air may be forced into the apparatus. Two taps are fitted on the top of the cylinder, which communicate respectively with the upper and lower chambers of the apparatus. The said taps are joined by means of rubber tubing to the "atomiser" or "pulveriser," which is simply a jet from which the air and liquid under pressure may issue simultaneously. In operation, air is compressed into the cylinder, and the above taps being opened, the air and antiseptic fluid are forced through the atomiser, resulting in the distribution of the liquid in a fine spray or cloud.

—H. T. P.

XIX.—PAPER, PASTEBOARD, Etc.

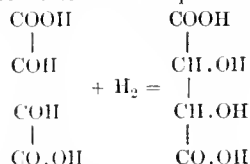
On the Influence of Incandescent Electric Light on Paper made from Wood-Cellulose and its Deterioration through Exposure. J. Wiesner. *Dingl. Polyt. J.* 1892, 284, 67—69.

See under II., page 596.

XX.—FINE CHEMICALS, ALKALOIDS. ESSENCES AND EXTRACTS.

New Synthetis of Tartaric Acid. P. Genvesse. *Compt. Rend.* 1892, 114, 555—557.

GLYOXYLIC acid (a constituent of unripe grapes, gooseberries, &c.) is converted into racemic acid by the action of nascent hydrogen, in accordance with the equation—



Zinc dust in dilute acetic acid solution is employed as the reducing agent, the product of the reaction being first worked up to calcium racemate, from which the free acid is prepared. The physical properties and analyses both of the calcium salt and of the free acid are in full accord with the recognised data. The author expresses the opinion that the tartaric acid found in nature may have been formed in an analogous manner.—C. A. K.

The Preparation of Quinine-di-methiodide from Cupreine. E. Grimaux and A. Arnaud. *Compt. Rend.* 1892, 114, 548—549.

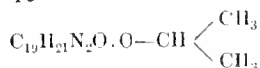
HESS has expressed the opinion that the formation of quinine-di-methiodide by the action of methyl iodide in presence of sodium on cupreine, as described by the authors (this Journal, 1891, 723 and 770), is partially due to their having employed impure cupreine, as he himself was only able to convert one-third of the cupreine employed into the quinine dimethiodide (this Journal, 1892, 177). A repetition of the experiment, however, shows that with cupreine quite free from quinine, a yield in one case of 78 per cent. and in a second of 83 per cent. of the theoretical amount was obtained, thus disproving the above assertion. The cupreine unacted upon was recovered from the mother-liquors.—C. A. K.

Homologues of Quinine. E. Grimaux and A. Arnaud. *Compt. Rend.* 1892, 114, 672—673.

THE method described by the authors of the preparation of quinine homologues from cupreine, the alkaloid base of *Quina cuprea* (this Journal, 1891, 723 and 770), has been applied to obtain propyl, iso-propyl, and amyl-cupreines.

Quinopropylene, $\text{C}_{19}\text{H}_{21}\text{N}_2\text{O}_2$, forms a characteristic basic sulphate, which crystallises in needles containing $\frac{1}{2}$ mols. of water of crystallisation. The dehydrated salt melts at $223^\circ\text{—}224^\circ\text{C.}$ and has a rotatory power $[\alpha]_D = 229.5^\circ$ at 22°C. The free base is precipitated as a white powder from the cold aqueous solution of the sulphate, by ammonia, in a hydrated condition, melting below 100°C. The dehydrated base melts at 164°C. The basic sulphate dissolves in 454 parts of water at 13°C.

Quino-isopropylene—



also forms a basic sulphate, closely resembling that of its isomeride. It contains one molecule of water of crystallisation, has the same rotatory power as the normal propyl salt, and dissolves in 367 parts of water at 10° C. The free base melts at 154° C.

Quinamyline, $C_{19}H_{21}N_2 \cdot O \cdot O \cdot C_3H_7$, is amorphous, and melts at 166.5°—167° C. The normal sulphate does not crystallise, but the basic sulphate forms long needles containing 2 mols. of water of crystallisation. It is with difficulty soluble in water, requiring 4,170 parts of water at 11.5° C. The above bases all fluoresce in dilute sulphuric acid solution.—C. A. K.

The Secondary Alkaloids of Belladonna. E. Merck. Jahresber. von E. Merck. Darmstadt, January 1892.

ATROPAMINE, belladonnine, hyoscyne, and their decomposition products, tropine, pseudo-tropine and tropic, atropic, and isotropic acids, have been found in the mother-liquors obtained after the separation of atropine from the belladonna extract. In addition to these the author has shown the presence of apo-tropine, which was obtained by Pesei by the action of nitric acid on atropine. It is a crystalline body, melting at 60—62° C., and appears to be identical with the atropamine isolated by Hess. It is decomposed by alcoholic potash into tropine and atropic acid. The supposed new base, boiling at 242° C., obtained by Ladenburg and Roth from belladonna extract is shown to be no other than pseudo-tropine.—C. A. K.

The Alkaloids of Belladonna Extract. L. van Itallie. Apoth. Zeit. 1892, 7, 27.

THE extract from belladonna was found to consist almost entirely of hyoscyamine. The object of the experiments was to discover whether any atropine might be formed from hyoscyamine during the extraction or subsequent treatment. This does not appear to be the case.—C. A. K.

Active Principle of the Boraginex. F. Schlagdenhauffen and E. Reeb. Pharm. Post. 1892, 25, 1.

BUCHNER isolated an alkaloid *Cynoglossine* from several plants belonging to the *Boraginex*. The author has obtained the same product from *Cynoglossum vulgare* and from *Heliotropium europæum*. The alkaloid contains nitrogen, gives the alkaloid reactions, and is coloured yellow by sulphuric acid, the colour gradually passing into peach-red. Buchner states that the physiological action of the base is akin to that of curare, but the author finds that it has quite a different action.—C. A. K.

Terpene hydrate from Eucalyptus Oil. E. Merck. Jahresber. von E. Merck, Darmstadt, January 1892.

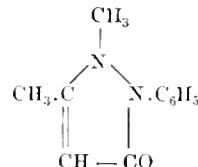
OIL of turpentine when allowed to stand with nitric acid and alcohol at the ordinary temperature of the air for some time, is known to yield terpene hydrate, which can be crystallised from alcohol. The same hydrate is obtained under analogous conditions from eucalyptus oils—both from *Ol. eucalypt. globuli* and from *Ol. eucalypt. australe*, of commerce. In the former case the formation of the hydrate is undoubtedly due to the presence of pinene in the oil, but in the latter its origin is obscure. It cannot be owing to the presence of cineol, because pure cineol was found by the author not to yield terpene hydrate when treated as above.—C. A. K.

An Alcohol of Antipyrine. J. W. Brühl. Ber. 25, 1892, 395—397.

It has been previously shown that by the simultaneous action of sodium and carbonic anhydride under suitable conditions, certain ketones are readily converted into the

corresponding alcohols and carboxylic acids; camphor, for example, yields borneol, $C_{10}H_{17} \cdot OH$, and camphocarboxylic acid, $C_{10}H_{15}O \cdot COOH$, in theoretical quantities, whilst menthon, $C_{10}H_{18}O$, under similar conditions, is converted into the alcohol, menthol, $C_{10}H_{19} \cdot OH$, and the dicarboxylic acid, $C_{10}H_{15}O(COOH)_2$.

Attempts to prepare analogous derivatives of antipyrine which, according to Knorr, is a ketone-like substance of the constitution—



by treatment with sodium and carbonic anhydride, have been successful only as regards the alcohol. When antipyrine (3 mols.) is dissolved in toluene, the solution mixed with sodium (4 atoms), in the form of wire, and gradually heated to boiling, while a stream of carbonic anhydride is passed into it, the colour changes to red, small quantities of methylamine are evolved, and the sodium dissolves, a yellow substance being produced; on adding ice-cold water the product passes into solution, but after a short time crystals are deposited. When the separation of crystals is at an end, the liquid is decanted, and the product purified by recrystallisation from dilute alcohol. It has the composition, $C_{11}H_{14}N_2O$, and is, therefore, a dehydroantipyrine, or antipyrine alcohol. It melts at 144°—145°, is colourless when pure, and is readily soluble in hot alcohol, acetone, benzene, chloroform, and ethylacetate, but only sparingly in water, light petroleum, and ether.—F. S. K.

Menthol. A. Berkenheim. Ber. 25, 685—698.

MENTHOL is proved to belong to the naphthene group, found in Russian petroleum. This proof was obtained by converting it by reduction, &c., into a hydrocarbon, $C_{10}H_{20}$, which, in all its physical properties as well as chemical behaviour, is shown to be identical with already known naphthenes. In view of the researches of other chemists who have found that menthol is reducible to cymene, the naphthene obtained by the author must contain a ring composed of six carbon atoms.

The fact is pointed out of the considerably higher specific gravity of the naphthenes as compared with the paraffins and olefines. The connexion with the terpenes is plain from the convertibility of terpene hydrate into an alcohol closely related to menthol, viz., $C_{10}H_{20}O$. Besides this a simple reduction of menthol to a hydrocarbon, $C_{10}H_{16}$, has been effected. This hydrocarbon possesses the character of a terpene, forming an addition bromine compound, uniting with a halogen-hydrogen molecule directly, and oxidising easily on exposure to the air, &c. It has yet to be discovered if this hydrocarbon is one of the already known terpenes, or a new one.—W. S.

Investigation of Terpenes, &c. J. W. Brühl. Ber. 25, 1796.

See under XXIII., page 638.

Condensation of Chloral and Butylchloral with Paraldehyde and Ketones. W. Königs. Ber. 25, 792—802.

See under XXIII., page 640.

Corydaline II. J. J. Dobbie and A. Lauder. Proc. Chem. Soc. [113], 123—124.

In confirmation of the formula proposed in their first paper (this Journal, 1892, 264), the authors give the results of analyses of the bromhydride and ethylsulphate—



The alkaloid examined by the authors is identical with that obtained by Aldermann from the roots of *Corydalis cava*, by extracting with alcohol and exhausting the alcoholic solution with benzene. The two alkaloids agree in composition, in solubility, in melting point, in their action on polarised light (dextro-rotatory), and in the character of the salts which they form. On the other hand, it is quite distinct from hydroberberine, with which Aldermann believed his alkaloid to be identical or, at least, isomeric.

When treated with concentrated solution of hydrogen iodide, one molecular weight of corydaline gives four molecular proportions of methyl iodide and the iodhydride of a new alkaloid which has the formula $C_{13}H_{21}NO_4 \cdot HI$. The alkaloid is obtained from this salt by the addition of ammonia or potassium hydroxide, and dissolves in excess of either agent. It possesses powerful reducing properties, and dissolves in alcohol, forming a deep red-coloured solution. The conclusion that the four oxygen atoms in corydaline are united to methyl groups is confirmed.—W. S.

PATENTS.

Manufacture of an Iodine Derivative of Phenacetin. W. F. Riedel, Berlin. Eng. Pat. 8584, May 19, 1891.

When a solution of phenacetin in water, alcohol, or glacial acetic acid is mixed with a solution of iodine in potassium iodide or other suitable solvent and a mineral acid added to the mixture, a chocolate-coloured crystalline powder is precipitated, having the composition $C_{20}H_{25}N_2O_4I_3$. The product appears to contain 2 molecules of phenacetin to 3 atoms of iodine. It is almost insoluble in water, readily soluble in alcohol and in glacial acetic acid, and melts at $130^\circ C.$ with decomposition. The solutions decompose on boiling with evolution of iodine. Recrystallised from glacial acetic acid large oblong crystals are obtained having a greenish-red lustre. The name "*Iodophenin*" is proposed for the new compound, which, owing to the ease with which it gives off iodine is applicable for therapeutic purposes.

—C. A. K.

A New and more Economical Method for the Production of Nitrous Oxide. Watson Smith and W. Elmore, London. Eng. Pat. 9023, May 27, 1891.

Nitrous oxide is prepared by heating in a suitable retort 17 parts of commercial sodium nitrate or 20 parts of potassium nitrate with 13—14 parts of ammonium sulphate, the nitrous oxide evolved being purified in any suitable manner.

To free the gas from any alkaline or acid matters, it is passed through weak acid and alkaline solutions. The materials, which should be dry, may be previously mixed, or the nitrate may be fused by itself and the ammonium sulphate added gradually. But the former method is preferred. The temperature should be maintained at about $230^\circ C.$ during the greater part of the reaction, and then finally raised to $300^\circ C.$ —J. W. L.

Improvements in the Manufacture of Iso-Eugenol and Poly-Iso-Eugenol. J. Y. Johnson, London. From F. von Heyden, Nachfolger, Radebeul, Germany. Eng. Pat. 9450, June 4, 1891.

When eugenol is heated with a concentrated solution of caustic potash to a sufficiently high temperature, it is readily converted into iso-eugenol, although previous observers, working with dilute solutions of alkali, found that the change did not occur. As a solvent for the

alkali, methyl or ethyl alcohol, water, or hydrocarbons can be employed, and the temperature to which the mixture must be heated depends upon the degree of concentration of the alkaline solution, being between $105^\circ C.$ and $125^\circ C.$ in the case of alcoholic solutions, and between $115^\circ C.$ and $150^\circ C.$ for aqueous solutions. The iso-eugenol is separated from the products of the reaction by the addition of acid, and can be purified either by converting it into a salt and separating it again by addition of acid or by recrystallising it from a suitable solvent at a low temperature. The pure product melts at $33^\circ C.$, and boils between $264^\circ C.$ and $265^\circ C.$ The caustic potash in the above reaction cannot be replaced by caustic soda, but a mixture of the two alkalis in varying proportions can be employed. Iso-eugenol is readily polymerised by small quantities of mineral acids, acid chlorides, or metallic haloids, poly-iso-eugenol being formed. This body crystallises from alcohol in colourless, odourless needles melting at $177^\circ C.$ —C. A. K.

Improvements in Apparatus for Obtaining or Separating Oxygen from Atmospheric Air. J. H. Parkinson, Stretford, Lancashire. Eng. Pat. 9457, June 4, 1891.

The specification relates to the apparatus used for the separation of oxygen from atmospheric air by forcing or drawing purified atmospheric air through heated oxygen-absorbing material, especially permanganates, and subsequently drawing off the absorbed oxygen by reducing the pressure, according to the process already patented (Eng. Pat. 14,925, 1890; this Journal, 1891, 947).

The apparatus is designed with the object of making the process a continuous one, and consists essentially in the construction and arrangement of retorts, valves, and regulating apparatus. Full details, together with drawings, are included in the specification.—C. A. K.

Manufacture of Meta-Amido-Benzaldehyde and of Salts thereof. O. Imray, London. From The "Farbwerke vormals Meister, Lucius, and Brüning," Hoechst-on-Main, Germany. Eng. Pat. 11,049, June 29, 1891.

The bisulphite compound of meta-nitrobenzaldehyde is converted into the corresponding meta-amidobenzaldehyde compound by any of the usual reducing agents. When dilute sulphuric acid and zinc are employed the acid is gradually added whilst the mixture is kept at a temperature of 38° — $40^\circ C.$ When the addition of acid is completed, the temperature is raised to $50^\circ C.$ and the heating continued until the decomposition is complete. The solution is then filtered and the filtrate accurately neutralised by soda, when a flocculent yellowish precipitate of an internal condensation product of meta-amidobenzaldehyde is obtained, which yields the salts of the aldehyde when treated with mineral acids. This is filtered off, washed, and dried. The free aldehyde cannot be isolated; when liberated from its salts, it passes over into a non-oxygenised base, having the composition $C_{11}H_9N$. With mineral acids it regenerates the salts of meta-amidobenzaldehyde, and when heated with mineral acids in presence of tertiary bases, meta-amido-tetra-alkyl-diamido-triphenyl-methanes result.

Ferrous sulphate and soda or other alkali are employed in preference to zinc and acid for the reduction of the nitrobenzaldehyde bisulphite.—C. A. K.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

New Gold Compounds for Photographic Purposes, &c.
Brit. Jour. Phot. **39**, 354.

M. P. MERCIER has prepared several new neutral gold salts, viz., auro-phosphates, auro-acetates, auro-succinates &c., by neutralising gold chloride with alkaline phosphates, acetates, &c. The auro-phosphate in water only, forms a toning bath giving rich violet-black tones. M. Mercier also has brought out a new developer called Fluoreal, the base being presumably para-amidophenol, and is coloured by the addition of fluorescein, to prevent veiling during development. In conjunction with this, caustic lithia and anhydrous sulphite of soda are used, the latter being much more stable in the anhydrous state, besides dissolving very rapidly.—J. C. C.

Metal and Amidol. Amateur Photographer, **15**, 453, 459.
From the Photographische Correspondenz.

THESE are two new developers; the first is a salt of mono-methyl-para-amido-meta-cresol, and is used in connexion with sodium sulphite and an alkaline carbonate. Bromide may be used as a restrainer. Metal and sulphite alone may be used as a developer for chloride and chloro-bromide plates. The second developer, discovered by Hauff and Bogisch, is diamidophenol, and is used in conjunction with neutral sodium sulphite only, alkalis colouring the solution an intense blue-green. As a restrainer, bromide of potassium is preferably used.—J. C. C.

The Action of Light on Silver Chloride. H. B. Baker.
Proc. Chem. Soc. 1892 [113], 120—122.

THE small loss in weight which silver chloride undergoes on exposure to light has led the author to investigate whether oxygen is absorbed at the same time that chlorine is evolved, Robert Hunt having long ago stated that such an absorption does take place. In the first experiments, silver chloride was exposed to light in a bulb connected with a long tube standing over potassium hydrate solution: a very noticeable absorption took place. Similar experiments with oxygen, instead of air, gave similar results, showing that oxygen was the gas absorbed. Attempts were then made to find in what proportions the elements silver, chlorine, and oxygen were combined in the darkened substance, but so little of the dark substance was produced (less than 0.1 gm. in 50 grms. of unaltered chloride) that a direct analysis was found to be impossible, and an indirect method was adopted.

In the first experiments to ascertain the formula, the evolved chlorine was absorbed by potassium iodide, and the iodine which it liberated was determined; the silver was determined by treating the blackened chloride with strong ammonia and weighing the residual metal; and the oxygen by treating the dark substance with pure chlorine and measuring the oxygen evolved. The results giving the formula Ag_2ClO .

It was found that the thoroughly-dried darkened substance, free from oxygen, gave an amount of water when reduced in pure hydrogen which corresponded to an amount of oxygen differing from that determined by other methods by less than 1 per cent.

If the darkened substance be really an oxychloride, it should not be produced in absence of oxygen. This was found to be the case, no darkening being observed in a vacuum or in carbon dioxide. Likewise no darkening was produced when silver chloride was exposed under pure dry carbon tetrachloride. It is to be noted, however, that carbon tetrachloride, unless carefully purified, contains substances, such as alcohol, carbon bisulphide, &c., which cause reduction of silver chloride and the deposition of black silver or silver sulphide, which darkening has hitherto been confounded with the darkening which takes place in air.

Lastly, when darkened silver chloride is boiled with pure potassium chloride, the whole dissolves, silver chloride being found in the solution together with potash. The production of alkali seems to prove that oxygen is present in the darkened substance in the combined state.—J. C. C.

PATENTS.

Improved Means or Apparatus for Producing Artificial Light for Photographic and other Purposes. J. Y. Johnson, London. From P. Nadar, Paris, France. Eng. Pat. 3042, February 19, 1891.

THIS apparatus consists of a chamber containing powdered magnesium through which a central tube passes. The lower end of the tube is placed over an air jet which forces the magnesium powder upwards through the tube into the centre of a spirit flame, where it is burnt, any ignited particles which fall back being caught in a water-trough. The air-jet is produced continuously or intermittently by means of a rubber ball or by other means. Instead of a spirit flame, an annular Bunsen flame may be used and other substances than magnesium may be burnt, such as powdered zinc in a jet of oxygen gas. Another arrangement is described for producing a large area of flame, in which the air current carrying magnesium is projected into the centre of a flame produced from a trough of burning spirit, the whole arrangement being placed under a hood.—H. K. T.

Process for Producing Coloured Photographs. V. Mathieu, London. Eng. Pat. 6342, April 1, 1892.

THE negative is rendered orthochromatic by the introduction of colour screens. The print is made upon albumenised paper sensitised in a 15 per cent. silver bath, and is toned with gold, fixed, &c. It is then coated on the back with alcohol to coagulate the albumen, and with one or more coats of white Venetian turpentine mixed with alcohol or essence of turpentine in order to render it transparent. The print is then dried in a stove described in the specification. After the application of a light varnish of isinglass or gum arabic solution, the necessary colours are applied to the back of the print, which may be then mounted and varnished with copal varnish or otherwise treated.—J. C. C.

Improvements in Letter-press and Lithographic Processes based upon Photography. E. Albert, Schwabing, Germany. Eng. Pat. 6571, April 16, 1891.

THESE improvements consist in the use of tints which have gradations in tone in the dark lines or line waves, which tints may either be produced mechanically, or by photography from an ordinary tint by giving the lens a parallel displacement during exposure, thus producing a gradation in intensity in the line; or the same result may be attained by displacing the tint or even the sensitive plate during the exposure of the picture.—J. C. C.

Improvements in the Methods of Producing Two or more Coloured Prints. E. Albert, Schwabing, Germany. Eng. Pat. 6634, April 17, 1891.

THE inventor claims printing from printing surfaces drawn or produced by photography by means of screens or tints so placed that the direction of the lines forming the tint for each colour varies by an angle of about 30° or 60° . By this means disturbing designs or patterns are avoided.—J. C. C.

Improvements in Magnesium Lights for Photographic and Signalling Purposes. E. Bäckh, Stuttgart, Germany. Eng. Pat. 7635, May 2, 1891.

See under II., page 597.

Method of and Apparatus for Reproducing Photographs.
B. Krantz and H. Zeissler, London. Eng. Pat. 7785,
May 5, 1891.

From a negative, with or without a grained plate interposed, a print is taken, which is transferred by exposure to light, to a piece of calico having on one side a sensitised film of gelatin, this is then high etched with glycerin and ammonia, and mounted on a block of wood which may be used as a hand stamp, or it is mounted on a self-inking arrangement with a parallel motion, described by the inventors.—J. C. C.

Improvements in or Connected with the Preparation of Lithographic Stones for Half-Tone and Colour Printing.
B. Krantz and H. Zeissler, London. Eng. Pat. 8120,
May 12, 1891.

The improvements consist of printing from a negative on paper sensitised with a special composition (for the details of which the specification must be consulted), transferring this print to the stone by means of a bath of ammonia solution, and fixing with a solution of gall nuts in water, and drying; the picture is then etched up by a solution of nitric acid.—J. C. C.

Improved Method of Photo-Etching on Zinc and Copper.
B. Krantz and H. Zeissler, London. Eng. Pat. 8121,
May 12, 1891.

A TIN plate is first coated with lamp-black and then with Chinese white; it is then ruled through the white only, so as to show black lines. Upon this an image is thrown by a magic lantern, of the picture required, a photographic negative is then taken of this image, from which a print is taken on a zinc or copper plate sensitised with bitumen. This is developed with turpentine, and then etched in a particular manner described in detail in the specification. In place of photographing the image on the ruled plate, a print may be taken from a combination of an ordinary negative and one of the ruled plate, and finished as described.—J. C. C.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENT.

Improved Manner and Apparatus for Nitrating Cotton, Cellulose, Straw, and similar Substances. J. Selwig and B. Lange, Brunswick, Germany. Eng. Pat. 10,747,
June 24, 1891.

THE patentees have devised a "centrifugal nitrating apparatus," consisting of a perforated revolving basket of a centrifugal machine arranged inside the nitrating vat. The cotton is thus practically nitrated in the centrifugal machine, and after allowing the acid to run off the nitro-cellulose can be dried by centrifugal force.—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

Azolitmin paper. R. Dietl. Pharm. Zeit. 1892, 37, 7.

AZOLITMIN paper, which is a specially sensitive indicator, both for acids and for bases, is prepared as follows:—50 grms. of litmus are digested with 1 litre of water for 12 hours, and the operation repeated with a second litre of water. The united filtrates are mixed with 100 grms. of sand and hydrochloric acid added, till the carbon dioxide is completely expelled and the solution turned red. The whole is then evaporated to dryness and heated until the hydrochloric acid is expelled. The residue is ground to a fine powder which is well washed, first with hot and then with cold water until the filtrate is no longer coloured. The washed product is kept in stoppered bottles protected from the light, after gentle drying between filter paper. To prepare the paper 10 grms. of the azolitmin sand are treated with 100 grms. of hot water, 15 grms. of ammonium chloride added, and the solution filtered after allowing to stand for a short time. The blue solution turns red-violet on being allowed to evaporate spontaneously, owing to the loss of ammonia, in which state it can be employed as a test for bases.—C. A. K.

A New Condenser for Laboratory Use. F. Evers. Ber. 1891, 24, 3950—3951.

THE apparatus described by the author consists practically of a Liebig's condenser in which the inner tube has been considerably widened and provided with an additional and internal cooling space.

Owing to the large cooling surface thus provided, this form of condenser is very efficient and requires but little cooling water. A condenser 30 cm. in length will serve to condense the vapours of liquids, boiling as low as 32° C. without appreciable loss. The apparatus is very suitable for the fractional distillation of liquids of low boiling point.—H. T. P.

PATENTS.

Improvements in Instruments used for Determining the Specific Gravities of Liquids. F. W. Fletcher, Enfield, Middlesex. Eng. Pat. 12,363, July 21, 1891.

THE improvement consists in having a thermometer attached to hydrometers, so that the temperature of the liquid can be ascertained at the moment of taking its specific gravity.—C. A. K.

Improvements in and connected with Tubes and other Receptacles for Storing and Immersing Hydrometers and the like. F. W. Fletcher, Enfield. Eng. Pat. 12,465,
July 22, 1891.

THE tube or receptacle has a cushion at the bottom upon which the hydrometer rests, and in the cover there is a perforated diaphragm through which the stem of the hydrometer passes, and presses against an elastic spring or cushion in the top. The tube may be used as an immersion tube after removal of the cover.—J. C. C.

Improvements in Assay or Chemical Balances. C. F. Betting, Wehlheiden, Cassel, Germany. Eng. Pat. 2117,
February 3, 1892.

THE improvements consist of a mechanical arrangement whereby the weights can be applied to and removed from the balance without opening the case. The mechanism consists essentially of a series of levers adapted to carry the weights and to place them on the pans as required,

through the medium of cams worked by knobs placed outside the case. Full descriptive details and diagrams are given in the specification.—C. A. K.

INORGANIC CHEMISTRY.— QUANTITATIVE.

Analysis of Antimony Ores. A. Carnot. *Compt. Rend.* 1892, **114**, 587—590.

Owing to the unavoidable loss of metal which occurs in the estimation of antimony in its ores in the dry way the author employed the following methods and found them to be more satisfactory:—

1. *Sulphide Ores.*—A quantity of the ore (2–3 grms.) containing about 1 grm. of antimony as far as can be roughly estimated, is warmed with 50–60 cc. of concentrated hydrochloric acid as long as any visible action takes place, and the solution is then decanted on to a filter; this treatment is twice repeated, a few drops of nitric acid being added the second time. The filtrate and washings are then diluted with an equal volume of water, the antimony precipitated with tin at 80°–90°, the precipitate washed by decantation with dilute hydrochloric acid, thrown on to a tared filter, washed with warm water and alcohol successively, dried at 100°, and weighed. The results are correct to within about 1 per cent.

2. *Oxidised Ores.*—In the case of ores containing both oxide and sulphide of antimony, and which are sometimes only attacked by concentrated hydrochloric acid with great difficulty, the finely-divided substance (2 to 5 grms.) is first heated just below 300° in a stream of hydrogen sulphide for about an hour; the quantity of antimony which remains undissolved by hydrochloric acid after this treatment is quite insignificant. The subsequent analysis is carried out as described above.

The presence of iron, or of zinc, does not affect the results; lead, if present, is partly precipitated with the antimony, and on warming the precipitated metal with yellow sodium sulphide there remains an insoluble residue of lead sulphide.—F. S. K.

The Determination of Iron and Aluminium in Presence of Phosphoric Acid. W. H. Krug. *Journ. Anal. and Appl. Chem.* 1891, **5**, 671.

THE author has examined the methods of Glaser, Jones, Jones-Stutzer and Vogel's modification of the same, and McElroy, and considers that of the last named chemist the most satisfactory on account of its being more accurate whilst not less rapid than the others. It is as follows:—100 cc. (corresponding to 1 grm. of substance) of a nitric acid solution of the substance are placed in a 500 cc. flask and treated with ammonium molybdate to precipitate the phosphoric acid, a little ammonium nitrate being added to promote the precipitation. The mixture is allowed to stand for several hours and the flask then filled to the mark. Two portions of 200 cc. each are then withdrawn and precipitated at a low temperature with ammonia, a small quantity of ammonium nitrate being added for the purpose of keeping the mixture cool. The precipitate of aluminium and ferric hydrates obtained in this manner is readily soluble in acids. It is filtered and washed and dissolved in dilute nitric acid, and again precipitated in the cold with ammonia for the purpose of removing any traces of molybdic anhydride which may be present, and is then washed, dried, ignited, and weighed. The weighed precipitate is finally fused with potassium hydrogen sulphate, and the iron determined volumetrically in the usual way.

The first filtrate from the precipitate of ferric and aluminium hydrates contains any calcium and magnesium which may be present. These may be separated by successive precipitation at a low temperature with ammonium oxalate and ammonium phosphate, the low temperature being necessary to prevent co-precipitation of molybdic anhydride.

—E. B.

The Estimation of Slag in Wrought Iron. A. E. Barrows and T. Turner. *Proc. Chem. Soc.* 1892 [113], 122–123.

It is known that in puddling cast iron comparatively rich in non-metallic elements the yield of puddled bar is greater than with less impure materials, but the loss on reheating and rolling into finished iron is also greater. It has been contended that this difference is due to intermingled slag.

The authors prepared four samples of iron, viz., best bar, best sheet from the same bar, common bar and common sheet from the same. Pig iron of known composition was used; the yield of common puddled bar was 6·5 per cent. greater than the other, but the loss in reheating was also 1·5 per cent. greater, leaving a balance of 5 per cent. in favour of the common iron. The composition of the samples was as follows:—

	Best.		Common.	
	Bar.	Sheet.	Bar.	Sheet.
Carbon	0·060	0·035	0·045	0·032
Silicon	0·228	0·168	0·275	0·221
Phosphorus	0·178	0·175	0·589	0·390

These results show that the silicon is equally, and very slightly, reduced in each case, while the phosphorus was much reduced in common iron and but scarcely affected in best. This does not favour the view that much more slag is removed in one case than the other.

By dissolving the iron in a cold solution of sodium copper chloride, the authors have obtained the following values:—

	Best.		Common.	
	Bar.	Sheet.	Bar.	Sheet.
Slag per cent.....	3·83	2·58	3·85	2·85
Loss on reheating.....	1·25 per cent.		1·00 per cent.	

This method requires to be further examined and checked by other processes before the results can be accepted, but they are, at least, a fairly close approximation to the truth. Though the chlorine process (*Chem. Soc. J. Trans.* **45**, 265) is not suited for slags containing iron, it appears to be correct for cast-iron analysis, since the slag from the blast furnace seldom contains more than a trace of iron.

The authors conclude that for practical purposes the weight of slag in best and common iron may be taken as identical, and that on reheating and rolling each loses about the same weight of slag. The additional loss noticed on reheating impure iron is due chiefly to the elimination of phosphorus, probably in the form of ferrous phosphate.

—W. S.

PATENT.

Improvements in Apparatus and Appliances for the Rapid Determination of Carbon in Steel. A. Tropenas, Sheffield, and A. E. Wells, Rotherham. *Eng. Pat.* 2785, February 16, 1891.

THE inventors have found that after the boiling period in the Bessemer and allied pneumatic processes, the percentage of carbonic anhydride in the converter gases at any moment maintains a perfectly definite relation with the percentage of carbon in the metal at the time. It is therefore proposed to estimate the percentage of carbon in the metal by withdrawing a definite quantity of the gases and determining the amount of carbonic anhydride present. The apparatus used consists of a test tube connected on the one hand with a supply of lime water, solution of lead salts, litmus or other indicator, and on the other hand with a tube through which gases can be driven or drawn over from the converter. A quantity of the indicator is admitted into the test tube, the gas allowed to pass in for a given

period, say 10 seconds, and the test tube compared with a series of carefully prepared standards. A modification of this method consists in drawing off 100 cc. of the gases (by connecting the pipe with a burette filled with water and allowing the latter to flow out) and forcing this through some indicator as before. In a further modification, the burette filled with gas is connected with a vessel containing a dilute solution of caustic potash, and the amount of carbonic anhydride determined from the rise of the solution in the tube.

It is stated that with suitable apparatus an observation can be made in 10 to 20 seconds.—S. B. A. A.

ORGANIC CHEMISTRY.— QUALITATIVE.

Colorimetric Determination of Vanillin. F. Moerk. Amer. J. Pharm. 1891, 63, 572.

To prepare the vanillin solution it must first be decolourised if necessary by means of lead hydrate, prepared by adding caustic potash to a solution of lead nitrate containing a drop of phenolphthalein until a distinct red colouration appears. The precipitate thus obtained is washed with water and made up to 100 cc. To carry out the test 2 cc. of the vanilla extract are treated with 50 cc. of water, 20 cc. of the lead hydrate added and the whole made up to 100 cc. The solution is filtered after standing a few minutes, and 50 cc. are treated with an excess of bromine water; a 1 per cent. solution of ferrous sulphate is then added until the maximum intensity of colour is obtained, when the whole is made up to 100 cc., allowed to stand some time, and then filtered. The colouration obtained is compared with that given by standards containing from 0.002–0.005 gm. of vanillin in 100 cc. The method is reliable if the vanilla extract is not coloured; if it is, a yellow tinge always remains even after the treatment with lead hydrate, which decreases the accuracy of the test. The smell of the vanillin is quite destroyed in this reaction, whilst that of coumarin remains: the test therefore serves as a means of detecting small quantities of coumarin in the extract.

—C. A. K.

Examination of Vegetable Lubricating Oils specially regarding Qualitative Tests. Holde. Mitth. Königl. techn. Versuchsanst. Berlin, 1891, 294.

THE author has critically examined the various colour reactions which are in vogue for the testing of vegetable oils. He obtained the following results:—(The samples of oil used were sufficiently pure, as confirmed by their iodine and saponification values, and by their physical properties.)

Tests for Rape Oil.—The presence of rape-oil—say in olive oil—was considered as proved when sulphur had been found in the saponified oil (black precipitate with lead solution), the assumption being made, that all oils extracted from the seeds of *Crucifera* contained sulphur. The author found—as before him Schweissinger—that there are in commerce rape oils which are free from sulphur. Schaedler has already stated that cold-expressed rape oils do not contain sulphur. On the other hand due regard must be had to the fact that oils extracted from the seeds by means of carbon bisulphide may retain small quantities of sulphur from the latter.

Schneider's reaction, which is stated to detect the presence of even 2 per cent. of rape oil in olive oil (dissolve one volume of the oil in two volumes of ether and add 20–30 drops of a saturated alcoholic solution of silver nitrate; the lower layer becomes brownish and at last black if the quantity of rape oil present is large, but, if small, distinctly brown after 12 hours' standing) had not been found to answer in the hands of the author on examining pure rape oil, even after six hours only a dirty green sediment being obtained. It should be remembered that cotton oil gives colourations similar to those mentioned by Schneider.

The author examined next the test proposed by Villavechia and Fabris (this Journal, 1891, 390) who recommend the saponification of 10 cc. of the oil with alcoholic potash and the addition of 2 cc. of a silver nitrate solution followed by

one of 10 cc. of nitric acid (1:3). On shaking the mixture a brown ring is stated to appear between the two layers if rape oil be present, whilst pure olive oil gives no reaction. The author, however, obtained black rings with pure olive oil and also with two samples of rape oil. This test must, therefore, be also considered as valueless.

Test for Cotton Oil.—The author examined the following reactions:—(a.) Bechi's test (this Journal, 1888, 135). One sample of cotton oil gave the brown colour of Bechi's test, whilst another sample and likewise a pure olive oil gave a yellow colour. A mixture of pure olive oil and 30 per cent. of the cotton oil showing the brown colour, gave, on testing, no longer the brown colour. Although the samples of cotton oil used by the author were old ones, and may consequently have undergone some alteration as far as regards the silver-reducing substances, he does not hesitate to condemn Bechi's test as valueless. (b.) Bechi's test as modified by Villavechia and Fabris has also to be rejected. (c.) Milliau's test (this Journal, 1888, 593) seemed at first to be a reliable one. But on heating a sample of cotton oil to 240° C. it was found that no reduction of silver takes place, an observation which detracts greatly from the value of Milliau's test. (d.) Hirschsohn's test. This test is based on the reduction of a gold chloride solution by cotton oil. But Moersch already has stated that a number of other oils give the same red colour; the author adds to Moersch's list: hemp oil. Besides, cotton oil heated to 240° C. no longer reduces the gold chloride solution. (e.) Nitric acid test. Nitric acid of 1.37 sp. gr. was not found to give characteristic reactions. Therefore nitric acid of 1.41 sp. gr. was tried. Pure cotton oils gave deep reddish-brown colourations, whilst olive oils became yellow. But a pure, refined rape oil gave also the brown colour. In mixtures of olive oil and cotton oil 20 per cent. of the latter could be detected; an admixture of 10 per cent. could not be ascertained. Therefore the nitric acid test is also useless.

Test for Sesame Oil.—Bauduin's test was found to be thoroughly reliable and capable of indicating even 0.5 per cent. sesame oil. Sesame oil heated to 200° C. showed the colour just as well as a not heated sample. The author uses Bauduin's test in the following manner:—Take a lump of beet sugar of the size of a pea and shake it with 2 cc. of hydrochloric acid of sp. gr. 1.19 until the greatest part of the sugar is dissolved. Add an equal volume of oil and shake violently. Allow to stand; when sesame oil is present the aqueous layer will be found coloured red. The colour has to be observed at once, as later on the liquid becomes dark brown.

Test for Drying Oils.—Larger quantities of drying oils in olive oil, &c. may be easily detected by the so-called quantitative reactions. The colour reactions recommended in text-books have been found to be valueless.

Brullé's Test for Seed Oils.—(This Journal, 1888, 457.) The author rejects this test altogether.

Test for Train Oil.—(This Journal, 1891, 729.)

Test for Mineral Oils.—(This Journal, 1889, 735.) It was noticed that in the presence of small quantities of mineral oils the latter may be redissolved on adding larger quantities of water; therefore the turbidity appearing on the first addition of water has to be considered as characteristic.

Test for Rosin Oil.—The test described by the author (this Journal, 1890, 418) is considered as satisfactory.

It will thus be clear that all the colour tests which have been proposed for the examination of mixtures of fatty oils—with the exception of the test for sesame oil—are valueless.—J. L.

Detection of Rosin Oils in Essence of Turpentine.

M. Zune. Compt. Rend. 114, 490.

THE author has examined the various products derived from the crude turpentine of the Landes, Gironde, &c., and finds that for the detection of rosin oil in the essence of turpentine it is sufficient to submit the sample to a fractional distillation, collecting the first three-fourths separately and then determining the refractive indices of the four portions. If the essence is pure the difference between the indices of

the first and last fourth should not exceed 0.00400 and will generally fall below 0.00350, whilst the presence of 1 per cent. only of rosin oil would raise the difference to at least 0.00600. If there is 4 per cent. or more of adulteration it is readily recognised by the simple determination of the refractive index of the essence, but where the slightest doubt exists it is advisable to resort to distillation.

—S. B. A. A.

ORGANIC CHEMISTRY.— QUANTITATIVE.

Investigation of Terpenes and their Derivatives. J. W. Brühl. Ber. **25**, 1796—1813.

A RESEARCH in its details of purely scientific value. A deduction of some technical and general interest is, that camphoric acid is not as has been supposed, a mono- but a true bibasic acid.

In the titration of this acid (Friedel, Compt. Rend. **113**, December 14, 1891) phenolphthalein is the best indicator. Corallin (with camphoric acid yellow, with alkalis red) can be used successfully.—W. S.

New and Simple Method for Estimating the Quantity of Rosin-Size contained in Paper. W. Herzberg. Mitthl. aus d. Königl. tech. Versuchs. zu Berlin, 1892, **10** [2], 80—85.

THE author proposes to place a portion of the paper to be examined on a watch glass and to pour upon it four to six drops of ether. After 15 or 20 seconds the ether evaporates, and in case any appreciable amount of size is contained in the paper, a slight stain surrounded by an edge of a somewhat darker colour is observed under direct light. In different sorts of paper the shape of the stain, as also the form of its surrounding edge, may differ. To discover the amount of rosin in paper the latter is to be treated with absolute alcohol. On adding water to the alcohol in case any rosin was present in the paper, the fluid will become turbid or milky. According to the degree of turbidity or milkiness of the fluid measured by a standard, the amount of rosin may be determined.—P. D.

Determination of the Extractive Matters in Brandy. Zeits. für Spiritusind. **14**, 215.

AS, according to the German excise laws, all brandy containing more than 3 per cent. of extract is considered a liqueur, the accurate determination of the extract is of importance.

An amount of about 100 grms. of the liquor to be tested is evaporated to about one-third to one-fourth of its bulk. When all the alcohol has been expelled, indicated by the odour, the residue is made up to about the original volume. The specific gravity of the solution indicates the amount of extract.—A. L. S.

On the Quantitative Determination of the Fibres Used in Paper Making. W. Herzberg. Königl. tech. Versuchs. z. Berlin, **10**, 1892 [1], 7.

THE microscope is well adapted for the recognition of the fibres in a paper, since by its aid the smallest difference in their anatomic structure can be observed with certainty. Up to the present time all attempts further to develop these characteristics have been more or less failures, especially those methods which depend entirely upon colour reactions. All such reactions can only facilitate the separation of fibres into groups, and it must be insisted on that no colour reactions can be considered as absolutely characteristic of

one definite fibre (Mittheilungen, 1887, Sonderheft III. 1). Nor is it probable that the recognition of fibres could ever be certain if alone based on such a reaction. Fibres from the same source in consequence of variations in the conditions of manufacture do not all give the same reactions, and this method will not bear close investigation. The qualitative examination of fibres in consequence of the similarity of the structure is not without difficulties. These become still greater when it is necessary for a quantitative determination to be made. Cellulose ($C_6H_{10}O_5$), regardless of its origin, gives almost the same reactions with all reagents.

In connexion with the difficulties of determination it may be remarked that the Prussian Government make as standard for normal paper Class II., 25 per cent. of cellulose. At the time of making this standard not very much work had been done in the direction of accurate quantitative fibre determination, but in consequence the subject had to receive attention.

It has been observed that in the course of repulping paper by treating with dilute caustic soda to remove resin, &c., and shaking with garnets, preparatory to a microscopical examination, that whilst part of the fibres sink, part remain floating on the surface. However, an examination showed no difference between the fibres that floated and those that sank, so that their behaviour cannot be attributed to any actual differences in specific gravity, but is probably purely mechanical, and caused by air bubbles being attached to the floating fibres.

Further proof that specific gravity had nothing to do with the matter was obtained by employing various saturated solutions (sodium and barium chloride), but in every case the result was as has been described. Further attempts were made to separate fibres by their different capacities of absorption. Fibres may be placed for a few hours in a solution of barium chloride, there washed, and allowed to stand some time in dilute sulphuric acid, thus forming insoluble barium sulphate in the fibres themselves, it was hoped that by this means it would be found possible to make a separation of the variously loaded fibres, and by using liquids of varying gravities. Although the fibres were treated with all sorts of solutions and precipitants they were found to have no more tendency to separate than before treatment. Separation was tried by means of a cuprammonium solution, a well-known solvent for cellulose, although it was exceedingly improbable that by this means an accurate quantitative determination could be made; it was, however, thought possible that whilst pure cellulose, such as cotton, would be rapidly dissolved, the impurer forms might be scarcely affected. Experiment showed that this was not the case, and that as a qualitative method it was untrustworthy.

That the fibres could be approximately determined in the field of the microscope was certain, but the question was whether the results so obtained were sufficiently accurate for practical purposes.

The characteristics of part of the fibres in finished papers, linen, or cotton, are often so destroyed in processes of manufacture that it is impossible with certainty to trace their origin.

The case is different with chemically purified cellulose (esparto, straw, wood, &c.), which require little treatment in the beating engine, and are found, fibres, cells, &c. in a good state of preservation in paper.

In making a preparation for examination it is advisable to take tiny pieces of paper from various sheets and to pay special attention to the even distribution of the fibres over the object glass.

The determination may be made either by counting the various fibres in a series of microscopic fields or by comparing the appearance of the preparations to be examined with those of known fibre contents. Of course, to ensure reliable results in either case, the average of a large number of observations must be taken. In measuring fibres and particles of fibres it is well to take as unit for calculation the diameter or radius of the field of observation.

If 50 observations of a paper gave 7 linen fibres to 5 cotton, the approximate per cent. value would be 58 per cent. linen, 42 per cent. cotton.

* Mechanical wood-pulp may be taken as an exception to this rule, as when coloured it can be recognised under the microscope with the greatest ease, and also after treatment with various reagents (this Journal, 1890, 1068).

A mixture was made of 50 per cent. linen and 50 per cent. wood cellulose fibres, and 100 observations made and the fibres counted. The result showed that the average found was equivalent to 45 per cent. complete linen and 56.5 per cent. wood cellulose fibres, allowing an average error of 1.70 a maximum of 2.7 per cent., and a probable error of 1 per cent.

It is obvious that direct calculation of the fibres will not give the true proportions by weight, and that the result would have to be multiplied by a coefficient found by experiment. Thus the method would be both uncertain and tedious.

A new method of valuation is proposed and it is made to include the loading of the fibres. In the table given only the pure fibres however are taken into consideration. To facilitate matters and for the sake of comparison a series of mixtures of known fibre-content were tested. The fibres were still counted under the microscope, but certain numerical checks and allowances were made. Very minute and lengthy details, illustrated by numerous tables, are given, and for these the original must be consulted. They show the limits of accuracy and error in making these micro-chemical examinations. The examination may be simplified by using a solution of 1.15 grms. iodine and 2 grms. potassium iodide in 20 grms. of water, to which 2 cc. of glycerol have been added.

The fibres by their colour may be separated at a glance, cotton, linen, hemp, &c. being dark brown, straw, wood, and esparto cellulose, nearly colourless, mechanical wood, jute, and other lignified fibres, orange.

The modified method of microscopical valuation of papers will be introduced into the Government laboratory in Berlin, and from January 1893, notice is given to paper makers that paper said to belong to Class II. will be expected only to contain 25 per cent. wood-, straw-, or esparto cellulose.

—P. N. E.

Dégiras. R. Ruhsam. Jahresb. der Deutsch. Gerberschule zu Freiberg in Sachsen. 1891—1892, 3, 3—17. (This Journal, 1891, 557, 1013.)

The proper *dégiras* (Moëllon) is the oil expressed in lukewarm water from chamois leather in the final stage of

tauning. Inasmuch as the whole process consists in oiling the skins, stocking them, allowing them to heat in heaps, and repeating the last two operations as often as is judged necessary, it is obvious that the excess of oil finally expressed must most reasonably be regarded as an alteration product of the cod-oil originally used.

The high estimation in which *dégiras* has always been held as a currying agent has caused many imitations to find their way into the market, and much of the research which has been expended on this substance during the last few years has been for the purpose of detecting and valuing these spurious specimens. A summary of the leading opinions as to the constitution of *dégiras* will be found in this Journal, 1891, 557; the author of the present paper calls attention especially to the "*dégiras-former*" first isolated by Jean and found by him to exist in small quantity in the original cod-oil (*thran*), but in much larger quantity in the *dégiras*. This resinous substance is insoluble in petroleum ether, and Simand has pronounced no *dégiras* to be genuine and pure unless it contains at least 12 per cent. of "*dégiras-former*" when the moisture is 20 per cent. An analytical method can be based on this statement.

The samples 1—9 in the following table are French artificial *dégiras** No. 10 is called an "*emulsion-fat*;" No. 11 is a genuine *dégiras* obtained in the chamois leather process from the cod oil No. 12.

The water was determined by heating 2—3 grms. of the sample in a weighed platinum crucible with a Bunsen burner until an empyreumatic odour indicated the complete dehydration of the fat.

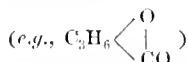
The iodine absorptions were determined as usual, the insoluble fatty acids being first freed from "*dégiras-former*" by solution in petroleum ether. It will be noted that the iodine absorption of the genuine *dégiras* is much higher than that of the artificial samples, so that this should serve as an indication of quality; doubtless it is the presence of fats of low iodine absorption, such as tallow, yolk, and cocoa-nut oil, that lowers the absorption of the artificial *dégiras*.

* *Kunst dégras* is thus rendered; it would appear that by this term the author means *dégiras* obtained in the currying process as opposed to that obtained in chamois-leather making; to this latter he subsequently refers as *Moëllon*.—A. G. B.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
No. of Sample.	Water per Cent.	Iodine Absorption Per Cent.			Acid No.	Saponification No.	Ether No. (difference between 6 and 7).	Constant Acid No.	Constant Saponification No.	Constant Ether No. (difference between 9 and 10).	Acetyl Acid No.	Acetyl Saponification No.	Acetyl No. (difference between 12 and 13).	True Acetyl No. (difference between 14 and 15).
		Dégiras (Anhydrous.)	Insoluble Fatty Acids.	Acetylated Fatty Acids.										
		Mgms. of KOH per Grm. of Anhydrous Dégiras.													Mgms. of KOH per Grm. of Fatty Acids.		Mgms. of KOH per Grm. of Acetylated Fatty Acids.
1	19.1	74.7	70.5	73.1	37.7	..	..	185.5	224.3	38.8	181.0	280.0	90.0	60.2
2	12.9	64.2	58.6	52.7	72.7	110.4	37.7	102.8	131.5	28.7	92.6	164.7	72.1	43.4
3	12.4	77.4	75.4	90.4	40.2	110.7	70.5	129.6	172.9	43.4	128.9	196.1	67.2	23.8
4	15.9	78.4	70.2	66.6	50.1	134.8	84.7	162.9	193.7	30.8	157.0	237.0	80.0	49.2
5	16.4	77.8	78.5	76.2	52.7	137.4	84.7	163.5	185.9	22.4	160.9	227.0	66.1	43.7
6	11.5	76.6	76.5	75.7	64.9	108.8	43.9	175.8	229.6	53.8	171.0	282.5	111.5	57.7
7	13.9	96.7	95.9	88.9	..	..	..	182.5	215.6	33.1	178.7	212.4	33.7	0.6
8	17.3	83.7	93.4	102.7	28.9	160.8	71.9	96.7	197.1	100.4	92.8	175.4	82.6	..
9	16.6	80.9	..	..	52.0	141.2	89.2	..	..	..	..	..	..	..
10	5.3	74.4	79.3	73.0	54.1	125.2	71.1	179.5	210.2	30.7	180.1	217.0	36.9	6.2
11	..	127.7	162.3	127.4	..	163.8	..	186.8	212.2	31.4	176.8	228.3	51.5	20.1
12	..	126.7	106.0	101.9	..	186.0	..	159.3	213.2	53.9	158.2	215.7	57.5	3.7
Mean of 1—10	..	78.5	77.6	77.7	50.4	121.2	70.8	160.3 (except No. 8).	195.5 (except No. 8).	35.2 (except No. 8).	149.2	221.3	72.1	..

The "acid number" (col. 6) is the amount of KOH required to neutralise the original sample of degreas, while the "saponification number" (col. 7) is the amount required to saponify the original sample. The difference between these two is the "ether number" (col. 8) or amount of KOH consumed in actual saponification. The genuine degreas has a saponification number lower than the original cod oil, but higher than the artificial degreas; the latter nearly always contains mineral oil.

The "constant acid number" (col. 9) represents the amount of KOH neutralised by the fatty acids of the degreas in the cold, the "constant saponification number" (col. 10) being the amount neutralised by heating the fatty acids with the KOH, in the same way as for the saponification of the fat. The difference "constant ether number" (col. 11) represents the amount of KOH expended in converting any lactones which the degreas may contain into potassium salts of the corresponding hydroxy fatty acids; for such lactones—



are unaffected by cold alkalis, but capable of neutralising hot alkalis (being converted for example into $C_3H_5(OH)COOK$) (Compare Benedikt, *Analyse der Fette und Wachsthen* 2, 142.)

"The acetyl acid number" (col. 12) is the amount of KOH neutralised in the cold by the acetylated fatty acids. The acetylation is effected by boiling with acetic anhydride (Benedikt, *loc. cit.*) and converts any hydroxy acids into derivatives which contain acetyl in place of the hydroxyl-hydrogen. These acetyl derivatives are not decomposed by cold KOH, and the "acetyl acid number" would be identical with the "constant acid number" save for the higher molecular weight resulting from the introduction of acetyl. The "acetyl saponification number" (col. 13) is the amount of KOH requisite for the neutralisation of the acetylated acids when the process is conducted as for ordinary saponification at the boiling point; under these conditions the acetyl-derivatives are converted into potassium acetate and potassium salts of the hydroxy acids. The difference between the "acetyl saponification number" and the "acetyl acid number" is the "acetyl number" (col. 14); this however, includes the "constant ether number," (for the lactones consume hot, but not cold KOH), and is not a measure of the hydroxy acids present; nor can the exact amount of KOH consumed in de-acetylising the acids be found by subtracting the "constant ether number" from the "acetyl number," because the molecular weight of the acetylated acids is higher, and introduces a proportional error. Thus the "true acetyl number" (col. 15) is only the closest approximation to a measure of the hydroxy acids in the original fat that can be obtained. The numbers in this column are, however, comparable among themselves, and show that genuine degreas has a higher content of hydroxy acids than its parent cod oil, a result which is contrary to the statement of Weiss.

Fabron (this Journal, 1891, 557.) regards the "degreas-former" as a mixture of hydroxy fatty acids and gives its iodine absorption as 65.9. The author found the iodine absorption of the "degreas-former" from sample 1 to be 78.8; he hopes to throw light on its constitution by determining its "constant ether number" and "acetyl number."—A. G. B.

The Specific Gravity of Textiles. M. de Chardonnet. *Compt. Rend.* 114, 489.

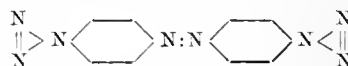
For the exact determination of the specific gravity of silk the author cuts a small skein into pieces not more than 1 mm. in length: these are suspended in a dilute solution of borotungstate of cadmium of approximately the required density, the air is then exhausted, the materials shaken up, air admitted, and the exhaustion, &c. repeated for several hours in succession. When the fibres are thoroughly saturated, either water or a concentrated solution of the borotungstate is added until the fibres remain suspended in the liquid; the latter is then allowed to stand for some time.

the density again adjusted if necessary by the addition of either of the ingredients, and the specific gravity of the liquid taken with the usual precautions.

In this way the author finds the specific gravity of raw silk to be 1.66 and of seoured silk 1.43.—S. B. A. A.

A Method for Determining the Number of NH₂ Groups in Certain Organic Bases. R. Meldola and E. M. Hawkins. *Proc. Chem. Soc.* 1892 [114], 133—134.

In the course of an investigation upon which the authors are still engaged, the question has arisen as to whether a certain base contains two NH₂ groups, or one NH₂ and one NH group. The ordinary methods of acetylating, diazotising, the formation of azo-derivatives, &c., having given ambiguous results, the authors have made experiments to ascertain whether in such cases the azomide could be formed by Griess's method (action of ammonia on the diazo-perbromide), as the determination of nitrogen in the pure product would leave no doubt as to the number of NH₂ groups which had been diazotised. As a test case they have started with the symmetrical *p*-diamido-azobenzene (p)NH₂.C₆H₄.N₂.C₆H₄.NH₂(*p*); this base is not easy to prepare in quantity by the methods usually described, and it was only after many experiments that they found the method patented by the Soc. Anon. des Mat. Color. de St. Denis (Eng. Pat. 1579, January 29, 1820) to be the most direct although the yield it affords is not very large. According to this method diazotised paranitraniline is combined with β -naphtholdisulphonic acid in alkaline solution (the G- and R-salts need not be separated), and the purified colouring matter is reduced by boiling with caustic soda and grape sugar. The base thus prepared was purified, diazotised in the presence of hydrochloric acid and converted into the tetrazepbromide in the usual way. The latter, which forms an orange crystalline powder, was allowed to remain for some hours in contact with cold dilute ammonia. The product after several crystallisations from alcohol forms lustrous silvery scales, melting sharply at 142°. A little above this temperature it explodes. Analysis confirms the formula—



The substance is readily soluble in benzene, slightly soluble in petroleum, and crystallises beautifully from hot glacial acetic acid. Nitric acid or sodium nitrite added to the acetic acid solution produces an evanescent magenta-red colouration. The compound is easily reduced both by acid and alkaline reducing agents to paraphenylenediamine; the authors were unable to convert it into a diphenyl base by means of cold stannous chloride.—W. S.

ANALYTICAL AND SCIENTIFIC NOTES.

Condensations of Chloral and Butylchloral with Paraldehyde and Ketones. W. Königs. *Ber.* 25, 792—802.

ALTHOUGH chloral itself is not found in the vegetable kingdom, yet the hydroxyl compound corresponding to it viz., glyoxylic acid, has been proved by Brunner (*Ber.* 19, 595) to exist in certain plant juices. Brunner and Chuard find that glyoxylic acid occurs in plants, especially in the green portions thereof, during certain stages of development.

Thus, the acid has been discovered in unripe grapes, apples, plums, currants, and in large proportions in green gooseberries, as well as in the leaves of these plants. But this acid was found to have disappeared in the ripe fruits.

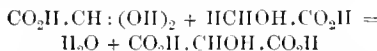
Brunner and Chuard point out that this gradual diminution of the glyoxylic acid in the fruit-ripening process, is not improbably of significance in the formation of the fruit-acids.

Garzarolli has prepared inactive malic acid synthetically from chloral and malonic acid. Similarly—in part at least—this widely-diffused acid could, it is considered, be formed

in plants, by the union or conjunction of one molecule of glyoxylic acid with one mol. of malonic acid, with the elimination of carbonic acid.

Malonic acid has only so far been discovered in the beet-root by Lippmann (Ber. **14**, 1183.) Very possibly it is formed there by the condensation of 1 mol. of formaldehyde with 2 mols. of formic acid.

Since glyoxylic acid as well as glycollic acid occur in unripe grapes (Erlenmeyer, Jahresb. der Chem. 1866, 373), and since both acids gradually disappear during the ripening of the grapes, it may probably be assumed that both these acids condense to form tartaric acid—



Again, von Miller and Spadz (Ber. **18**, 3402), and also Einhorn (Annalen, **246**, 164), carried out reactions running very smoothly by warming chloral with α - and γ -methylpyridines or methylquinolines. By exchanging chlorine for hydroxyl they obtained lactic and acrylic acids of the pyridine or quinoline series, which possess great interest because of their close relationship to many of the vegeto-alkaloids.—W. S.

Some Well-defined Alloys of Sodium. Joannis. Compt. Rend. 1892, **114**, 585.

An alloy of the composition PbNa is obtained, mixed, however, with sodamide, when lead is added to excess of sodammonium, and the powder produced in this way washed, in absence of air, with anhydrous liquid ammonia until the latter is no longer coloured blue; it rapidly oxidises on exposure to the air, and it is decomposed by water. An alloy of lead and potassium, having the composition Pb_2K , can be prepared in a similar manner, and as the potassium is very readily soluble in anhydrous liquid ammonia the alloy is easily obtained in a pure condition.

The alloy of the composition BiNa_3 , obtained by treating bismuth with excess of sodammonium, is a dark bluish granular substance, it is spontaneously inflammable in the air, and is decomposed by water.

The alloy of the composition SbNa_3 , prepared in like manner, is a black compound which takes fire on exposure to the air, and is decomposed by water.—F. S. K.

New Books.

CHEMISCH TECHNISCHES REPERTORIUM. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der Technischen und Industriellen Chemie mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. EMIL JACOBSEN. 1891. Zweites Halbjahr, erste Hälfte. Mit in der Text gedruckten Illustrationen. Berlin. 1892. R. Gaertner's Verlagsbuchhandlung. Hermann Heyfelder, S.W. Schönebergerstrasse, 26. London: H. Grevel & Co., 33, King Street, Covent Garden.

THIS Quarterly Journal of Applied Chemistry in this the third issue for 1891, treats of the following branches:—Building Materials, Cements, Artificial Stone, Colouring Matters, Dyeing and Calico Printing, &c. Fats, Oils, Illuminating and Heating Materials. Fermented Liquors. Tanning, Preparation of Leather and Glue. Textiles. Glass and Earthenware. Wood and Horn. India-rubber. Cements, Adhesives, &c. Lakes, Varnishes, and Paints. Metals. The text of this number is plentifully and well illustrated with wood engravings. The Abstracts of German Chemical Patents regularly appearing in this quarterly journal, form a valuable feature of the work.

HANDWÖRTERBUCH DER PHARMACIE. Praktisches Handbuch für Apotheker, Aertze, Medicinbeamte, und Drogisten. Herausgegeben von A. BRESTOWSKI. Zwei Bände. Wien und Leipsic: Wilhelm Braumüller, K. U. K. Hof- und Universitäts-Buchhändler. 1892. London: H. Grevel and Co., 33, King Street, Covent Garden.

THIS Dictionary of Pharmacy, issued in parts, large 8vo., has reached the issue of the third number. The work is to be completed in about 24 such numbers, the price of each being 2.40 marks, or about 2s. 4½d. The third number commences with page 161, and ends with page 240. (See this Journal, 1892, 374, Vol. 1). It commences with an article descriptive of *Asimine*, the alkaloid of the seeds of *Asimina triloba*. The mode of dealing with the subject is typical of that adopted throughout the work, with all the substances described. First, general statements and formulae, with occurrence, if a natural product, or *Mode of Preparation* if an artificially prepared product. Then follow *Properties*, next *Reactions*, and finally, *Uses*.

Part III. closes on page 240 with an uncompleted article, to be completed in Part IV., on "*Bernsteinöl*," oil of amber.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

(From the Board of Trade Journal.)

ITALY.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220.4 lb. avoirdupois. Lire = 9 ⁹/₁₆ d.

The following decisions affecting the classification of articles in the Italian Customs tariff have recently been given by the Italian Customs authorities:—

Cuproina (a drug).—Category 43d. Duty, 2 lire per quintal.

Hipnal (a drug).—Category 33b. Duty, 12 lire per quintal.

Iodopyrine.—Category 33b. Duty, 12 lire per quintal.

Phosphate of sodium.—Category 51b. Duty, 4 lire per quintal.

Basic sulphate of iron.—Category 43c. Duty, 2 lire per quintal.

CUSTOMS TARIFF OF PORTUGAL.

Comparative Statement showing the Customs duties now levied and those previously in force in Portugal.

Note.—An addition of 7 per cent. was imposed upon all articles in the first column, not subject to conventional duties, 1 per cent. being added by law of July 1889, and a further 6 per cent. by law of 30th July 1890.

Tariff No.	Articles.	Duties of Tariff of 1887.	Duties now in force.
		Reis.	Reis.
	CLASS I.—ANIMALS, LIVING.		
	CLASS II.—RAW MATERIAL FOR USE IN INDUSTRY AND COMMERCE.		
	Animal Products.		
12	Animal residues and products not otherwise specified	2 % ad val. Per Kilog.	3 % ad val. Per Kilog.
14	Gelatin, glue, and isinglass...	60	70
26	Animal oils and fats (except lard, grease, and margarine)	10	10
27	List and wool rags.....	2.7	6

CUSTOMS TARIFF OF PORTUGAL—continued.

Tariff No.	Articles.	Duties of Tariff of 1887.	Duties now in force.
	CLASS II.—RAW MATERIAL FOR USE IN INDUSTRY AND COMMERCE—cont.	Reis.	Reis.
	<i>Animal Products—cont.</i>	Per Kilog.	Per Kilog.
30	Hides and skins, cowhides ...	85	120
31	" tanned with bark, including sole leather	Duties vary	300
32	" tanned, otherwise than with bark, varnished and morocced	355	600
33	" tanned, otherwise than with bark, not elsewhere specified	Duties vary	500
34	" in the rough, or prepared for hats	Duties vary	10
35	Kid, without distinction of colour or finish, and for whatever use	860	1,000
	<i>Vegetable Products.</i>		
46	Camphor, refined	100	200
47	Caoutchouc, gutta-percha, ebonite, &c., rough or prepared	16'5	15
48	Charcoal	0'3	2
50	Malt and yeast	5	6
69	Oils, "gergelon" and "mendobi," and any other that may serve as substitutes for oils and oils used for food purposes	50	200
70	" cotton seed	800	200
71	" palm nut, concrete	1'6	2
72	" sweet almond .....	..	120
73	" fixed, liquid, not otherwise specified in	50	70
74	" vegetable, concrete	1'6	40
75	" essential, turpentine	1'8	5
76	" " not otherwise specified	700	750
77	Woods, roots, and barks used for colouring or dyeing purposes, in block or in powder	0'7	1
79	Resins, gums, and resinous gums	1'7	2
80	Oleaginous seeds, not otherwise specified, including Mancarra and coprah	0'5	Per 100 Kilogs. 1
81	Vegetable juices and materials, not otherwise specified	7 % ad val.	7 % ad val.
	<i>Mineral Products.</i>		
83	Mineral waters (including the tax)	Per Kilog. 25	Per Kilog. 50
84	Tar and pitch (mineral)	Duties vary	Per Ton. 100
85	Cement and gypsum	} Duties vary	Per Kilog. 3'5
86	Lime and "Pozzolana"		1'5
87	Coal	325	345
88	Coke and briquettes	325	400
89	Sulphur	339'4	330
90	Ice	160	1,000
91	Mineral products, not otherwise specified, unwrought ..	Duties vary	100

CUSTOMS TARIFF OF PORTUGAL—continued.

Tariff No.	Articles.	Duties of Tariff of 1887.	Duties now in force.
	CLASS II.—RAW MATERIAL FOR USE IN INDUSTRY AND COMMERCE—cont.	Reis.	Reis.
	<i>Mineral Products—cont.</i>		Per Kilog.
95	Mineral ores, lead	2 % ad val.	1,500
96	Mineral ores, not specified ...	2 % ad val.	500
	(Mineral oils for lighting purposes, including all oils from which a product giving light can be obtained, crude, pure, or refined, and their residues)	Per Kilog. 62	..
	(Mineral substances, and their products, not otherwise specified)	2	..
97	Mineral oils, light, for illuminating purposes .....	..	67
98	Mineral oils, medium .....	..	60
99	Mineral oils, heavy, for lubricating machines, and mineral substances and their products, not otherwise specified .....	..	2
100	Glass and crystal, broken, ...	2 % ad val.	1
	<i>Metals.</i>		
104	Antimony ore, plain or sulphuretted	Per Kilog. 4'9	5
105	Lead, crude or in pigs	Duties vary	10
106	" hammered or in wire ..	Duties vary	60
107	Lead alloyed with antimony ..	2'4	2
108	Copper, pure, brass, bronze, and similar alloys, hammered or rolled, to be used in manufacture	35	40
109	Copper, pure, brass, bronze, and similar alloys, in wire ..	80	40
110	Copper, pure, brass, bronze, and similar alloys, hammered or rolled, in pigs or in the metal	Duties vary	5
111	Tin, unwrought	Duties vary	2
112	" hammered or in wire	Duties vary	40
113	" in blocks for soldering purposes	6'6	80
119	Quicksilver	17'7	15
126	Platinum, in a porous state or in dust	Free	Free
127	" hammered or in wire ..	6,000	6,500
128	Zinc, cast, rolled, crude, or in the metal	Duties vary	2
129	Metals, not otherwise distinguished, crude	4'4	5
	<i>Chemical Products.</i>		
130	Acids, acetic, pyroligneous, indicating 6 degs. Beaumé's areometer	0'7	1
131	" arsenic	1'4	1
132	" nitric	30	30
133	" hydrochloric and sulphuric	1	2
134	Alkalis, caustic, solid or liquid ..	10	10
135	Nitrate of potash (saltpetre) ..	35	15

CUSTOMS TARIFF OF PORTUGAL—continued.

Tariff No.	Articles.	Duties of Tariff of 1887.	Duties now in force.
	CLASS II.—RAW MATERIAL FOR USE IN INDUSTRY AND COMMERCE—cont.	Reis.	Reis.
	<i>Chemical Products—cont.</i>	Per Kilog.	Per Kilog.
136	Nitrate of silver	337'5	350
137	" soda	0'8	1
138	Soda, boracic	2'4	2
139	Bromine, iodine, and phosphorus	16'8	15
140	Carbonate of potash, unrefined	7	7
141	" " refined.. ..	55	25
142	" soda, crude	0'8	1
143	" " crystallised or refined, dry	15	16
144	Chlorate of calcium	0'6	1
145	" sodium	10	10
146	Salts of quinine, chlorhydrate, sulphate, tannate, or valerian, &c. ....	..	2,000
147	Sulphate of soda, of potash of copper, and of iron	5	5
148	All other chemical products not otherwise distinguished	12 % <i>ad val.</i>	13 % <i>ad val.</i>
	<i>Miscellaneous Products.</i>	Per Kilog.	Per Kilog.
149	Acids, fatty, and refined, oleine and paraffin	60	65
	(Paraffin, refined)	60	..
150	Chemical manures for agricultural purposes	0'3	0'3
151	Shreds, fragments, and rags to be pulped for paper making, and pulp in whatever state and of whatever quality for the manufacture of paper	0'8	1
152	Wax, animal, vegetable, or mineral, crude (gross weight)	20	22
153	Colours and dyes, in the dust or as stone, not prepared (gross weight)	Duties vary	7
154	Dye extracts, in whatever state (gross weight)	Duties vary	3
155	Margarine .....	..	400
156	Paste for rollers of typographic machines	Duties vary	200
157	Lamp black (gross weight) ..	Duties vary	100
158	Saccharin	*15,000	18,000
159	Substances intended for use for medicine or for perfumery, not otherwise distinguished	7 % <i>ad val.</i>	7 % <i>ad val.</i>
160	Candle wicks	Per Kilog. 150	Per Kilog. 160
	CLASS III.—YARNS, TISSUES, FELTS, AND MANUFACTURES THEREOF.		
	CLASS IV.—FOOD PRODUCTS.		
	<i>Beverages.</i>	Per Decalitre	Per Decalitre
319	Beer	780	840
322	Vinegar	218	400

CUSTOMS TARIFF OF PORTUGAL—continued.

Tariff No.	Articles.	Duties of Tariff of 1887.	Duties now in force.
	CLASS IV.—FOOD PRODUCTS—cont.	Reis.	Reis.
	<i>Farinaceous Substances.</i>	Per Kilog.	Per Kilog.
329	Starch, in powder or fecula ..	60	65
330	" in pieces, or prepared, in powder	90	120
	<i>Colonial Produce.</i>		
339	Sugar, refined by the Portuguese method, and sugar superior to No. 20, Dutch standard	135	145
340	Sugar, not otherwise specified	110	120
347	Molasses and similar products	23	60
	<i>Miscellaneous.</i>	Per Decalitre	
353	Oil, olive (gross weight)	700	150
354	Lard, and melted grease	Per Kilog. 100	200
	CLASS V.—APPARATUS, &c.		
369	Apparatus of copper for distilling and concentrating purposes	50	100
375	Charcoal, in grains, tablets, and sticks	Duties vary	1
376	Sensitive plates for photography	27 % <i>ad val.</i>	100
384	Instruments and apparatus for use in chemical laboratories (except those of glass or earthenware)	Per Kilog. 25	30
	CLASS VI.—MISCELLANEOUS MANUFACTURES.		
438	Hides and leather, manufactured, not otherwise specified	555	1,200
440	Caoutchouc and gutta-percha, manufactured	500	600
441	Do., combs	220	2,000
442	Do., tubes and threads	20	25
	<i>Manufactures of Mineral Products.</i>		
453	Earthenware and fine stone ware	100	200
454	Common stone ware	2	15
455	Stone, porcelain wares	220	300
456	Bricks, tiles, mosaics, &c., glazed, painted, or ornamented .....	..	10
457	Minerals, worked up, not otherwise distinguished	3 % <i>ad val.</i>	20 % <i>ad val.</i>
458	Ceramic products, manufactured, not otherwise specified	Per Kilog. 2	Per Kilog. 4
459	Glass, common, black or dark blue, in bottles or demijohns of any size, common glass, chestnut colour or dark yellow, in bottles or demijohns holding not less than 7 decilitres; and common glass of any other colour (except white) in bottles and demijohns holding not less than 1 litre	20	20

* By decree of 20th August 1889.

CUSTOMS TARIFF OF PORTUGAL—*continued.*

Tariff No.	Articles.	Duties of Tariff of 1887.	Duties now in force.
	CLASS VI.—MISCELLANEOUS MANUFACTURES— <i>cont.</i>	Reis.	Reis.
	<i>Manufactures of Mineral Products—cont.</i>		
460	Glass, common, of whatever colour (except white), in vessels, &c., not otherwise specified	Per Kilog. 20	Per Kilog. 100
461	Glass, in plates, polished, opaque.....	27 % <i>ad val.</i>	Per Met. Quintal. 2,400
462	Glass, in plates, polished, transparent.....	27 % <i>ad val.</i>	3,000
463	Glass, manufactured, lamp chimneys	Per Kilog. 110	Per Kilog. 200
464	Glass, in plates, not polished, and all other manufactures of glass, not otherwise specified	110	300
	<i>Metal Manufactures.</i>		
473	Lead, manufactured.....	53	80
474	Copper, pure; brass, bronze, and similar alloys (taps or spigots and valve)	Duties vary	800
475	Do., do. (in tubes)	10	5
476	Do., do. (all other, not otherwise distinguished)	230	400
477	Tin, manufactured.....	60	200
479	Metals, not otherwise specified	Pay as copper	400
496	Zinc, in sheets	27	80
497	„ manufactured.....	60	400
	<i>Paper.</i>		
512	Paper for writing, white or coloured, in whatever condition	120	110
	(Packing paper).....	18	..
513	Paper for printing, common (ordinary paper for journals), including also albumised paper, paper for lithographing, and sensitised paper for photography	18	25
519	Envelopes and paper bags ...	120	200
	<i>Miscellaneous.</i>		
545	Glue, liquid (including tare) .	10	150
546	„ dried or in paste.....	10	20
548	Dynamite and gunpowder....	250	270
553	Miners' fuses.....	4'2	5
554	Fuses not otherwise specified	300	350
561	Fireworks (gross weight) ...	60	150
564	Shoe blacking.....	80	150
565	Matches	80	1,200
567	Medicines: pills and extracts, &c.	300	2,000
568	„ globules (including tare) ..	..	5,900
569	„ pastilles (including tare)...	..	1,200
570	„ simple or compounded (including tare)...	300	600
572	Oilcloth for flooring.....	65	150

CUSTOMS TARIFF OF PORTUGAL—*continued.*

Tariff No.	Articles.	Duties of Tariff of 1887.	Duties now in force.
	CLASS IV.—MISCELLANEOUS MANUFACTURES— <i>cont.</i>	Reis.	Reis.
	<i>Miscellaneous—cont.</i>		
573	Oilcloth not otherwise specified	Per Kilog. 500	Per Kilog. 700
574	Articles made of oilcloth	500	1,000
575	Perfumery of all sorts (including tare).....	220	1,000
576	Gunpowder in cartridges (including tare)	350	500
578	Soap.....	50	60
579	„ balls (including tare) ..	220	500
583	Ink (for writing) (including tare).....	50	100
584	Dyes, prepared, liquid or in paste, exceeding 100 kilos. (including tare) .....	..	80
585	Dyes, prepared, liquid or in paste, less than 100 kilos. (including tare)	Duties vary Per Kilog. 80	40 % <i>ad val.</i> Per Kilog. 120
590	Candles of every description .		
591	Varnishes made with alcohol or ether.....	30	400
592	„ all other, not distinguished	30	200

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

THE PETROLEUM TRADE OF THE CAUCASUS.

Aassib Effendi, Turkish Consul-General at Tiflis, has just addressed to his Government a very interesting report on the petroleum trade of the Caucasus. Extracts from this report are given by the *Journal de la Chambre de Commerce de Constantinople* for the 11th June, in which the following passages occur:—

It is since 1873 that the petroleum industry has entered into its phase of progress and of development by reason of the decision taken by the Government to throw it open to private enterprise, by selling the petroleum lands, divided into lots of 10 square deciatines each, to private persons. At that time the lands sold contained no more than 221 wells.

The celebrated springs of Balakhani are situated 20 kilometres distant from Baku, on a bare and arid plateau swept by the winds, at an elevation of about 60 metres above the level of the Caspian Sea. The appearance of this place is very dull and wretched.

The petroleum lands occupy an area of about 8 kiloms.; Balakhani and Goumrakhani are connected by a railway with the town of Baku.

In the opinion of well-informed persons the whole of this region is of volcanic origin.

At the present time Balakhani and Sabountchi possess more than 1,000 wells, some of them newly bored, producing in 24 hours as much as 400,000 pounds.

From 1873, when the production was only about 4,000,000 pounds, to 1882, when it was 50,000,000 pounds, the progress of this industry was constant. But on selling the petroleum lands as mentioned above, the Government

levied taxes on the products of distillation. It was to receive 25 copecks per pound of the distilled products, and for this purpose special regulations were drawn up, according to which these taxes were collected for the time taken to distil the petroleum in stills of a certain volume. This system did not fail to bring about the result that might have been expected. All the small merchants endeavoured to accelerate distillation in order to produce a greater proportion of products within a given time, no matter what the quality might be. The petroleum decomposed and produced fires and explosions, and every effort was made to over-ride the law by paying a tax of only two or three copecks instead of 25 copecks per pound. By reason of this deplorable state of affairs, more than half of the 200 Baku works closed their establishments, whilst the remaining ones were put to considerable loss by reason of the engagements entered into.

The price of kerosene fell to an enormous extent and the naphtha trade entered into a terrible crisis, and it was at this time that the Government came to the aid of the industry by abolishing the taxes.

As a result of this action the producers bestowed their attention on the quality of the merchandise; improvements and machines of every kind were introduced, and among these works that of M. Nobel occupied the front rank. The house of Nobel Brothers was the first to introduce into the naphtha industry all the technical and scientific methods applicable to this branch. It started at Baku in 1874; the following year it purchased a small business and undertook the production of petroleum on a small scale. At this time the conveyance of petroleum to Baku was effected by means of earthen and leather bottles. M. Nobel endeavoured to show the absurdity of this primitive method of transport, and recommended that pipes should be constructed, but the majority of the merchants rejected the proposal. This gentlemen then constructed the first pipe at his own cost and demonstrated the utility of it to his colleagues, several of whom very soon imitated his example, and Baku has to-day a dozen lines of pipes, each of which cost more than 100,000 roubles. The Nobel house did not shrink before any difficulty; it brought specialists from America and utilised their knowledge, and in a short time it was at the head of the petroleum industry. Another innovation carried out was as follows:—The petroleum was shipped in barrels, a system which had many drawbacks; the proposition made by Nobel to the Kavkaz and Mercury Navigation Company of the Caspian and the Volga, to build tank-boats intended for the exclusive conveyance of the petroleum having been also rejected, the firm of Nobel constructed several of these vessels at their own expense. This innovation, of which even the Americans had not yet thought, was accepted by the two petroleum-producing countries, and the tank-boats, the number of which is constantly increasing, are to be found on all the waters of the civilised world.

Up to 1887 the Nobel house, owing to the millions at its disposal and the impulse given by it to the naphtha trade, had almost eclipsed all the other houses in competition with it; but when in 1887 the Rothschild house of Paris took a part in the Russian petroleum industry, Nobel took a secondary place. Since that time, owing to the competition brought about by the participation of Rothschild in this trade, the extraction of naphtha and its derivatives has increased in enormous proportions, as the following figures go to show:—

Years.	Raw Naphtha.	Petroleum.
	Pounds.	Pounds.
1887	165,000,000	41,000,000
1888	192,000,000	50,240,000
1889	205,000,000	61,485,242
1890	239,000,000	68,379,049

The petroleum exported from Baku from 1888 to 1890 inclusively is distributed as follows:—

Years.	Batoum.	Persia.	Russia.	Total.
	Pounds.	Pounds.	Pounds.	Pounds.
1888	28,115,123	265,321	21,559,565	50,240,000
1889	37,060,594	385,447	24,039,201	61,485,242
1890	44,198,743	312,465	23,867,840	68,379,049

The following gives the quantity of other derivatives of naphtha for the same years:—

Years.	Lubricating Oil.	Benzine, Gasoline, and other Derivatives.	Residues.
	Pounds.	Pounds.	Pounds.
1888	2,576,000	..	61,846,000
1889	3,350,000	303,000	88,886,000
1890	4,518,000	522,000	96,903,000

The quantity of petroleum exported to foreign countries by way of Batoum, for the same period of three years, is distributed as follows:—

1888, 22,540,352 pounds; 1889, 29,383,595 pounds; 1890, 36,211,838 pounds.

The following is a statement of the foreign countries to which petroleum was exported in 1890, as well as of the quantity for each:—

Austria, 6,489,000 pounds; England, 7,870,000; Belgium, 2,095,000; Germany, 422,900; Netherlands, 562,000; Italy, 1,740,000; Portugal, 16,000; France and Algeria, 194,000; Danubian States, 592,000; Greece, 2,242,000; Turkey, 2,583,000; Malta, 82,000; Philippine Islands, 431,000; India, 3,080,000; China, 2,474,000; Japan, 2,482,000; and Indo-China, 3,131,000 pounds.

The quantity of raw naphtha and its derivatives exported from Baku from 1888 to 1890 is distributed as follows:—

1888, 6,007,607 pounds to foreign countries and 367,417 pounds to Russia; 1889, 7,073,011 pounds and 461,879 pounds; 1890, 6,212,667 pounds and 426,853 pounds.

The following statistical data are for the year 1891, during which the naphtha industry has realised further enormous progress:—

In that year there were exported 9,839,352 pounds of raw naphtha, 72,885,331 pounds of lamp oil, 6,187,966 pounds of lubricating oil; total, 187,141,870 pounds.

Of this quantity there were conveyed by sea 9,239,291 pounds of naphtha, 25,784,700 pounds of lamp oil, 917,120 pounds of lubricating oil, and 89,787,466 pounds of naphtha residues; by railway, 600,061 pounds of naphtha, 47,100,631 pounds of lamp oil, 5,270,846 pounds of lubricating oil, and 8,441,155 pounds of residues.

The petroleum was distributed as follows:—25,236,502 pounds for the interior of Russia, 219,641 pounds for the different regions of Transcaucasia, 328,557 pounds for Persia, 46,204,273 pounds for Batoum, and 896,358 pounds for different localities situated along the track of the railway.

The total of the naphtha extracted during the year 1891 was 289,575,400 pounds.

CHINA.

Formosa Camphor.

In 1891 there was a slight improvement in the export of camphor from Tainan, in Southern Formosa. It reached 2,524 cwt., as against 904 cwt. in 1890. The Government monopoly is said to be abolished, but the heavy tax imposed in order to defray the expenses of frontier defence prevents foreigners here competing successfully with the Government farm. The expenses of transport, too, are heavier than in

the north of the island, and it does not seem probable that there will be any great development of the camphor trade here unless the tax is abolished or reduced. There has been very little trouble from savages in the centre of the island; indeed there has only been one instance of the savages attacking camphor distillers during the last five years. In the north, apparently, the distillers have not been so fortunate.

Opium.

Mr. Pelham Warren gives an intelligent criticism of the condition of the opium business at Tainan in his report dated March 29th, 1892. The import of Indian opium is on the decrease, and Persian is increasing. One reason for the decrease of the Indian is because it is much dearer than Persian; another is the uncertainty in regard to the weight of the drug contained in each chest. There ought to be 120 catties, but the weight varies from 116 to 110. Although Persian opium is not so good as Indian, it is being steadily improved to suit Chinese taste. After it has been once smoked, the ashes, if the opium is of the best quality, can be used mixed with fresh opium some six or seven times, whereas Benares cannot be thus used more than once. The smoke of Persian opium is milder, and in consequence more suitable to a tropical climate, and this opium can be smoked alone. Unless some change is made in the Indian opium to suit popular taste there is no chance of its recovering its position in the Formosa markets that it once held. Native opium is imported from Tung-an, about 20 miles from Amoy, and also from Wenchow and Taichow, and is, as a rule, smuggled in junks. It is made into square cakes, and, being very soft, is usually squeezed into large bamboo pipes, and thus evades search.

PERSIA.

The city of Meshed, in Eastern Persia, is the centre of a district in which British and Russian traders are now struggling for supremacy. Much of the trade of the province of Khorassan (of which Meshed is the capital) is still done through Bombay and the Persian Gulf ports, about 280,000*l.* worth of goods coming that way in 1890—91, against 210,000*l.* worth imported from Russian territory by way of the Transcasian railway, Astrabad, and Merv, or Bokhara. The trade with Afghanistan is dwindling to nothing, as the Ameer is doing everything he can to stop the importation of Indian goods through his dominions.

The number of British traders in Meshed during the year 1890—91 was 11. The number is slowly on the increase. They are all men of substance, doing a large trade with Bokhara and Samarkand and other places in Russian Central Asia.

Drugs.

The chief articles of export were 47,316*l.* worth of opium, which goes mostly to China, though the Russians are also beginning to take a great deal, and 5,612*l.* worth of asafoetida, all of which goes to India.

Gum Tragacanth.

Gum tragacanth was scarce throughout Persia in 1891, hence only a small quantity was brought to market at Burudjird during the summer, and prices were high. Arrivals also took place from the Bakhtiari mountains, but the gum from those parts is all of second and third quality, nearly all of which is bought by Persian merchants and forwarded to Kermanshah.

The Opium Industry.

The opium industry, although introduced into Persia at a relatively recent date, has largely developed within recent years. In 1870 there were exported 800 boxes of 150 lb. each, and now the production is distributed in the following manner:—Ispahan, 2,300 boxes; Yezd, 4,000; Kerman,

500; Khorassan, 3,000; Chiraz, 1,200; Kermanshah, 300; Burudjird, 500; other districts, 1,200; total, 13,000 boxes, of which 3,000 are consumed in the country. The product is prepared differently according as it is destined for Europe or China. That which is sent to Europe is as pure as possible; each box contains 90 kilos. of opium. For China, on the contrary, raw opium is sent which has to bear an addition of from 10 to 12 per cent. of oil; consignments are made in boxes weighing 62 kilos., and in blocks of 1 kilog. each. The Hotz and Ziegler houses, as well as the Commercial Company of the Persian Gulf, at Ispahan, analyse their opium and guarantee 10 per cent. of morphine; certain consignments yield 12 per cent. and even more. Persian opium is, therefore, by no means inferior to the Turkish product of the same quality.—*Chemist and Druggist.*

THE GERMAN CHEMICAL INDUSTRY.

Our Consul at Frankfurt-on-the-Main, in a report on the industrial condition of Germany, gives the following table of figures relating to the exportation of drugs and chemicals from Germany:—

Articles.	Quantity.		
	1891.	1890.	1889.
Essential oils.	Met. Cntrs. 2,516	Met. Cntrs. 3,652	Met. Cntrs. 2,250
Soda calcined.	353,303	270,510	195,274
Potassium.	110,934	106,281	115,759
Alkaloids.	584	561	372
Quinine.	1,869	1,565	1,716
Chloride of potassium.	769,962	676,680	754,587
Iodide of potassium.	977	1,062	1,076
Sulphate of potash.	301,888	193,133	218,478
Mineral waters.	335,632	363,629	304,773
Salicylic acid.	2,170	2,440	2,375
Saltpetre.	96,629	101,349	81,017
Hydrochloric acid.	103,123	89,562	62,018
Tartaric acid.	7,769	10,211	15,982

These figures, the Consul says, show that the increases in the exports of this year are generally in the important, and the decreases in the less important articles. The opinion, therefore, formed of the trade in general of the chemical industry for this year will not be an unfavourable one. Germany's chemical industry takes a high place, and its products are forwarded to almost all countries of the world. The reason for this extension is to be found in the high theoretical talents of the German people and the excellent schools, which, year by year, furnish a body of educated chemists to advance the trade of the country.

The Potash Salts.

One branch of the chemical industry is worthy of special attention—namely, the potassic salts. This industry has formed a syndicate which publishes accounts every year, and thus facilitates inspection of the course of business.

Of chloride of potassium (80 per cent.) the sales were, in—

	Met. Centners.
1891.	1,341,639
1890.	1,265,526
1889.	1,237,482

These quantities were distributed as follows:—

—	1891.	1890.	1889.
	Met. Cntrs.	Met. Cntrs.	Met. Cntrs.
Germany	137,989	406,126	416,882
North America	356,700	296,000	319,000
England	123,100	138,000	110,000
Scotland	81,500	91,000	48,000
France.....	151,000	152,000	107,000

The total amount of sales in muriate of potassium (90 per cent.) were:—

	Met. Centners.
1891	179,804
1890	129,471
1889	62,213

America is also the largest consumer of this salt, then follow Germany, the United Kingdom, and France.

Kieserite.

The total sales of kiserite in 1871 were 285,591 centners; in 1890, 320,048 centners; and in 1889, 318,239 centners. Of these quantities the United Kingdom took, respectively, 251,454, 281,938, and 253,172 centners. Several products, of which kiserite is one, are almost exclusively manufactured in Germany for foreign countries.

With regard to the general condition of the industry, the Consul remarks: "The Frankfort quinine factory records a further increase in its production. The consumption of quinine is increasing in almost all parts of the world. In glycerin, cocaine, strychnine, and other pharmaceutical preparations (of which the factory in question is one of the chief producers in Europe), the demand throughout the year was very active, although mostly at reduced prices. The coal-tar colour industry, too, had another good year. In 1891 a whole series of new medicines produced from coal-tar were introduced before due examination of their merits or demerits. It is supposed that the public will sooner or later object to being experimented upon chiefly for the benefit of manufacturers."—*Ibid.*

GENERAL TRADE NOTES.

CANADIAN MINERAL STATISTICS FOR 1891.

The following is extracted from the *Canadian Gazette* for the 23rd June:—

The Dominion Geological Survey Department has issued a summary of Canada's mineral production during 1891. The list of metals is headed by nickel, of which 4,626,627 lb. were marketed, fetching about 555,195*l.* Then follow 9,529,076 lb. of copper, worth 247,756*l.*; 51,040 oz. of gold, worth 185,097*l.*; 415,493 oz. of silver, worth 81,436*l.*; 68,979 tons of iron ore, worth 30,401*l.*; and 588,665 lb. of lead, worth 5,121*l.*, besides platinum valued at 2,000*l.* and 12*l.* worth of antimony ore. The whole of the metallic products were valued at about 1,107,000*l.* Taking the non-metallic substances in order of value, it appears that 3,400,479 tons of coal were marketed, bringing 1,558,431*l.* Bricks made a poor second—173,808,000, worth 209,462*l.* Then come 755,298 barrels of petroleum, 200,909*l.*; 9,000 tons of asbestos, 200,000*l.*; 187,685 cubic yards of building stone, 141,740*l.*; pottery valued at 51,768*l.*; 1,829,894 bushels of lime, 50,243*l.*; 45,460*l.* worth of drain pipes; 65,362 tons of pyrites, 39,217*l.*; 203,545 tons of gypsum, 38,419*l.*; 57,084 tons of coke, 35,118*l.*; 23,588 tons of phosphate, 32,338*l.*; 45,021 tons of salt, 32,235*l.*; 11,779,000 tiles, 28,159*l.*; 22,624*l.* worth of terra-cotta; 93,779 barrels

of cement, 21,817*l.*; and smaller quantities of arsenic, felspar, fireclay, flagstones, granite, graphite, grindstones, magnesite, mica (14,302*l.*), mineral paints, mineral waters (10,813*l.*), moulding sand and soapstone, and 11,900*l.* worth of sand and gravel exported, making a total of 2,766,553*l.* in the non-metallic list. Adding 116,427*l.* for products not yet returned, these being chiefly building materials, the whole mineral production of Canada last year is valued at four millions sterling.

BEET-SUGAR INDUSTRY IN SPAIN.

The *Bulletin du Musée Commercial* says that for some years past great efforts have been made in Spain to develop the manufacture of beet sugar. The Belgian Consul at Madrid writes that the authorities of Aragon (*comité d'initiative*) have just granted to all agriculturists engaged in cultivating the sugar-beet in 1893 an advance of 100 francs, as well as the manures required for cultivation. The *Bulletin* adds that this measure must have the effect of encouraging the establishment of new factories, and consequently orders for building and other material may shortly be looked for.

QUICKSILVER IN RUSSIA.

The nature of the sunken pits and mounds found in Ekaterinoshav and Bachmut, so long a mystery, has been made known through the enterprise of Messrs. Auerbach and Co. According to Glückauf there was no mention in Russian history of the people who worked them or of the metal extracted, but it is supposed that they were worked by the people of South Russia 1,000 years ago. Upon investigation a bed of sandstone, impregnated with cinnabar, was found interstratified with beds of carboniferous formation. In 1887, 12,000 tons of ore were raised, giving employment to 125 men. This ore was treated by two cupolas and two reverberatory furnaces, 85 men being employed. Two thousand two hundred tons treated in the reverberatory furnaces yielded 20½ tons of quicksilver; 9,000 tons treated in the cupolas yielded 42·3 tons, being a little over one-half per cent. of metal.—*Engineering and Mining Journal.*

NICKEL COINAGE.

The increased cheapness of nickel owing to the large output of the Canadian mines is leading to a more extended use of this valuable metal. Only lately it was mentioned that the French Government proposed to use 400 tons in nickel coinage. Austria, it seems, is about to follow her example.

At a recent meeting of the Austro-Hungarian Parliament, says Oberberggrath Ernst, in the *Oest. Zeits. für Berg und Hüttenwesen*, it was proposed to issue 10 and 20 farthing pieces of pure nickel, and 1 and 2 farthing pieces of bronze. After mentioning several alloys that have been tried and found wanting, among others the "packfong," containing 6 per cent. silver, coined in Switzerland in 1860, he instances an alloy of 25 per cent. nickel and 75 per cent. copper as one which experiments have proved with one exception to be suitable for small coin. This alloy is cheap, durable, and hard to counterfeit. Its hardness, compared with that of copper, is 3 to 2. It can only be coined with powerful and well-constructed machinery, and the impression is sharp and clear. The one fault to be found with it is that while bright when new, it soon becomes dull, and gives the offensive odour characteristic of copper. With the exception of Germany, all the large countries have ceased to coin this alloy.

Nickel is especially suitable for small coins on account of its cheapness, durability, sharpness of the impression, and, most important of all, its lasting brightness, but until a process for manufacturing pure nickel was devised at the Berndorfer Metallfabrik, the metal could not be coined on account of its brittleness. In 1889—81 Switzerland commenced the coinage of 20 rappen pieces of pure nickel, the dies being furnished by Krupp, of Berndorf. Krupp also furnished the plates for Mexico and Serbia for their copper-nickel coins.

He further adds that, while the former coinage of copper nickel in Switzerland, Mexico, Servia, &c. took but 200,000 kilogrammes of nickel, the proposed coinage in Austria of 42,000,000 crowns in 10 and 20 heller pieces will require not less than 1,050,000 kilos. of pure nickel, and that of Hungary about 450,000 kilos.—*Ibid.*

IMPORTS AND EXPORTS OF COLOURS THROUGH THE GERMAN CUSTOMS, 1888—1891.

Lehne's Fürber Zeitung, 1891—2, p. 209.

	—	Import (I.). Export (E.).	Imports and Exports in				Imports from and Exports to Great Britain.
			1888.	1889.	1890.	1891.	
			Kilos.	Kilos.	Kilos.	Kilos.	Kilos.
Indigo.....	{	I.	15,780	19,350	20,076	12,658	3,569
	{	E.	5,616	7,449	7,330	5,556	63
Indigo carmine.....	{	I.	331*	682	611	463	18
	{	E.	514*	891	909	798	31
Logwood	{	I.	521,045	508,104	528,806	471,914	3,694
	{	E.	80,196	95,168	107,008	97,449	2,949
Pastie	{	I.	70,343	66,909	65,292	12,931	1,945
	{	E.	9,015	16,624	20,717	14,574	110
Red woods.....	{	I.	66,525	83,086	69,162	30,323	2,126
	{	E.	11,345	14,890	13,805	12,056	942
Dye-wood extracts.....	{	I.	50,923	45,491	46,855	47,448	1,971
	{	E.	14,817	16,831	15,819	15,601	1,340
Madder.....	{	I.	5,077	3,821	2,495	2,466	145
	{	E.	3,282	2,633	2,339	1,970	..
Cochineal	{	I.	1,119	904	772	939	369
	{	E.	350	557	591	327	..
Safflower	{	I.	53	56	112	25	8
	{	E.	22	29	13	13	..
Quercitron Bark.....	{	I.	9,332	10,249	14,263	8,124	262
	{	E.	1,183	1,806	1,101	1,799	..
Catechu (cutch).....	{	I.	68,739	72,867	73,500	61,268	12,264
	{	E.	11,196	14,963	22,072	18,705	956
Orchil, orchil extract, &c.....	{	I.	7,335	3,974	8,809	4,441	371
	{	E.	3,214	2,568	2,510	2,695	267
Alizarin	{	I.	280	207	131	785	173
	{	E.	67,322	77,926	79,955	81,685	27,391
Aniline and coal-tar colours.....	{	I.	6,427	6,979	6,211	6,881	954
	{	E.	60,060	69,749	72,797	86,818	18,194
Colour lakes	{	I.	178*	121	186	220	77
	{	E.	2,591*	1,293	4,626	4,748	661
Vermilion	{	I.	171	286	227	258	154
	{	E.	1,875	2,238	2,209	2,040	720
Red-lead	{	I.	3,835	3,921	4,492	4,291	3,044
	{	E.	55,914	60,404	58,299	56,874	14,604
Prussian blue.....	{	I.	431	417	1,024	1,561	25
	{	E.	5,666	1,176	5,411	6,900	1,587
Ultramarine blue, green, &c., nat. and art.....	{	I.	579	611	691	574	11
	{	E.	53,273	52,832	52,583	44,010	19,305
Natural mineral colours (excluding white).....	{	I.	62,266	60,996	73,067	59,189	8,964
	{	E.	91,325	86,688	83,959	85,415	3,934

* The numbers are from the second half-year of 1888 only.

—W. E. K.

METALLURGICAL AND CHEMICAL PRODUCTION OF ITALY IN 1890.

Products.	No. of Establishments.	No. of Workmen.	1890.		1889.	
			Tons.	Value.	Tons.	Value.
Cast iron	12	254	14,346	Dols. 425,784	13,473	Dols. 424,619
Iron.....	326	13,799	176,374	9,709,728	181,623	10,068,680
Steel			107,676	5,821,181	157,899	7,035,167
Gold.....	3	157	Kg. 206,312	108,836	Kg. 215,555	113,969
Silver.....	1	550	Kg. 34,428	1,164,432	Kg. 33,685	1,205,150
Lead			17,768	1,137,152	18,135	1,235,220
Copper and alloys.....	10	1,291	6,406	2,404,566	6,904	2,449,200
Mercury	3	50	Kg. 449,226	583,194	Kg. 385,500	454,890
Antimony	1	30	182	54,716	195	56,013
Sea salt.....	73	2,061	442,010	897,851	420,625	529,790
Brine salt	2	198	9,879	67,739	10,014	54,028
Refined sulphur	14	225	43,337	987,108	53,216	991,717
Ground sulphur	25	300	56,323	1,226,063	54,105	1,077,811
Asphalt.....	4	115	10,302	80,594	None	..
Petroleum	4	44	350	42,000	None	..
Boric acid.....	11	497	1,874	187,400	2,473	247,200
Borax			950	114,000	..	..
Coal.....	10	516	559,300	3,363,640	506,700	3,068,680
Charcoal.....	15	222	16,750	301,160	13,750	234,500
Alum	7	109	1,294	26,272	1,380	30,116
Sulphate.....			2,553	58,430	2,667	61,248
Alumina .....			..	..	..	..
Total 1890.....	521	21,018	..	28,762,752	..	..
Total 1889.....	518	24,622	..	29,139,517	..	..
Difference 1890.....	+ 3	~ 3,604	..	- 376,765	..	..

—Engineering and Mining Journal.

THE NEW TANNING SCHOOL IN FREIBERG IN SAXONY.

F. H. Huenlein, *Jahresb. der Deutsch. Gerberschule zu Freiberg in Sachsen, 1891—92*, 3, 18—24.

This is a description of the new tanning school which has been established at Freiberg in Saxony. The curriculum aims at teaching the students tanning in all its branches, thus giving him a more catholic knowledge than he could obtain in an ordinary tannery. Measurement is the dominant principle, and the student is made to note the weight, size, and strength of all raw materials, by-products, and finished goods; the water-supply is continually tested.

—A. G. B.

RUSSIAN SODA.

By a revision of the railway transport rates for the conveyance of soda, resulting in their reduction on all the Russian lines, the Government hopes, according to the Journal of the Minister of Finance, to promote the Russian soda industry, particularly as regards the manufacture of caustic soda, and, in time, to exclude the foreign product from the Russian markets. This action has been taken in consequence of representations made to the Railway Department by representatives of this industry, urging the necessity of a reduction in the railway rates for soda, which were such as made it impossible to compete with the foreign material.

The imports of foreign soda into Russia, distinguishing the chief ports of entry, were as follows in 1889 and 1890:—

	Caustic Soda.		Crystallised and other Soda.	
	1889.	1890.	1889.	1890.
	Tons.	Tons.	Tons.	Tons.
St. Petersburg ..	7,023	6,685	3,973	3,182
Odessa.....	2,395	2,861	450	273
Alexandrovo	209	112	2,105	2,105
Riga.....	1,752	1,579	852	1,015
Other ports.....	5,853	5,545	4,320	5,003
Total imports	17,232	16,762	11,700	11,668

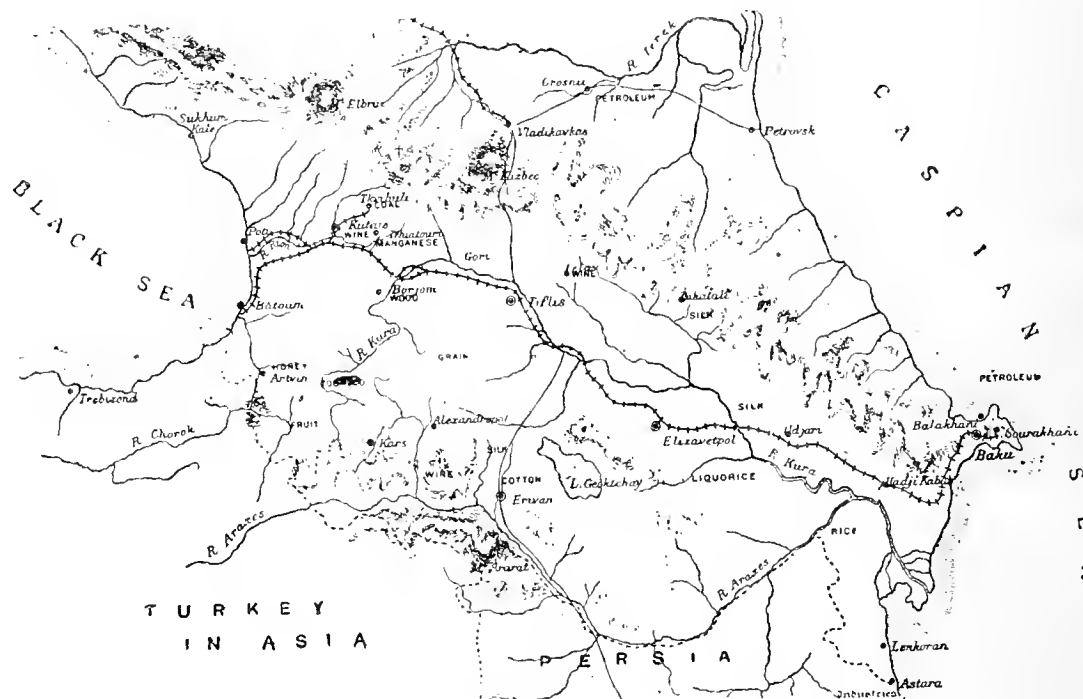
The railway transport statistics show that in 1889, out of 45,112 tons of soda conveyed on all Russian lines, only 4,741 tons were imported, and out of the 28,430 tons of caustic and crystal soda imported in 1890, only about 17 per cent. were imported by rail, the remainder having been

used either at the ports and stations of entry or in their neighbourhood. These facts, in the opinion of the Russian Government, show that the competition with foreign soda must as far as possible be minimised, both in the interests of the native soda industry and of the railways, which, under a reduced transport tariff, would convey the soda much greater distances, viz., from the seats of production at Lisichansk on the Donetz line, in the province of Yetaterinoslav, and Beregniaki, a town on the upper Kama, in the Government of Perm. The sole representatives of this industry in Russia are the firm of Messrs. Linbunoff, Solvay, and Co., whose works are situated at the places named, and who, when the question of reducing the railway transport rates was being discussed, stated that they could manufacture sufficient soda to supply the demands of the whole Empire. The new tariff rates for soda which

came into force on the 1st ultimo, place Russian soda at a considerable advantage as compared with the imported article, which has to pay Customs duty at the rate of 90 copecks (gold) per pound (about 8s. 10d. a cwt.) of caustic soda, and 55 copecks (gold) per pound (about 5s. 5d. a cwt.) of crystal soda. The new transport rates, moreover, are higher for the former than the latter.—*Industries.*

RUSSIAN INDUSTRIES.

The illustration given herewith, reproduced from a recent Foreign Office report, represents the Trans-Caucasia district of Russia. The map shows the towns where an export trade is carried on, and indicates the staple industries or productions of the various districts.



MAP OF TRANS-CAUCASIA SHOWING THE PRODUCTIONS OF THE VARIOUS DISTRICTS.

According to the new regulation for the supply of Portland cement in Russia, this material is to be made either from calcareous marl or a mixture containing clay and chalk, by burning until friable, and then grinding to a fine powder. The hydraulic modulus, or ratio of the sum of the parts by weight of CaO and $(\text{K}_2\text{O} + \text{Na}_2\text{O})$ to that of the parts by weight of SiO_2 , Al_2O_3 , and Fe_2O_3 , ought not to fall below 1.7 nor to exceed 2.2 for Portland cement.

$$\frac{\text{CaO} + \text{Na}_2\text{O} + \text{K}_2\text{O}}{\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3} = 1.7 \text{ to } 2.2.$$

The percentage of sulphuric acid and magnesia should not be greater than 1.75 to 3 in Portland cements ready for use, and the specific gravity must not be less than 3.05. The cement should not set in less than one hour, or take longer than eight hours. A sieve with 4,900 meshes per sq. cm. should not pass less than 50 per cent., and one with 900 meshes per sq. cm. should pass all but 15 per cent. of residue. The cement after seven days' setting should be able to show a limit of elasticity of 20 kilos. per sq. cm., and after 28 days 25 kilos. per sq. cm. A test piece prepared with 3 parts sand and one cement, should be able to stand after seven days, 5 kilos., and after 28 days 8 kilos. per sq. cm.

During June last 183,379 tons of coal and coke, &c. were imported into Russia from Great Britain, as against 253,434 tons in June 1891. The Warsaw Coal Mining Company has declared a dividend of 6 per cent. for the past year.

In June last Russia exported to Great Britain 128,150 cwt. of jute and 21,634 cwt. of hemp, as compared with 155,336 and 21,187 cwt. respectively in June 1891. The Carl Scheibler Cotton Manufacturing Company of Lodz has declared a dividend of 7 per cent. for the past financial year.

The imports from Great Britain of alkali in June last amounted to 23,448 cwt., as compared with 67,573 cwt. in June 1891. The balance sheet of the Russian branch establishment of the Baden Aniline and Soda Manufacturing Company at Butirki, near Moscow, shows a profit for the past year of 129,950 roubles, after allowing 5 per cent. interest on the capital employed and providing appropriations for the depreciation and suspense accounts.

The important fishing industry of the River Volga is suffering from the effect of petroleum shipments, and will probably be entirely destroyed. The petroleum is introduced into the river from the innumerable boats, lighters, and tank-vessels engaged in the petroleum industry on the

Caspian Sea and the Volga. The quantity of petroleum carried from Baku to Astrachan and to further points on the river is very large, and several million poods of petroleum find their way every year into the river during transhipment, &c. The fish suffer greatly from this, the more so as the vegetation along the river is also destroyed by the effects of the petroleum. It has, therefore, been advocated that wooden vessels and lighters should not be allowed to carry petroleum, and that all the waste or unclean petroleum should be removed from the vessels without being allowed to pass into the river.—*Industries.*

ARTICLES OF INTEREST TO TECHNOLOGISTS AND MANUFACTURERS.

The following articles in the *Board of Trade Journal* for July will repay perusal:—

"Obstacles to British Foreign Trade"	p. 6
"The Spanish Sherry Trade"	p. 14
"Tanning Industry in the United States"	p. 19
"Customs Duties on the Importation of Hops" ..	p. 47
"The Working of Salt Marshes in France" ...	p. 81
"Coffee Adulterants in Canada"	p. 93

NITRATE OF SODA.

Shipments, Consumption, Stocks, and Prices, from 1885 to 1892.

		1885.	1887.	1889.	1891.	1892.
Shipments from South American ports to all parts for the six months ending 30th June	Tons	177,000	233,000	357,000	254,000	402,000
Do. for the 12 months ending 30th June	"	403,000	507,000	853,000	945,000	907,000
Afloat for Europe on 30th June	"	104,000	125,000	178,000	131,000	180,000
Stocks in United Kingdom ports:—						
		1885.	1887.	1889.	1891.	1892.
Liverpool..... Tons	12,000	3,250	7,000	11,000	8,000	22,000
London	3,300	2,800	2,500	6,300	1,700	
Out ports	6,700	3,950	8,500	8,700	7,300	
Stocks in Continental ports on 30th June	Tons	60,000	10,000	92,000	120,000	107,000
Consumption in United Kingdom for the six months ending 30th June	"	73,000	*68,000	73,000	90,000	84,000
Do. in Continent do. do.	"	220,000	243,000	359,000	550,000	493,000
Do. in United Kingdom for the 12 months do.	"	100,600	*92,000	100,000	118,000	111,000
Do. in Continent do. do.	"	338,000	355,000	516,000	721,000	646,000
Do. in United States do. do.	"	45,000	55,000	60,000	90,000	100,000
Do. in the World do. do.	"	483,000	502,000	706,000	921,000	860,000
Visible supply on 30th June (including the quantity afloat for Europe and Stocks in United Kingdom and Continent)	"	186,000	115,000	288,000	276,000	304,000
London Spot price on 30th June	per Cwt.	10s. 6d.	9s.	8s. 6d.	8s. 4½d.	8s. 3d.

* Inclusive of 10,000 tons exported to the Continent.

W. MONTGOMERY & CO.

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

	Month ending 30th June	
	1891.	1892.
	£	£
Metals.....	2,195,516	2,056,635
Chemicals and dyestuffs.....	596,909	482,680
Oils.....	659,166	541,983
Raw materials for non-textile industries.	3,063,930	3,656,785
Total value of all imports	36,850,124	32,811,854

SUMMARY OF EXPORTS.

	Month ending 30th June	
	1891.	1892.
	£	£
Metals (other than machinery)	4,225,304	2,698,453
Chemicals and medicines	761,104	647,628
Miscellaneous articles.....	2,886,133	2,287,367
Total value of all exports.....	21,434,309	18,070,318

IMPORTS OF METALS FOR MONTH ENDING 30TH JUNE.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Copper:—			£	£
Ore..... Tons	12,613	4,790	90,749	40,457
Regulus..... "	14,015	17,393	363,482	412,608
Unwrought "	4,137	2,832	233,078	132,377
Iron:—				
Ore..... "	292,358	246,214	237,282	182,162
Bolt, bar, &c.... "	8,575	7,549	89,956	73,714
Steel, unwrought.. "	638	783	6,155	7,032
Lead, pig and sheet "	15,896	16,312	205,232	178,335
Pyrites..... "	50,133	54,770	86,325	96,376
Quicksilver..... Lb.	1,002,100	2,077,050	98,324	186,932
Tin..... Cwt.	30,582	33,421	139,615	162,310
Zinc..... Tons	4,749	5,554	104,781	124,528
Other articles... Value £	..	..	540,267	439,864
Total value of metals	..	..	2,195,316	2,036,635

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 30TH JUNE.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Bark, Peruvian .. Cwt.	7,113	7,024	15,091	15,371
Bristles..... Lb.	286,459	204,109	42,326	29,254
Caoutchouc..... Cwt.	26,898	17,275	329,245	161,846
Gum:—				
Arabic..... "	4,888	4,318	12,044	12,598
Lac, &c..... "	10,514	7,275	36,843	27,339
Gutta-percha "	4,382	3,121	47,036	44,439
Hides, raw:—				
Dry..... "	41,445	28,422	111,728	84,291
Wet..... "	48,375	42,345	114,525	87,161
Ivory..... "	815	741	39,549	34,317
Manure:—				
Guano..... Tons	2,162	3,722	10,713	32,030
Bones..... "	4,772	3,820	22,522	16,883
Paraffin..... Cwt.	56,269	20,552	80,312	32,060
Linen rags..... Tons	3,019	2,572	30,503	24,854
Esparto..... "	20,803	16,286	100,521	79,361
Palp of wood "	16,756	15,749	81,836	79,873
Rosin..... Cwt.	269,487	143,259	69,118	33,693
Tallow and stearin "	143,665	150,365	185,682	189,214
Tar..... Barrels	3,918	5,496	2,394	2,949
Wood:—				
Hewn..... Loads	236,281	228,457	442,356	429,672
Sawn..... "	569,518	635,532	1,156,335	1,327,778
Staves..... "	18,435	13,954	61,285	43,487
Mahogany..... Tons	4,362	2,972	40,288	17,067
Other articles.... Value £	..	..	930,785	873,408
Total value.....	..	..	3,963,939	3,685,785

Besides the above, drugs to the value of 57,100, were imported as against 77,767, in June 1891.

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 30TH JUNE.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Alkali..... Cwt.	7,549	7,356	£ 4,810	£ 4,973
Bark (tanners, &c.) "	53,948	34,048	27,190	13,920
Brimstone..... "	58,830	16,789	17,710	12,559
Chemicals..... Value £	..	..	124,153	123,926
Cochineal..... Cwt.	545	431	3,377	2,872
Cutch and gambier Tons	1,962	1,717	47,093	36,696
Dyes:—				
Aniline..... Value £	..	..	20,978	20,522
Alizarine..... "	..	..	31,239	16,464
Other..... "	..	..	2,587	264
Indigo..... Cwt.	1,467	960	23,902	16,191
Nitrate of soda.... "	169,224	91,863	74,515	35,587
Nitrate of potash. "	16,318	20,986	15,047	18,651
Valonia..... Tons	1,021	2,468	21,808	35,533
Other articles... Value £	..	..	185,490	139,522
Total value of chemicals	..	..	596,909	482,680

IMPORTS OF OILS FOR MONTH ENDING 30TH JUNE.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Cocoa-nut..... Cwt.	55,216	17,711	£ 81,654	£ 19,947
Olive..... Tons	1,958	2,315	78,837	84,131
Palm..... Cwt.	92,233	81,748	109,150	92,288
Petroleum..... Gall.	8,779,812	8,993,357	174,975	161,682
Seed..... Tons	1,401	986	36,769	25,928
Train, &c..... Tons	3,434	3,008	73,436	54,497
Turpentine..... Cwt.	27,117	35,823	38,195	39,734
Other articles .. Value £	..	..	63,150	63,776
Total value of oils ...	..	..	659,166	541,983

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 30TH JUNE.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Alkali..... Cwt.	519,834	390,425	£ 196,831	£ 150,956
Bleaching materials "	134,915	98,418	46,618	39,367
Chemical manures, Tons	28,738	28,287	177,313	165,484
Medicines..... Value £	..	..	88,906	74,641
Other articles ... "	..	..	251,346	216,880
Total value.....	..	..	761,104	647,328

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 30TH JUNE.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Brass..... Cwt.	9,795	10,471	£ 41,290	£ 41,347
Copper:—				
Unwrought..... „	60,915	81,233	169,993	200,158
Wrought..... „	27,798	24,697	90,526	75,561
Mixed metal.... „	25,311	13,971	71,234	35,255
Hardware..... Value £	..	..	208,558	183,988
Implements..... „	..	..	114,783	104,192
Iron and steel..... Tons	358,895	215,348	3,068,000	1,813,407
Lead..... „	5,252	4,857	73,734	58,296
Plated wares... Value £	..	..	31,079	21,288
Telegraph wires, &c. „	..	..	220,985	24,177
Tin..... Cwt.	7,581	10,354	36,410	51,651
Zinc..... „	15,057	14,673	15,032	13,427
Other articles.. Value £	..	..	80,970	76,203
Total value.....	..	..	4,225,591	2,698,953

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 30TH JUNE.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Gunpowder..... Lb.	1,404,500	732,300	£ 31,004	£ 19,378
Military stores.. Value £	..	..	87,510	72,987
Candles..... Lb.	1,309,100	1,376,900	28,615	25,817
Caoutchouc..... Value £	..	..	102,357	91,355
Cement..... Tons	62,785	39,048	124,510	71,880
Products of coal Value £	..	..	152,699	89,175
Earthenware... „	..	..	164,212	131,601
Stoneware..... „	..	..	15,342	13,343
Glass:—				
Plate..... Sq. Ft.	233,461	172,525	18,156	10,020
Flint..... Cwt.	8,801	9,845	20,604	20,908
Bottles..... „	69,772	62,413	30,547	30,099
Other kinds.... „	20,558	15,173	17,499	13,120
Leather:—				
Unwrought.... „	13,438	10,721	119,314	101,723
Wrought..... Value £	..	..	28,262	21,981
Seed oil..... Tons	5,533	4,937	125,975	97,200
Floorcloth..... Sq. Yds.	1,637,400	1,339,100	70,909	59,262
Painters' materials Val. £	..	..	143,646	143,437
Paper..... Cwt.	90,141	76,071	154,607	129,392
Rags..... Tons	5,234	4,361	35,968	30,147
Soap..... Cwt.	50,690	39,672	51,887	45,424
Total value.....	..	..	2,885,133	2,287,267

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

11,694. F. W. Scott, E. G. Scott, and F. W. Scott, jun. Improvements in or connected with evaporating apparatus. June 22.

11,704. H. E. Newton.—From E. A. Ashcroft and J. Howell, New South Wales. An improved mode of and apparatus for generating steam by the aid of molten slag from smelting and other furnaces. Complete Specification. June 22.

11,705. E. J. Barbier. Improvements in the method of and apparatus for distilling, separating, and concentrating acids of mixed liquids, and for treating substances in solution. June 22.

12,798. F. D. Marshall and E. Blum. Improvements in means or apparatus for effecting the turning or stirring of oxide of iron, lime, or other matters. July 12.

13,035. R. Haddan.—From W. Durr and A. Custodis, Germany. Improvements in means for measuring the density of gases and like purposes. July 15.

13,103. F. W. Scott, E. G. Scott, and F. W. Scott, jun. Improvements in or connected with evaporating or concentrating apparatus. July 16.

COMPLETE SPECIFICATIONS ACCEPTED.*

1891.

11,353. W. O. Taylor. The oxidising retort furnace. June 29.

11,640. A. G. Southby and F. D. Blyth. Apparatus for making ice, refrigerating, evaporating, and desiccating. July 6.

11,691. J. A. Burley.—From A. T. Lagniez. Apparatus for the automatic regulation of pressures and temperatures. July 20.

12,053. L. Damaze. Apparatus for measuring temperatures and pressures. July 6.

14,640. O. Intze. Gas-holders. July 6.

1892.

9538. H. Hirtzel. Still columns. June 29.

11,296. W. J. Mirrlees and D. Ballingall. Apparatus for evaporating, concentrating, and distilling liquids. July 20.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

11,465. W. D. A. Bost and T. F. Haldane. Improvements in the manufacture of fire-lighters. June 20.

11,504. L. Chapman. Improvements in and apparatus for obtaining oxygen and nitrogen from atmospheric air. June 20.

11,800. J. Scott and H. Darwen. An incombustible composition for "gas-fire" bodies and other articles. June 24.

11,809. S. Marcus and E. F. Bothe. Improvements in air and gas carburating apparatus. June 24.

11,910. J. T. Holmes. Improvements in fire-lighters. June 27.

12,387. A. V. Newton.—From A. Noble, France. Improvements in the production of oxygen gas. July 4.

12,390. S. Pitt.—From C. Heinzerling, Germany. Process for the separation and recovery of benzol, alcohol, ether, and other easily volatile substances from air or other gas. July 4.

12,421. W. Young and A. Bell. Improvements in the decomposition of mineral oils for the production of illuminating gas. July 5.

12,441. H. H. Lake.—From W. H. Harris, United States. Improvements relating to the manufacture of gas. July 5.

12,664. The Automatic Coal-Gas Retort Co., Lim. An improved apparatus for charging inclined gas retorts. July 9.

12,716. A. Noteman. An improved process of and apparatus for making heating and illuminating gas. Complete Specification. July 11.

12,762. E. A. Erb. Improvements in the combustion of carbonaceous fuel. Complete Specification. July 12.

12,781. D. Westlake. Improvements in the method of and materials for agglomerating small coal, peat, or other material for compression into blocks or briquettes. July 12.

12,924. The Northern Counties Hydro-Oxygen Gas Co., Lim., and P. B. W. Goble. Improvements in apparatus for manufacturing oil gas. July 14.

13,007. J. W. Armstrong. Improvements in apparatus for supplying fuel to gas producers. July 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

11,740. J. H. R. Dinsmore. Improvements in the manufacture of gas for illuminating and heating purposes, and in or connected with apparatus therefor. July 13.

15,552. R. Orr and R. M. Sutherland. See Class III.

1892.

15,69. J. Tennant, J. Tennant, and W. R. Tennant. Candles. July 20.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

15,287. L. Hugues. Apparatus for distillation of fatty acids and other substances. July 13.

15,552. R. Orr and R. M. Sutherland. Retorts for distilling shale and like minerals, and for dealing with the resulting products. July 13.

20,753. F. H. Pickles and R. H. Pickles. Purification of pyrolignites. July 6.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

7337A. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of alkylated naphthylamine sulpho acids. Filed June 20. Date claimed April 16, 1892.

11,502. J. R. Geigy. Production of yellow to orange colouring matters. June 20.

11,522. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of dihydroxynaphthalene sulpho acids. June 20.

11,533. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture of new colouring matters. Complete Specification. June 20.

11,865. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture and production of naphthalene sulpho acids. June 25.

11,876. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture and production of new basic colouring matters. June 25.

12,296. Read, Holliday and Sons, Lim., and J. Turner. Improvements in the production of azo colouring matters. July 2.

12,579. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture and production of anthra-quinone derivatives. July 7.

12,580. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture and production of new alizarin derivatives. July 7.

12,720. J. R. Geigy. Production of blue triphenylmethane colouring matters or dyes. July 11.

13,029. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture of blue mordant dyeing colouring matters. July 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

14,723. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Manufacture and production of new dyes related to the rhodamine series. June 29.

15,143. J. A. Hewitt.—From L. Cassella and Co. Manufacture of blue dyestuffs. July 13.

15,494. The Clayton Aniline Co., Lim., and J. Hall. Manufacture and production of colouring matters. June 29.

15,725. S. Pitt.—From L. Cassella and Co. Manufacture of colouring matters from amidonaphtholsulphonic acids. July 20.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

11,581. W. E. Heys.—From E. F. Dranez, H. P. J. Vassart, and J. H. S. M. Delattre, France. Improvements in the method of and apparatus for removing fatty matters and other impurities from wool and similar textile materials. June 21.

11,994. T. J. Hutchinson and R. B. Hardman. An improved process for the recovery of the cloth from damaged waterproofed fabrics. June 28.

13,008. F. Fleming. Improvements in linoleum or oilcloth, and in the manufacture of same. July 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

11,831. F. Lehner. Manufacture of artificial and mixed silk threads, and apparatus therefor. June 29.

12,679. F. V. M. Raabe. Manufacture of yarn from certain vegetable waste fibres. June 29.

12,681. W. E. Gedge.—From F. Mommer and Co. Process and apparatus for treating textile fibres in bobbins with a liquor. July 13.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

11,479. J. Grime. Improvements in vats for use in the dyeing of indigo blues. June 20.

11,529. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in dyeing and printing with azo dyestuffs. June 20.

11,914. W. Crippin and C. O. Weber. Improvements in the bleaching of cotton and other fibrous materials in the raw or manufactured or partly manufactured state. June 27.

11,915. W. Crippin and C. O. Weber. Improvements in the dyeing of alizarine red on cotton and other fibrous materials in the raw, manufactured, or partly manufactured state. June 27.

11,916. W. Crippin and C. O. Weber. Improvements in the dyeing of aniline black on cotton and other fibrous materials in the raw or manufactured or partly manufactured state. June 27.

12,921. Read, Holliday, and Sons, Limited, and H. Bind-schadler. Improvements in the production of an indigo vat or bath employed in the dyeing with indigo. July 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

13,955. W. J. S. Grawitz. Improvements in dyeing and printing textile fibres with aniline and its homologues or derivatives. June 29.

14,657. E. Gessler. Process and apparatus for the treatment of textile fibres with liquids and vapours or gases. July 6.

17,082. H. H. Lake.—From K. Oehler. Dyeing or printing woollen and other goods. July 20.

18,588. G. Young and W. Crippin. Construction of hollow perforated skewers employed for dyeing and otherwise treating cops of yarn or thread, and their arrangement in connexion with the parts on which they are to be used. July 6.

1892.

7555. C. Schnürcb. Method and apparatus for effecting the oxidation of aniline black in the process of dyeing cotton thread or wool on bobbins and cops. June 29.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

11,828. A. T. Hall and G. C. Robinson. Improvements in the treatment of waste liquors from metallurgical processes to obtain zinc or its compounds. June 24.

11,889. P. Römer. Improvements in the process for the production of potassium carbonate from potassium sulphate. June 25.

12,155. H. S. Ellworthy. Improvements in the manufacture of carbonic acid gas. June 30.

12,275. G. W. Sharp. Improvements in the manufacture of caustic soda or potash. July 2.

12,294. H. W. Wallis. Improvements in the manufacture of chlorine. July 2.

12,726. E. J. Barbier. Improvements in the manufacture of sulphuric acids. July 11.

12,878. H. W. Wallis. Improvements in the manufacture of chlorine. July 13.

12,884. E. Küchenmeister. Improvements in the manufacture of vinegar and in apparatus therefor. Complete Specification. July 13.

12,977. C. A. Burghardt. See Class XI.

12,985. J. H. Kidd. The manufacture of ferric-chloride from "waste products." July 15.

13,047. H. W. Wallis. Improvements in the manufacture of chlorine. July 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

16,512. R. E. Chatfield. Manufacture of nitric acid. July 20.

1892.

88. H. H. Lake.—From E. B. Cutton. Production of soda and chlorine and apparatus therefor. July 6.

89. H. H. Lake.—From E. B. Cutton. Production of liquid chlorine and apparatus therefor. July 6.

9884. W. P. Thompson.—From A. L. Lawton and W. S. Dodge. Manufacture of salt (chloride of sodium). June 29.

10,851. A. MacNab. Manufacture of bay salt. July 13.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

11,462. H. Lockwood. The manufacture of sewage sludge into bricks, pots, tiles, and drain pipes, and sanitary ware. June 20.

12,585. H. Forester. An improved mode or method of decorating china and earthenware articles. July 8.

12,939. H. Doulton and J. Slater. Improvements in treating vitreous substances for making metallic connexions thereto. July 14.

13,067. E. J. Tompkinson. Improvements in the manufacture or modes of making pottery articles. July 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

11,637. B. A. Spaul. Manufacture of glass bottles and the like, and apparatus therefor. July 6.

13,354. H. Lane and A. Chamberlain. Annealing furnaces. July 13.

14,918. J. P. Guy. Manufacture of earthenware articles, such as tiles and bricks, and machinery or apparatus therefor. July 13.

15,067. A. Cay. Manufacture of certain kinds of articles of glass, and machinery or apparatus to be employed in the said manufacture. July 6.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

11,765. W. Webster. Improved treatment of the solid deposit or sludge from sewage for the application thereof to the manufacture of cement and other purposes. June 23.

11,766. W. H. Talbot and C. H. Venning. A process for hardening and preserving natural and artificial stone and other like building material. June 23.

12,174. O. Terp. Improvements in the manufacture of artificial stone and hard compositions applicable to building and paving purposes, to moulds for cement castings, to safes, and to other articles and purposes. Complete Specification. June 30.

12,331. H. H. Lake. From L. Enricht, United States. An improved manufacture of artificial stone or cement. July 2.

12,332. H. H. Lake. From L. Enricht, United States. An improved manufacture of artificial stone or cement. July 2.

12,490. W. Smith. Improvements in the construction of fireproof floors. July 6.

12,512. J. Salkeld. Improvements in the construction of fireproof floors, ceilings, and other parts of buildings. July 6.

12,756. W. P. Thompson.—From La Societe Anonymes Constructions Economiques, Belgium. Improvements in the manufacture of artificial stone and other similar building materials. July 12.

12,913. H. Faija. An improved firebrick or compound. July 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

15,101. E. Lodge and F. Jury. A new or improved chemical treatment or application for cleaning stone, marble, granite, and the like. July 20.

15,509. G. Dolenz. Process for the manufacture of artificial stone and marble. July 13.

1892.

8292. G. M. Graham. Artificial stone blocks. July 20.

9332. A. J. Boulton.—From J. A. Chanter. Pavements. June 29.

10,196. P. A. H. Wehner. Manufacture of artificial wood. July 13.

11,170. G. W. Parker. Construction of floors, ceilings, and roofs of buildings; also applicable to the construction of side walks and pavements. July 20.

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

8612a. E. H. Saniter. Improvements in or relating to the purification of iron. Filed June 27. Date applied for January 21, 1892, being date of application in Belgium.

11,552. C. M. Pielsticker. Improvements in the method of extracting gold and silver from ores. June 21.

11,606. F. Siemens. An improvement in the manufacture of iron and steel. June 21.

11,662. T. I. Williams. Improvements in the tinning machine for coating metal plates or sheets with tin or other metal or alloy. June 22.

11,828. A. T. Hall and G. C. Robinson. See Class VII.

11,854. W. L. Wise.—From A. E. Woolf, United States. Improvements in separating metals from their ores and in apparatus therefor. June 25.

12,343. J. Nicholas. Improved means of extracting copper, gold, silver, and other metals from ores, &c. July 4.

12,491. J. David. Improvements in treating rich argentiferous blende and other ores. July 6.

12,492. J. David. Improvements in extracting silver and certain base metals from ores or compounds containing the same. July 6.

12,554. C. M. Pielsticker. Improvements in the extraction of gold and silver from ores. July 7.

12,641. J. C. Montgomerie. Improvements in the extraction of gold and silver from ores or compounds containing the same, and in apparatus applicable for use in the treatment of such materials by means of solvents. July 8.

12,719. H. J. Allison.—From P. A. Emanuel, United States. Process of making aluminium. July 11.

12,733. C. D. Abel.—From Wirth and Co., Germany. Process for the production of metallic antimony. July 11.

12,776. R. E. B. Crompton. Improvements in regulating temperatures in manufacturing metals, and in means or apparatus employed therein. July 12.

12,898. M. Hillas and R. Squire. Improvements in the method of and apparatus for hardening and tempering steel wire. July 14.

12,920. W. Wright and J. B. Hamond. Improvements in the treatment of zinc and other ores and in the recovery of by-products. July 14.

12,936. D. Earnshaw and C. C. Cooper. A new system of moulding for casting metals or any other compositions. July 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

11,177. E. Polte. Spinning metal. June 29.

13,354. H. Lane and A. Chamberlain. Annealing furnaces. July 13.

13,714. M. Mannaberg and J. Cliff. Construction of steel-making furnaces. July 6.

15,142. W. R. Lake.—From G. F. Simonds. Hardening and tempering steel, and apparatus therefor. July 13.

16,348. J. J. Shedlock and T. Denny. Process and apparatus for extraction of metals from ores. June 29.

19,992. S. Ward, W. Guest, and W. Miller. Manufacture of semi-divided bars of steel, and the like. July 6.

1892.

2498. S. H. Brown and M. McBarron. Annealing metals. July 13.

2583. J. Woodcock, J. Smith, W. M. Mackey. Preparing ores, oxides, and compounds of iron for smelting. July 20.

5651. H. H. Lake.—From H. F. Brown. Ore-roasting furnaces. July 6.

8834. E. W. Cooke. An alloy. July 6.

9522. J. E. Filassier and J. Fauré. Metallurgical furnaces for steel-making or cementation purposes. June 29.

9523. J. E. Filassier and J. Fauré. Manufacture of cast steel. June 29.

9859. J. C. Fraley. Process for rendering iron, steel, and similar metals homogeneous. June 29.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

11,532. W. A. Boese. Improvements in secondary or storage batteries. June 20.

11,835. E. J. Finot. Improvements in the process and apparatus for tanning hides and skins with electrolytic action. June 24.

12,306. J. B. Lee. Improvements in the construction of secondary batteries for electrical storage purposes. Complete Specification. July 2.

12,381. E. B. Bright and M. Bailey. Improvements in the manufacture of plates for storage batteries or accumulators and the accessories thereto. July 1.

12,731. Siemens Bros. and Co., Limited.—From Siemens and Halske, Germany. Improvements in electrolytic extraction of zinc. July 11.

12,977. C. A. Burghardt. Improvements in the electrolytic production of caustic soda or caustic potash. July 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

11,108. T. Coad. Electric primary batteries. July 6.

15,050. E. A. Le Soeur. Electrolysis. July 13.

15,407. G. Cohen. Galvanic batteries. July 20.

17,426. E. Andreoli. Apparatus for generating ozone by electricity. July 6.

1892.

6007. T. Parker and A. E. Robinson. Cells for electrolysing chloride solutions. July 20.

9346. C. Kellner. Apparatus for the production of chlorine and alkalis by electrolysis. July 20.

9347. C. Kellner. Process for the separation of the alkali obtained by electrolytical decomposition of halogen compounds from the electrolyte which has not been decomposed. July 20.

9379. G. D. Burton. Heating and working metal bars by electricity. July 6.

9380. G. D. Burton. Mechanism for converting electric currents, and method of applying the same to the working of metals. June 29.

9541. F. Schmalhaus. Electric accumulator or secondary battery. June 29.

10,850. H. Weymersch. Primary voltaic batteries. July 13.

11,147. H. H. Lloyd. Secondary or storage batteries. July 20.

11,154. W. P. Thompson.—From C. L. Coffin. Method of welding metals electrically. July 20.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

11,691. H. L. Sharp, jun., and J. R. Causton. Tasmanian oils. June 22.

12,974. G. D. Macdougald and J. Sturrock. Improved process or means for marking soap cakes or bars with an indelible colour. Complete Specification. July 14.

13,081. W. P. Thompson.—From F. Illawaty and A. Kanitz, Austria. Improvements in or relating to the manufacture of washing soap. Complete Specification. July 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

14,902. J. Cathrein. Method and means for manufacturing soap. July 20.

16,034. R. Hutchison. Manufacture of lubricants. July 13.

1892.

10,765. W. P. Thompson.—From W. B. Brittingham. Detergent compounds. July 13.

XIII.—PAINTS, PIGMENTS VARNISHES, AND RESINS.

APPLICATIONS.

11,937. R. Michell. The manufacture of anti-fouling and non-corrosive composition paint. June 27.

12,175. O. Terp. Improvements in enamel paints for resisting damp, fire, and atmospheric influences, and in imitation mosaic and other articles made therewith. Complete Specification. June 30.

12,447. T. H. Copley. Improvements in the manufacture of metallic lead paint, lead colours, and other lead products from ores and substances containing lead. July 5.

15,518. A. J. Boulton.—From R. Lelièvre, France. An improved compound for cleaning wood-work, removing paint, or the like. July 6.

12,631. T. S. Lemon. Improvements in the manufacture of india-rubber and substitutes for india-rubber for insulating and other purposes. July 8.

12,728. P. Lehmann. Improvements relating to compounds suitable as protective coatings or paints for iron and steel. Complete Specification. July 11.

12,732. L. Pflug. Improvements in protective paints or compositions for ships. July 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

10,822. C. N. Jackson. A compound preparation to be used as a substitute for gutta-percha and similar products for insulating and waterproofing purposes. June 29.

12,895. A. Gutensohn. Method and appliances for the production of litharge from metallic lead. July 6.

1892.

9135. F. D. Mott. An elastic or resilient covering for ships' bottoms. June 29.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATION.

11,521. L. Munk. New or improved manufacture of material suitable for use as a substitute for whalebone. June 20.

COMPLETE SPECIFICATION ACCEPTED.

1892.

9889. L. Thery. Manufacture of artificial chamois leather. June 29.

XV.—AGRICULTURE AND MANURES.

APPLICATION.

12,432. J. T. Knowles. — From L. Baroni and P. Marchand, Italy. A composition for fixing ammoniacal nitrogen used in agriculture. Complete Specification. July 5.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

11,972. W. Hannah and F. Curtis. Improvements in the method of manufacturing sugar into cubes or other forms, and in means or apparatus to be employed therein. June 28.

12,586. T. Bayley. Improvements in the manufacture of dextrin. July 8.

COMPLETE SPECIFICATION ACCEPTED.

1891.

14,575. A. Schneller and W. J. Wisse. Refining sugar juice or molasses. July 20.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

11,481. D. H. Croll. Improvements in brewing. June 20.

11,604. G. E. Jaquemain. Improvements in and relating to the manufacture of beer. June 21.

11,638. R. C. Scott. Improvements in treating or ageing spirit. June 21.

11,784. F. Chavauty. New or improved manufacture of grape and other fruit wine. June 23.

12,214. J. Mosler, M. Schaffer, and A. Sachs. A process for the production of sugar-colour from brewery and distillery refuse. Complete Specification. July 1.

12,413. B. J. B. Mills. — From The Universal Carbonating Co., United States. Improvements in methods and apparatus for carbonating beer. Complete Specification. July 5.

12,645. R. H. Leaker. Improved apparatus for aerating and cooling wort. July 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

13,729. O. Perrier. Distilling and rectifying alcohol or other liquids, and apparatus employed therein. July 13.

14,658. F. J. Money. Malt mashing apparatus. July 6.

15,467. S. A. Croxford. Method and apparatus for straining brewers' wort. July 13.

1892.

6555. G. M. Johnson and E. de Cock. Method of treating beer for improving its qualities and colour. June 29.

8290. H. Gehrke. Apparatus for filtering beer and other alcoholic and gaseous liquids. July 13.

9538. H. Hürzel. Still columns. June 29.

10,305. B. J. B. Mills. — From The Universal Carbonating Co. Apparatus for impregnating beer with carbonic acid. July 6.

10,442. W. P. Thompson. — From L. Schmied. Manufacture of colouring malt. July 6.

10,496. J. Barton. Method and apparatus for mashing and brewing ale, beer, wines, and other fermented liquors. July 6.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

11,988. J. Y. Johnson. — From H. Salzer, United States. Improvements in means for preserving meat and the like. Complete Specification. June 28.

12,632. A. Bernstein. Improvements in the treatment of milk. July 8.

B.—Sanitary Chemistry.

11,462. H. Lockwood. See Class VIII.

11,724. J. W. Lodge. An improved complete continuous and automatic process and means to be employed in drying, absorbing, deodorising, pulverising, separating, storing, bagging, and weighing wet pulpy and pasty manure as produced and prepared by mixing, grinding, and blending together human and animal excreta and urine, animal garbage, market and town refuse, spent bark, spent dye-woods, stable litter, sewage sludge, and other refuse. June 23.

11,765. W. Webster. See Class IX.

11,989. C. G. Collins. An improved process of purifying water. Complete Specification. June 28.

12,268. S. H. Johnson and C. C. Hutchinson. Improvements in the preparation of sewage sludge for pressing. July 2.

C.—Disinfectants.

12,392. A. S. Chinnock, W. Fairley, C. E. McLaren, and P. Meeks. A new compound suitable for the purification of sewage and other polluted liquors. July 4.

12,433. E. O. Storr. New medical compound for disinfecting and fumigating purposes. July 5. Post-dated 1st March and re-numbered 12,433.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1891.

13,212. D. Tallerman. Preparation of cattle foods. June 29.

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ERRATUM IN BALLOT LIST.

Mr. A. Gordon Salamon was erroneously described as a "Consulting Gas Chemist," it should have been "Consulting Brewers' Chemist."

Communication.

NOTES ON THE ASSAY OF TIN ORES, CONCENTRATES, &c., WITH SPECIAL REFERENCE TO THE REDUCTION OF "BLACK TIN" BY POTASSIUM CYANIDE.

BY HORACE W. RENNIE AND W. H. DERRICK.

As is well known the assay of tin ores either by the wet or dry process offers peculiar difficulties arising from (1) the absolute insolubility of the only commercial ore of tin, viz., cassiterite; (2) the peculiar similarity of this mineral to many others frequently associated with it; (3) the volatility of metallic tin when in a state of fusion, and at the same time its affinity for silica, which is almost invariably present in the ores from which the metal has to be reduced.

The simplest, and at the same time almost universal, method of valuing tin ores in the rough state, is by the use of the vanning shovel. This method is based upon the fact that cassiterite is of very high specific gravity, and taking advantage of this, the operator is enabled, on the vanning shovel, by operations purely mechanical, to wash away the lighter minerals and so leave the cassiterite more or less pure and in a state fit for weighing.

Where the percentage of cassiterite is the object sought, we have proved that this process, when carefully conducted, is capable of giving most accurate and concordant results, as in our experiments on the subject we have almost invariably been able to get independent results differing at most by a fractional part of a grain per cent. As tin ores are invariably valued by the percentage of contained free cassiterite, this process is well adapted to the purpose. The weak points are, that being a mechanical process, it is too dependent not only upon the dexterity and skill, but the judgment and impartiality of the operator, whilst, at the same time, even although the correct percentage of cassiterite may be found, the crystals of cassiterite obtained vary in their purity, some containing considerable proportions of iron and silica; thus, even a thoroughly accurate estimation of the cassiterite in an ore by this process gives but an approximate estimate of the true percentage of metallic tin.

When it is necessary, as, for instance, in a smelting works, to assay concentrated ores for the contained metallic tin, various methods are adopted, perhaps the oldest and best known being the Cornish process, a very good description of which has been given by Mr. A. K. Barnett in Beringer's Manual of Assaying.

In this process the metal is reduced from the ore by fusion in a crucible with from one-sixth to one-fifth its weight of powdered anthracite, a high temperature being used. The bulk of the tin collects into a button, while at the same time there remain numberless prills, mixed with the unconsumed anthracite and fixed to the side of the crucible. These prills are collected on the vanning shovel, added to the main button, and the whole subjected to a process of refining, by melting at as low a temperature as possible in an iron ladle and recasting in a mould; this last detail is necessary, owing to the fact that a portion of iron is reduced with the tin, no precaution being taken to separate iron and other impurities in the oxide chemically, before reducing. This process has many inherent weak points, the chief being the extreme difficulty of collecting all the prills, the loss of tin by volatilisation in reducing (there being no appreciable amount of slag formed to act as a protecting cover), and the oxidation while refining.

In spite of these drawbacks, this process is capable in skilled hands of affording results of a fair approximation to accuracy, more especially when modified as in some of our experiments to be described later on.

On referring to the various handbooks of assaying which have been published during the last 30 or 40 years, it is rather

surprising to find how little attention seems to have been given to the subject of tin. For anything approaching to accurate results the only resource was a somewhat complicated *wet assay*. The three favourite methods of performing this being (1) by disintegration of a weighed portion of the ore by fusion with caustic potash in a silver crucible (solution of the meta-stannate of potash formed and separation of the tin by one of the ordinary reactions); (2) by reduction of the oxide in a current of hydrogen at red heat; (3) by fusion of the ore with six times its weight of a mixture of potassium carbonate and sulphur in a carefully closed crucible at a high temperature; solution of the sulphides of tin and potash formed in water (the sulphides of iron, copper, lead, &c., remaining as insoluble residues); precipitation by HCl of the tin as sulphide, which is then collected, dried, and converted into binoxide by a slow and very careful oxidation in a porcelain crucible over a blow-pipe lamp, or in the muffle. Of these three methods the last will give with care most accurate results, the drawbacks being (1) that only a small portion of the ore can be used, viz., 7 to 10 grains, with which weight it is impossible to get a fair sample; (2) that it is by no means an easy process and at the same time is a somewhat lengthy operation. It is, however, a most useful process when a complete analysis of the ore has to be made, as all the metals present are obtained in a state favouring easy separation and estimation. The following analyses were made by us by this process for the purpose of ascertaining the impurities present in a sample of commercial oxide of tin:—

I.

Stannic oxide*	90.00
Ferric oxide.....	7.30
Silica.....	2.70
	<hr/>
	100.00

* = Metallic tin 70.92 per cent.

II.

Stannic oxide*	89.75
Ferric oxide.....	8.80
Silica.....	1.45
	<hr/>
	100.00

* = Metallic tin 70.70 per cent.

A direct estimation of the metallic tin in this ore by reduction with KCy (as described later on) gave 70.75 per cent. tin, as compared with 70.81 per cent., the mean of the two above experiments.

We now come to the process with which this paper is chiefly concerned, viz., the dry assay of tin ores by reduction with potassium cyanide.

This method was brought into notice by Mitchell, in his celebrated manual of assaying, and his formula, simple and somewhat vague as it is, has been copied in almost every modern treatise on assaying.

This formula as usually given, runs as follows:—Ram into the bottom of a 3 oz. crucible a $\frac{1}{2}$ -in. layer of KCy, add the charge consisting of 100 grains of ore mixed with four to five times its weight of powdered KCy, heat at a moderate temperature for 10 minutes, remove the crucible, tap it gently, and when cool extract the button of tin from it.

At first sight this appears delightfully simple, but its very simplicity leaves many open points where serious errors may and will creep in. For although it is well known that tin is easily reduced from its oxide by fusion with KCy, so also are many other metals, including copper, iron, lead, zinc, and antimony, and as most ores of tin except the very purest contain some or all of these associated metals, so certainly will the tin reduced from such ores by the foregoing process be contaminated with these metals. And again, in describing his process Mitchell gives no special precaution as to the KCy used, whereas this is a most important point, there being so many grades of KCy

differing so greatly in their relative purities and reducing powers, that the selection of a suitable quality demands careful consideration.

A good deal of light was thrown upon this method of assaying by Professor H. O. Hofman in his articles on the Dry Assay of Tin Ores which appeared in the *Technology Quarterly*, 3, 112—143, and 3, 261—280 (see this Journal, 1890, 899 and 1154). These articles were evidently the result of long and careful research, and made clear many points which had previously been uninvestigated. The results of his experiments as to the reduction of tin from its ores by KCy under all sorts of varying conditions are very instructive—(1) especially with regard to differences of temperature during the assays; (2) the effect upon the assay of various impurities likely to be found in the ore; (3) the effect of impurities so often existing in the various samples of cyanide.

In our early experience we carefully worked out the various points brought forward by Hofman, and derived very great assistance from his suggestions, but we were gradually forced to the opinion that there was still much to be learned on this subject. This being so, we decided to make an exhaustive series of experiments, and believe we have so far eliminated the possible sources of error from this method of assaying as to render it possible to obtain results thereby, rivalling in accuracy such as might be obtained by a wet assay. Before actually detailing any of our own experiments we wish to draw attention to a few apparently inconsistent statements made by Hofman in the earlier portions of his papers. For instance, in describing the nature of the ores upon which his experiments were made, he says: "The cassiterite occurring in the Black Hills tin ore is quite pure, as is shown by the following analysis:—

Stream tin from Nigger Hill..	92.6 per cent. SnO_2
" " " " " "	93.0 " "
" " Southern Hill	92.8 " "

Now the average of these analyses is 92.8 per cent., thus leaving a margin of 7.2 per cent. of impurities. This seems hardly to agree with the assertion that the ores were *quite pure*. Judging from samples of stream tin we have examined we should consider the above percentage to indicate a somewhat low quality for *stream tin*. The various samples of stream tin which have come under our notice show an average of about 96.4 per cent. of SnO_2 , whilst one sample in particular which was taken in the rough by one of the writers from a bed only a few yards distant from the laboratory and panned out in an ordinary prospecting dish, showed after a careful duplicate assay 78.5 per cent. of metallic tin = 99.62 per cent. SnO_2 . This specimen consisted of large clear crystals of cassiterite which ground up to a pale buff-coloured powder, and might fairly be described as *practically pure*.

Hofman says that he used stream tin from the Nigger Hill as a basis for his experiments, and gives a long account of his elaborate method of purification before reduction, including "careful and gradual pulverisation, calcination, &c., washing in boiling aqua regia (the latter, as he says, to remove all soluble metallic compounds, iron, &c.), the ore being then washed with hot water and panned out irrespective of loss of fine tin which floated off with the tailings, giving them a chocolate brown colour,* after which the only impurities visible under the microscope were a few particles of garnet and quartz. This was followed by further pulverisation and sampling." The purified residue thus obtained he used in all the reductions he goes on to describe. He gives the result of an analysis of this concentrated sample as follows:—

	Per Cent.
SnO_2	86.24
Fe_2O_3	2.42
Mn_2O_3 , CaO , MgO	1.16
Insoluble.....	9.39

* Italics are our own.

The percentage of oxide thus shown is = 67·84 of metallic tin. A careful study of these details as given by Hofman reveals some apparent contradictions. For instance, after first pulverising and roasting the ore, he boiled in aqua regia and panned out the residue, remarking that the panning was carried on irrespective of the loss of some fine tin which floated off with the tailings, giving them a chocolate brown colour. Now we have examined some hundreds of samples of tin ore of every possible variety, and never once have we found that after pulverising and boiling in aqua regia, was there a residue of chocolate-brown colour, much less any tin of this colour. We have always found that oxide of tin after being freed from its coating of iron by washing with acids is of a colour varying from white to a pale buff, and we have no hesitation in giving our opinion that if there was any residue of a chocolate-brown colour it must have been due to compounds of iron which had not been properly dissolved out. We have never had the slightest difficulty, no matter how impure the original black tin, in obtaining a residue after pulverising and dissolving in aqua regia, consisting chiefly of SnO_2 and SiO_2 with traces of other insoluble minerals, the whole being entirely free from anything approaching a brown or red colour; and further, we easily succeeded by a short treatment on the vanning shovel in getting rid of the associated impurities and obtaining a residue of very nearly pure SnO_2 of creamy white colour, and this without the slightest appreciable loss of tin.

Another strange point is that the main object of Hoffman's experiments was, as he says, to discover the best method of estimating the tin in tin ores by the dry process: and yet, as we have remarked, he, in describing his mere preliminary treatment of even a favourable specimen of ore, has to admit that he loses tin before he can get it in a state suitable for the assay proper. This of course would entirely neutralise the practical value of any subsequent reductions however accurate.

As a prelude to a description of our own experiments we may remark that they were made in the laboratories of some of the largest mining companies in the Malay Peninsula, where although we often lacked the refinements of elaborate apparatus, &c., which are of course unobtainable in a place so far away from civilisation: we had the advantage of a close acquaintance with ores of tin of every imaginable description, both free and combined in all proportions with other minerals and averaging in produce from mere traces to almost cent. per cent.

The work which is necessary with the ores found in these mines is two kind, viz.: (1.) The assay and valuation of lode stuff, crude ores, &c., for purely local purposes, such as testing the produce of the various lodes, the payment of tributors, checking the battery returns, &c.; and (2) the assay of the dressed ores when ready for the market.

For the first of these purposes a knowledge of the percentage of oxide of tin contained in the various samples is all that is required. To obtain this there is no method which for rapidity and accuracy can at all compare with vanning on the shovel when proper precautions are used. Real skill in the use of the vanning shovel can only be acquired by long and careful practice and no amount of theoretical instruction is of much avail. The process has often been described and the best description with which we have met will be found in Beringer's Text-Book of Assaying in the chapter on "Tin." Vanning is much more difficult than panning with the gold pan, but at the same time we have proved most conclusively that for the above purpose it gives far better results. We may remark that contrary to the usual practice we always carefully pulverised our samples before vanning sufficiently fine to pass a 60 sieve, or even for ores in which the tin is low in quality and intimately associated with iron, a 90 sieve, the only exception being in cases where it is required to estimate simply the proportion of *free* cassiterite. We have examined a very large number of tin ore samples by this process and have found results to be entirely concordant and satisfactory. One great advantage is that this method is applicable to ores of every grade, the only variation

being that we used 200 grains with ores up to about 30 per cent. and 100 grains when the ores are richer than this.

For the second object, viz. the valuation of the commercial oxide of tin, it is necessary to estimate the percentage of contained metal. Having already pointed out the impracticability of wet assays for this purpose, the only resource is the dry process, and it was on finding the unsatisfactory nature of the various dry processes as commonly performed that led, as we have before mentioned, to our undertaking the lengthy series of experiments of which this paper is the outcome.

Leaving out of consideration the Cornish process of assay and its modifications on account of its many drawbacks (as mentioned in the early part of this paper), we now propose to give a description of our experiments in connection with the KCy assay.

1. Method as described by Mitchell:—

In this 100 grains of the dried and pulverised oxide were taken and mixed with 500 grains KCy and introduced into a London crucible of suitable size, into the bottom of which a layer of KCy had been previously rammed. A covering of about 50 grains KCy was put on top and a close-fitting crucible cover over all. The whole was then fused in the wind furnace, allowing 10 to 12 minutes of full red heat from the commencement of fusion, the button of tin obtained being weighed when cool. A few of the results thus obtained are shown in the following table:—

TABLE NO. 1.

	Grains obtained.	Per Cent.		Grains obtained.	Per Cent.
1	53·7	53·7	7	66·2	66·2
2	62·7	62·7	8	70·0	70·0
3	67·5	67·5	9	57·8	57·8
4	61·0	61·0	10	62·7	62·7
5	57·0	57·0	11	57·0	57·0
6	66·2	66·2	12	55·0	55·0

The samples Nos. 1 to 8 in this table were a high quality oxide with an average percentage of tin as found by wet assay of about 69½ per cent.; the samples 9 to 12 were oxides containing rather more iron and silica with an average percentage as shown by wet assay of about 66 per cent. It is at once seen that besides being generally much too low the assays varied in the most extraordinary manner among themselves, the latter fact being partly explained when we remember that the samples contained all the original iron and silica of the ores. It is well known on the one hand that iron when present is reduced with the tin by KCy, the amount so reduced being directly proportioned to the temperature used in the assay; on the other hand silica, which has a great affinity for tin, tends to form silicates of tin and potash, which enter into the slag; thus we see that there is iron tending to increase the apparent percentage of tin and silica tending to decrease it.

At a low temperature the silica prevents the reduction of some of the tin, and on increasing the temperature to obviate this, iron begins to be reduced with the tin, so that, plainly, unless it were possible so to proportion the amount of silica present with the iron as to be exactly sufficient to form a neutral slag of silicate of iron, and at the same time to judge the temperature so exactly that the silica would tend to combine with the iron and not with the tin, there must still by this process be inconcordant results varying from accuracy according to the impurities present, and from one another according to the temperature used.

In order to obviate these difficulties, the process was modified as follows:—

250 grains of a carefully pulverised sample having been boiled for half an hour with 3 oz. HCl and ½ oz. HNO₃, the residue is allowed to settle, the acid decanted

off, and the oxide again washed by careful decantation with water; the residue thus obtained is of a light buff colour, and is entirely freed from oxide of iron, pyrites, manganese, and other metals; wolfram, if present, is easily dissolved out by NH_4HO . To get rid of the silica, the oxide is washed out on to a vannig shovel previously wetted to prevent particles of the fine tin from floating, and then using a very small quantity of water, a quick circular motion is given to the shovel, gradually slowing down until the whole of the oxide is seen to be collected into the centre of the shovel; the silica present is then found as a pure white powder on top of the tin, from which it is easily distinguished by its difference of tint. The silica is easily and neatly got rid of, in one operation, by altering the motion of the shovel so as to cause the water gently to carry the lighter silica to one side, and so off the edge of the shovel, and this is effected without disturbing the heavy oxide of tin in the least.

The resulting purified oxide is dried on the shovel, brushed into a water-glass, and weighed, and the percentage noted.

A hundred grains of this oxide is then taken (in duplicate for safety) and reduced with KCy as described in the previous process. By multiplying the weight of the button of tin obtained by the percentage of clean oxide already found, the actual percentage of tin in the ore is indicated. A few of the results obtained by this modified process are shown in Table No. 2:—

TABLE NO. 2.

—	Percentage of Cleaned Oxide obtained.	Percentage of Metal found in Clean Oxide.	Actual Per- centage of Metal in the Ore.
7	87.9	71.7	63.0
8	92.1	70.0	64.5
9	92.0	72.0	66.2
10	82.7	72.0	59.5
11	88.4	73.0	64.5
12	56.7	70.6	40.0

In the foregoing table Nos. 7, 8, 9 were high quality black tin, 10 and 11 a coarser quality with more iron, and No. 12 a partly dressed oxide very coarse and impure.

It will be seen that, taking the cleaned oxide as a basis, the percentage of tin obtained from it in Nos. 7, 9, 10, and 11 was fairly close, and that the actual percentage of tin thus indicated in the ore, as shown in the third column, varied directly with the percentage of clean oxide as shown in column 1. These assays, however, were still much too low as regards the actual percentage of tin in the ore, but at the same time they were very useful as giving a foothold for further research.

The buttons of metal were found to be very different to those obtained by the first process, being very soft, silvery and malleable, and entirely free from any impurity.

It was further found that the cleaning of the oxide on the shovel as described did not involve the slightest loss of tin, as the washings on being collected were found to be entirely free from any trace of SnO_2 .

In the next method tried, the sample was prepared and cleaned as just described, and reduced in a similar manner with KCy, using at the same time an admixture of 5 grains powdered charcoal, the idea being, if possible, to increase the reducing power.

It was noticed that during fusion of the charges, considerable effervescence took place, and the charges had a tendency to boil over the sides of the pot, necessitating a very careful and somewhat slow fusion. Table No. 3 shows some results obtained in this manner.

TABLE NO. 3.

—	Percentage of cleaned Oxide obtained.	Percentage of Metal found in cleaned Oxide.	Actual Per- centage of Metal in the Ore.
13	92.1	72.1	65.40
14	{ 91.9 91.9	{ 72.3 72.3	{ 66.44 R* 66.44 D†
15	{ 91.4 91.4	{ 72.7 72.6	{ 66.45 R 66.36 D
16	{ 91.6 91.6	{ 73.1 72.5	{ 67.23 R 66.41 D
17	{ 92.7 92.8	{ 73.2 73.1	{ 67.85 R 67.84 D
18	{ 93.6 93.3	{ 73.0 73.5	{ 68.33 R 68.58 D
19	{ 92.0 92.5 92.5	{ 74.0 73.5 74.5	{ 68.08 R 67.99 R 67.99 D
20	83.4	72.5	60.46 R
21	{ 87.0 87.0	{ 72.5 72.6	{ 63.07 R 63.16 D
22	{ 86.4 86.4	{ 72.6 72.6	{ 62.73 R 62.73 D
23	87.0	72.5	63.51 R
24	{ 89.6 .. 87.0 ..	{ 72.7 73.0 72.7 72.2	{ 63.00 R .. 63.03 D

* "R" H. W. Rennie.

† "D" W. H. Derrick.

In the above table Nos. 13 to 19 were samples of high class black tin similar to those previously referred to, while Nos. 21 to 24 were of a similar character to the lower quality oxide also previously mentioned. Each number represents a separate individual sample of ore, and the chief thing this table shows is the remarkable uniformity in the percentage of metal found in the cleaned oxide, showing conclusively that the process we use for cleaning the samples before reduction leaves in all cases a cleaned residue of uniform quality. It will be noticed here, as in Table No. 2, that the actual percentage of metal in the ore varies directly with the amount of cleaned oxide obtained. In spite, however, of the closeness of the percentages of tin thus indicated in the cleaned oxide as obtained from the various samples we could not but feel sure that there was a loss of tin in each case, although it was plainly an uniform loss. The average percentage of metal found in the cleaned oxides was 72.8, whereas taking chemically pure SnO_2 at 78.8 per cent. tin we concluded that our cleaned oxide *ought* to show from 76.5 to 77 per cent. of tin. This too was borne out by a chemical analysis.

The close agreement of our results among themselves (as evidenced by column 2), together with our minutely careful method of working, prohibited us from believing that the lowness of the results could be due to any error in the manipulation, and as a last resource we were forced to throw the blame on our materials.

First of all we often noticed that the rough sides of the London crucibles we used were very apt to retain large numbers of minute prills of tin which were thus prevented from joining the button, and were as a rule too fine to attempt to collect; secondly we had doubts as to the efficiency of the KCy we had been using, although it had been supplied by

a first class wholesale house as pure pulverised cyanide of potassium. A chemical examination of this *pure* cyanide revealed the fact that it consisted largely of carbonate of potash, together with some cyanide, being however free from sulphates. The actual percentage of free cyanide present was roughly determined by titrating a solution of the sample with an ammoniacal solution of copper and comparing it with a standard solution of pure crystallised cyanide. We were somewhat astonished to find that the percentage of effective cyanide present, as shown by a duplicate assay, was under 50 per cent.

This of course explained matters, and we at once took steps to obtain a supply of pure cyanide (guaranteed 98 per cent.). In our first experiments with this we proceeded in a similar manner to the last described method, only using the new pure cyanide in place of the old—with a little charcoal added as before. The following table (No. 4) shows a few of the results thus obtained:—

TABLE No. 4.

—	Percentage of Cleaned Oxide obtained.	Percentage of Metal found in Cleaned Oxide.	Actual Per- centage of Metal in the Ore.
25	89.16	76.20	67.91 R
		76.14	67.89 R
	89.30	75.80	67.69 D
		76.00	67.87 D

The above assays were all on one sample of medium quality ore, each of the writers working in duplicate.

It is worthy of notice that in the first two assays the oxide was cleaned somewhat more thoroughly, thus giving a rather lower percentage of cleaned oxide, proportionately richer in tin, than the two assays shown last, the *ultimate* actual percentage of tin in the ore being practically identical. The average percentage of tin found in the cleaned oxide was 76.04, an increase of 3.24 per cent. on the last table.

We may note that we were here still using the London crucibles and reducing in a wind furnace, and our next advance was to try and obviate some of the disadvantages thus involved. (1.) Such as the tendency of the rough pots to retain tin. (2.) The difficulty of judging the temperature in the furnace. (3.) The dust of the fire. (4.) The risk of the crucibles upsetting, and so, if possible, to obtain better results still. To this end we discarded the rough London crucibles, and the use of the wind furnace, the method we adopted being as follows:—Having first cleaned the ore as in our former experiments we took a small, fine-grained clay crucible (such as is sometimes used for scorifying silver ores with lead in an open furnace), the crucible being about 3 in. high and 2½ in. in diameter; into the bottom of this we rammed a layer of *dried* pulverised cyanide, then introduced the charge of 50 grains of the cleaned oxide, mixed with 300 grains of pure dried KCy, a covering of dry KCy being placed on top while the addition of charcoal was discarded as unnecessary. The pot was closely covered and introduced into a muffle previously heated to redness. The charge soon fusing the crucible was kept at a cherry-red heat for 10 minutes, then slightly shaken, to wash down any prills of tin which might be adhering to the sides of the crucible, and the heat increased to a bright red for another five minutes, making a total of 15 minutes from time of complete fusion. The pot was allowed to cool and the button of tin extracted and weighed. The result of a few of the assays done in this manner are shown in Table 5.

In this table Nos. 26 to 31 were samples of high quality black tin, Nos. 32 to 38 medium quality ore, the impurities being chiefly iron, silica, and various insoluble silicates, while No. 39 was a specimen which has been previously referred to, of perfectly clean crystals of stream tin cassiterite.

TABLE No. 5.

—	Percentage of Cleaned Oxide obtained.	Percentage of Metal found in Cleaned Oxide.	Actual Per- centage of Metal in the Ore.
26	{	94.90	72.12 R
		94.70	72.35 D
27	{	94.30	72.05 D
		94.30	72.05 R
28	{	95.10	70.76 R
29	{	91.70	69.69 R
		91.20	69.31 D
30	{	91.60	70.53 R
		91.60	70.53 D
31	{	90.00	68.85 R
32	{	89.16	68.12 D*
33	{	89.00	68.32 R
		75.8	68.15 D
34	{	89.60	69.00 R
		77.0	69.00 D
35	{	88.25	68.13 R
		88.50	68.00 D
36	{	88.80	68.20 R
37	{	73.20	55.92 R
		73.50	55.86 D
38	{	75.50	58.93 R
		75.80	58.21 D
39	{	100.00	78.50 R
		100.00	78.50 D

* Same sample as No. 25.

This method fulfilled our best anticipations and proved to be wonderfully simple to manipulate, the charges being small, the heat easy to regulate, with a total freedom from dust and dirt. A few of the results are somewhat lower than others, and it was always found in such cases either that the heat had been too great and so caused bubbling, or too low, in which latter case the small globule of hard green slag, which is always formed by the combination with potash of the traces of silica invariably present in the oxide, however clean, had remained mixed with innumerable small prills of metal and so prevented a clean button from forming. It was found on the other hand that the best results were obtained when the heat had been just sufficient to cause this green slag to collect into a globule and rise to the surface of the fused charge, and yet not so high as to cause any loss by boiling. The average percentage of tin found in the cleaned oxides (the true test of the efficiency of the process) was 76.31, being 27 per cent. higher than that indicated by the previous table, and on taking six of the most favourable results we find an average of 77.03; and on calculating the actual percentage of tin in the ores by multiplying this figure with the percentage of cleaned oxide found, the results shown are strictly accurate, agreeing exactly with the chemical analysis of the ore. Further proof of the fact that there is no loss of tin by this process is given by the two assays of sample No. 39. This was a cassiterite as perfectly pure as possible, the only foreign matter present being a small trace of silica.

The duplicate assays we made on this for our own satisfaction give as shown 78.5 per cent. of metallic tin, absolutely pure, and taking chemically pure SnO_2 at 78.8 per cent., we have a margin allowing for the trace of silica present and any loss in manipulation, of only 0.3 per cent.

This we consider to be proof positive of the value of our process, and we doubt if any other known dry assay save the dry assay of gold by cupellation is capable of affording equally trustworthy results. We have recently had occasion to make a very large number of assays by this process and have always found it most satisfactory.

Before closing this paper we think it would be useful to draw attention to a few details of manipulation which are so essential that we have adopted them as maxims to be carefully observed in order to obtain the best results.

Make certain that the KCy is pure and use it finely powdered and thoroughly dry, taking care also that the ore, the spatula used, the paper on which the charge is mixed, and the crucible itself, are also all quite dry, to ensure which it is advisable to somewhat heat them.

Avoid crucibles with a rough interior surface.

With regard to temperature of assay introduce the crucibles into the muffle when at a red heat, so that the charges shall fuse quickly. From time of fusion leave for about 10 minutes, shake the pots gently in order to wash down any prills adhering to the sides, then increase heat for further five minutes in order to cause the globule of silicious slag to separate from the metal and rise to the surface. As soon as this is seen to be the case withdraw the crucibles.

When the crucibles have so far cooled that the whole contents have solidified, remove covers and fill up gradually with hot water. The pure white alkaline slag dissolves very readily when treated in this manner, leaving the button of tin at the bottom, of a silvery white colour, perfectly clean, and ready for weighing. A further advantage of this method of extracting the button is, that should there be any prills of tin, they are left in a state favourable for easy collection.

In closing, we may remark that this process is also well adapted to the assay of lead ores, whether sulphides, oxides, or carbonates, and in experiments on such we have ourselves recently made, with slight modifications of the process, we have found it to give most excellent results.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

The Production of the Spheroidal State in Boilers.
A. Witz. *Compt. Rend.* **114**, 1892, 411—414.

Among the suggested causes of boiler explosions, there is one which is based on the peculiar phenomena discovered by Leidenfrost and called by Boutigny the spheroidal state. This is frequently put forward as an explanation of boiler explosions which occur when the level of the water within a boiler has been allowed to fall below its normal height. It is assumed that when the bottom of the boiler has been allowed to get red hot, the water remains in the spheroidal state and there is scarcely any production of steam; but that as soon as the temperature of the metal falls below 170° C., the water again comes into actual contact with it, an enormous quantity of steam is generated, and an explosion results. On these assumptions the commonly accepted theory (Boutigny's) is based. It has been accepted without discussion and it appears to be confirmed by certain well-known lecture experiments. Thus a miniature boiler explosion can be produced in a small copper flask, the end of the spheroidal state being marked by the blowing out of a cork. But it has never been proved that the same actions take place on a large scale where the volume of water is considerable and its mass great in comparison with that of the metal. In order to submit this to the test of experiment, the author began by determining the rate of evaporation under the conditions of the classical lecture experiment, before and after the spheroidal state.

The experiments were carried on in a large iron spoon, heated at first in a mercury bath and finally over a naked flame. In each experiment 40 grms. of water were introduced and the time required for its complete evaporation noted. The following are the results:—

Temperature of the Metal.	Time required for Vaporisation.	
° C.	Min.	Secs.
111	2	0
191	0	38
243	0	25
260	0	22
320	0	20
Cherry red	10	20

This is in complete accord with the statements of the physical text-books; the rate of evaporation increases to a maximum which is followed by a sudden and notable drop; the rate at 320° C. being 31 times as great as at a red heat.

Experiments were next made with an upright cylindrical boiler provided with a flat circular bottom (3 dem. in diameter and 1.2 cm. thick) and kept constantly supplied with water to a depth of 8 cm. The boiler was heated from below, at first by Bunsen burners and finally (as giving the highest temperature) by a coke fire with forced blast. The supply of water being continually renewed, the bottom of the boiler never became red hot in spite of the intensity of the heat. The water boiled vigorously, and the rate of evaporation (expressed in kilos. per square metre per hour) increased continuously with the intensity of the heat from 63.3 to 433.5.

The supply of water was now stopped; the contents of the boiler evaporated completely and its bottom became red hot. It was now in the condition of an ordinary boiler which has become overheated owing to an insufficient supply of water. It is evident that the practical test of the correctness of the current theory comes in at this point. If on admitting water into the red-hot boiler the spheroidal state is produced, this will be shown by a marked reduction in the rate of evaporation (in the proportion of 31 to 1 or

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* Any of these specifications may be obtained by post by remitting 8d.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

thereabouts): if there is no such reduction it may be regarded as conclusive proof that the water is not in the spheroidal state.

On admitting water at 14° into the boiler (heated by seven Bunsen burners, a blowpipe flame and a oxyhydrogen jet) it was found that the rate of evaporation (expressed in the same units) was not reduced but was increased to 662·8. In a further experiment in which the boiler was still more intensely heated by a coke fire, water at a temperature of 90° was introduced; here the rate of evaporation reached the enormous figure of 991. In both cases a red heat was maintained. The author concludes that in actual practice water does not assume the spheroidal state in a red hot iron boiler, but that under these conditions the rate of evaporation reaches a figure which is so high as to merit the careful attention of engineers.—D. E. J.

PATENTS

Improved Method of, and Apparatus for Effecting the Condensation and Purification of Steam and other Condensable Vapours. E. Theisen, Sinzig-on-the-Rhine, Germany. Eng. Pat. 10,299, June 17, 1891.

IN order to avoid using the water resulting from the condensation of steam in a surface condenser attached to a steam engine from entering the boiler as feed-water, whereby it is liable to carry with it a considerable quantity of oil and other impurities, the inventor proposes to re-evaporate the said water by effecting with it the condensation of steam in a second surface condenser, aided by an air blast. He then condenses the re-evaporated water, thereby entirely freeing it from impurities and obtaining a perfectly pure supply for the boiler.—B.

Improved Apparatus for Mixing Liquids for Flushing or other Purposes. J. J. Adler, Ajmere, Rajputana, East India. Eng. Pat. 14,175, August 22, 1891.

THIS invention relates to a contrivance for the mixing of liquids in any desired proportion at the moment of their discharge under pressure from their respective receptacles. One of the discharge pipes of the liquids is closed by a spring valve, the stem of which carries a blade or disc acted upon by the rush of the liquid from the second pipe, whereby the said valve is opened in opposition to the action of its spring. The speed of the liquid issuing from the second pipe, the size and leverage of the disc, and the strength of the spring, are factors in determining the relative quantities of the liquids intended to be mixed.—B.

Apparatus for Regulating the Supply of Volatile Liquids in Refrigerating Machinery. T. B. Lightfoot, London. From the Gesellschaft für Linde's Eismaschinen, Wiesbaden, Germany. Eng. Pat. 7712, April 23, 1892.

WITH refrigerating machinery worked by the vaporisation of volatile liquids it is usual to regulate the quantity of volatile liquid flowing from the condenser to the vaporising apparatus by means of a valve adjusted and set for the passage of a determined quantity of the liquid in a constant stream. A great disadvantage arises from this regulating arrangement on account of the small quantity of refrigerating medium generally required, which necessitates the opening through the valve to be of very slight sectional area, causing frequent partial or complete obstruction through the lodgment or deposit of solid particles or impurities. The object of the present invention is to obviate this defect by causing the liquid to be admitted intermittently instead of in a constant stream, thereby dealing with larger quantities in a smaller space of time. The valve or cock in this case is actuated automatically by the engine at fixed intervals, and in order to allow for variation in the quantity of liquid to be ejected at each revolution or reciprocation, a moveable piston is fitted into the plug which can be regulated by hand so as to leave a larger or smaller space for the reception of liquid within the plug.—B.

Apparatus for Effecting the Interchange of Heat and Moisture by Means of Liquid Spray and Air-Currents. T. B. Lightfoot, London. From the Gesellschaft für Linde's Eismaschinen, Wiesbaden, Germany. Eng. Pat. 7713, April 23, 1892.

INSTEAD of using metallic surfaces perforated with fine holes for producing liquid spray, which holes are liable to be stopped up by the deposit of solid impurities, the inventor proposes to perforate the metal with long narrow slits preferably arranged in the circumference of a tube, allowing the liquid to issue in fan-like shape and to fall in thin sheets likely to split and to break up into drops, which action can be assisted by air currents. And he further causes thin blades of metal to protrude through the slits and be moved to travel to and fro periodically by mechanical means, in order to keep the slits free from deposit.—B.

Improvements in Apparatus for Purifying Water for Boiler and other Technical Purposes. W. P. Thompson, Liverpool. From A. Pennell, Kansas City, Missouri, U.S.A. Eng. Pat. 8833, May 10, 1892.

THE impure or hard water, mixed with the ingredients for purification or softening enters the side of a circular tank in a tangential direction, imparting rotary motion to the contents. The tank has a conical bottom on which the impurities collect, the inlet pipe being situated sufficiently high above the bottom to prevent the stirring up of the deposit, which is drawn off from time to time through a central opening. The purified water is stated to rise to the top of the tank, and leaves it by an overflow pipe.—B.

An Improved Continuously-Operating Centrifugal Machine. I. v. Szczeniowsky and G. v. Piontkowski, Podochien, Russia. Eng. Pat. 9286, May 16, 1892.

THE inventors construct a continuously-operating centrifugal machine by using a conical drum with perforated sides. The upper edge of the drum is surrounded by a short cylindrical perforated part, which rotates with the drum but is prevented from moving in a vertical direction, whilst the drum itself can be raised or lowered as required, thereby causing its upper edge to be surrounded by a short drum with vertical sides of more or less height. According as the height is greater or less, the material pushed outward and upwards on the inclined sides of the rotating conical drum forms a rim above of dried material of more or less thickness, which reacts on the ascending material and causes it to be retained under the action of the centrifugal force for a longer or shorter time. There are devices for raising and depressing the drum, for regulating the thickness of the material on its admission to the drum, for adjusting the issue of vapour or liquid required for mixing with the material on its passage along the sides of the drum, for collecting the liquids and vapour thrown off during the operation as well as the dried material itself.—B.

Improvements in Still Columns. H. Hirzel, Leipzig, Plagwitz, Germany. Eng. Pat. 9538, May 19, 1892.

IN Still column shelves, as usually constructed with the inlet and overflow pipes placed diametrically opposite to each other, the wash, in its passage from one to the other, frequently flows only along one side of the shelves, resulting in a decreased efficiency of the apparatus. The improvement consists in placing the inlet and outlet pipes closely together, but with a partition between them. By this means the wash is compelled to travel right round the central "bell" or "bonnet," and comes into contact with the whole of the vapour escaping underneath the latter.

—H. T. P.

II.—FUEL, GAS, AND LIGHT.

The Flameless Combustion of Coal-Gas. F. Parmentier.
Compt. Rend. 114, 1892, 744—746.

A PLATINUM crucible is heated in a Bunsen burner and the gas is turned off when the platinum is red hot. It is turned on again as soon as the crucible has cooled below a red heat. Thereupon the crucible again becomes hot and incandescent. Sometimes the gaseous mixture re-ignites.

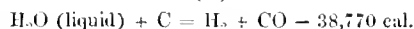
These facts are well known, but the re-ignition appears to be a phenomenon of an uncertain and capricious nature. The author has endeavoured to determine under what conditions it takes place. He first tried a fine wire (made either from compressed or fused platinum) and found that when treated as above described it always became raised, at first to a dull red, and then a bright red heat. When the wire was held at one-half the height of the flame, and outside the zone where the blue cone appears in the usual flame, re-ignition always occurs, and takes place suddenly. Wires of larger diameter were next tried, and it was found that as the thickness increased so also did the difficulty of producing ignition; with the larger sizes the temperatures obtained did not exceed a dull red heat. But if the wires, instead of being held over the burner, are rolled in spirals, vivid incandescence and ignition are again obtained. When a wire has lost its polish by long use or frequent heating, it does not so readily produce ignition. Platinum gauze, such as is used in apparatus for fractional distillation, very rapidly becomes red hot: then the gaseous mixture ignites above the gauze, and soon after the flame "catches down" to the burner. Spongy platinum becomes hot under the above circumstances, but it scarcely becomes red hot, and it does not cause ignition.

Platinum crucibles, such as are used in analysis, were next tried. Well-polished crucibles, and especially small ones, easily produced ignition. With larger crucibles ignition was only obtained with difficulty, and not at all when the capacity exceeded 50 cc. Nor did it occur with crucibles which were dirty or had lost their polish. This the author attributes to the fact that polished platinum has a lower emissive power, and therefore loses heat less readily.

It frequently happens that after ignition has been obtained several times, the next attempt fails, even with the same piece of platinum and under the same circumstances. The platinum becomes red hot, but does not set the mixture on fire. This happens frequently when the air in the room is undisturbed and the observer remains quiet. Under these circumstances ignition generally follows the slightest disturbance—any motion of the observer, a breath of air, or the shutting of a door. A parallel to this curious fact may be observed by holding a light near the orifice of a burner, but not quite near enough to set fire to the gas issuing from it. If the current of gas be stopped for an instant, or even slightly checked, ignition at once occurs.—D. E. J.

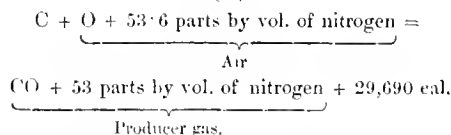
The formation of water-gas is an endothermic reaction, thus—

(1.)



The preparation of producer-gas is, on the other hand, exothermic—

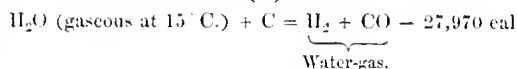
(2.)



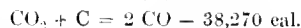
The amount of heat here recorded causes the theoretical temperature of producer-gas at the moment of its formation to be 2,169° C., assuming that the specific heat of its constituents is the same at high as at ordinary temperatures. This heat of formation (29,690 cal.) thus represented is utilised, if the gas be consumed on the spot as fast as it is produced, but is lost if the gas be conveyed to any distance, or stored and let cool to the ordinary temperature of the air, 15° C., the amount of heat then available being only that evolved by the combustion of the carbon monoxide in the gas, that is 67,960 cal. Out of a total of 97,650 cal., therefore, only 67,960 cal. would in this latter case be available, corresponding to a waste of 30·4 per cent. of the theoretical quantity.

Two methods exist by which this loss may be avoided. Either sufficient water may be introduced into the producer to form water gas at the expense of the sensible heat, or carbon dioxide may be led in and reduced to carbon monoxide by the same means. The product of the first process may be termed semi water-gas, and that of the second carbon dioxide producer-gas. The relative advantages of these plans is determined by the following considerations:—The thermal changes that occur in the generation of water-gas and producer-gas have been indicated in equations (1) and (2). Those proper to the formation of water-gas from water in the state of gas instead of in the liquid condition, and of carbon monoxide from carbon dioxide, are given below:—

(3.)



(4.)



The composition of an ideal generator-gas is 34·3 per cent. of CO and 65·7 per cent. of N by volume. When the heat of formation of this is utilised to the utmost by the first method given above, i.e., by the introduction of water, gaseous or liquid, the resulting semi water-gas has the composition—

	From Liquid H ₂ O at 15° C.	From Gaseous H ₂ O at 15° C.
	Per Cent. by Vol.	
Producer-gas.....	65·55	57·9
Water gas	34·45	42·1
	100·00	100·0
Equivalent to—		
Hydrogen.....	17·2	21·1
Carbon monoxide	39·7	40·9
Nitrogen.....	43·1	38·0
	100·0	100·0

The Conversion of Sensible Heat into Chemical Energy in the Production of Semi Water-Gas and Carbon Dioxide Producer-Gas. A. Naumann. Ber. 25, 1892, 556—562.

THREE methods exist for the conversion of coal into gas for heating purposes, the first being the production of ordinary coal-gas by destructive distillation; the second that of water-gas by the action of steam upon heated coal; whilst the third consists in the formation of producer-gas from coal and a limited quantity of air. Of these, coal-gas is too costly for any but small uses, only a portion of the total energy available being utilised. With regard to the others, their adoption depends on the thermo-chemical relations to be observed in their manufacture.

Carbon dioxide producer-gas made under the same conditions of perfect utilisation of the sensible heat has the composition—

	Vols. per Cent.
Producer-gas	65.3
Additional carbon monoxide	34.7
	100.0
Equivalent to—	
Carbon monoxide	57.1
Nitrogen	42.9
	100.0

The thermal values of producer-gas, water-gas, semi water-gas from liquid water (at 15° C.) and from gaseous water (at 15° C.), and of carbon dioxide producer-gas are exhibited in the following table:—

	Heat of combustion of 1 litre, the water produced being supposed gaseous at 15° C.	Calculated Temperature of Flame.	No. of Heat units given up by the products of combustion from 1 litre of the gas in cooling 1° C.
	Cal.	C.	Cal.
Producer-gas	1,044	1,904	0.5487
Carbon dioxide producer-gas	1,739	2,449	0.7101
Semi water-gas from liquid water at 15° C.	1,652	2,356	0.7016
Semi water-gas from gaseous water at 15° C.	1,790	2,431	0.7363
Water-gas	2,812	2,830	0.9664

In actual practice, Dowson gas, formed by blowing steam into a producer, represents a commercial variety of semi water-gas. The following are examples of its composition:—

	I.	II.
	Vols. per Cent.	
Hydrogen	18.73	17
Carbon monoxide	25.07	23
Methane	0.31	2
Ethylene	0.31	..
Carbon dioxide	6.57	6
Nitrogen	48.98	52
Oxygen	0.03	..
	100.00	100

The discrepancy between these results and those indicated above as representing the theoretical composition is elucidated by the consideration that the ideal semi water-gas is assumed to be produced from pure carbon, whereas coal is used commercially, and further, that if the conversion of the carbon dioxide, shown in the foregoing analyses, into carbon monoxide, were effected, the volume of the latter gas would be double that of the former, considerably raising the total percentage.

Another method, differing to some extent in principle from those which have been described, for utilising the sensible heat of a gas-producer pure and simple, is that adopted in the new Siemens furnace (Eng. Pat. 4644 of 1889, see this Journal, 1890, 1119) in which not only is steam blown into the producer, but a portion of the products of combustion are returned from the furnace to the producer, their sensible heat being thus rendered available.

By this method therefore a gas is made consisting partly of semi water-gas and partly of carbon dioxide producer-gas; it has the disadvantage that large quantities of nitrogen are introduced into the producer.

The paper concludes with a table giving the weights of the various products of combustion of 1 litre of each of the four types of fuel-gas which have been discussed:—

	Carbon Dioxide.	Nitrogen.	Water.
	Grams.		
Producer-gas	0.0662	1.6474	..
Semi water-gas from gaseous water at 15° C.	0.806	1.965	0.171
Carbon dioxide producer-gas	1.125	1.909	..
Water-gas	1.064	3.207	0.504

—B. B.

PATENTS.

An Improved Method for the Solidification of Mineral Oils. W. and W. F. S. Chenhall, Bristol. Eng. Pat. 4446, March 12, 1891.

THE solidification is effected by heating 600 parts of oils or volatile and inflammable fluids with 300 parts of fused or dissolved soda, 10 parts of dissolved chloride of lime, and 90 parts of resin, until the mixture becomes solid, after which the mass is pressed into such form, shape, and size as may be required for burning, package, and transport.

—D. B.

Improvements relating to the Treatment of Peat. E. Rischgitz, London. Eng. Pat. 10,452, June 19, 1891.

Two processes are here described for preserving peat from deterioration.

In one process the peat is thoroughly ground in a disintegrator, and then well mixed with an aqueous solution of hydrate of lime, free from carbonate; the fluid mixture is then run through channels to the drying ground, and when it has solidified, it is cut into blocks. The object of adding the lime-water is to neutralise the acids present in the peat; the lime also combines with the silica and alumina to form a protective petrification. When the peat is poor in mineral constituents, a small quantity of some silicate, such as potassium silicate, is mixed with the lime-water, and sometimes a little potassium permanganate is added to accelerate the setting of the coating solution. Peat treated in this way does not require to be compressed into bricks by machinery, and when thoroughly dried it ignites readily, and gives a bright and large flame.

In the second process the acids in the peat are neutralised by the addition of soda, potash, ferrous sulphate, or other suitable substance.—F. S. K.

Improvements in or connected with the Manufacture of Illuminating Gas. J. H. Fergusson, Liverpool. Eng. Pat. 13,431, August 8, 1891.

IN order to obtain a richer gas and a higher "make" from any given coal, the following process is adopted:—The coal is carbonised in the usual manner at a high temperature and the gas passed into the hydraulic main, the dip-pipes being closed with a liquid seal. The gas, and the undensified tarry vapours, are then passed through ducts or channels, which are at a comparatively low temperature, and in which the condensable vapours are converted into a permanent gas; the temperature of these ducts is controlled by suitable dampers, the outlet being kept much cooler than the inlet. Tar may also be advantageously introduced into the ducts.—F. S. K.

Improvements in the Purification of Gas. W. L. Wise, London. From Solvay and Co., Brussels. Eng. Pat. 13,550, August 11, 1891.

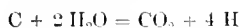
It is well known that it is difficult, with the ordinary materials, to entirely remove the last traces of carbon dioxide from coal-gas, and that in consequence the illuminating power of the gas is appreciably diminished. According to this patent the gas, purified in the usual manner, is passed through a purifier containing ferrite of soda, which absorbs even the slightest trace of carbon dioxide; the purifying material is prepared as described in former patents (Eng. Pat. 4364, 1892, and Eng. Pat. 1974, 1887), and when exhausted it can be revived by heating it at a temperature above 700° C. in a suitable retort.

Ferrite of soda also absorbs sulphuretted hydrogen, but the spent material in this case cannot be readily revived.

—F. S. K.

New or Improved Processes for the Manufacture of Gas from Water Vapour, and for Purification and Separation of Mixed Gases. A. Longsdon, London. Eng. Pat. 8426, May 4, 1892.

ONE of the greatest objections to the use of water-gas for domestic purposes is its poisonous nature, which is due to the presence of carbon monoxide. By impregnating the carbonaceous material with a solution of potassium carbonate before it is raised to incandescence and treated with steam, the temperature at which the decomposition takes place can be kept as low as possible; under these conditions the reaction which takes place can be represented by the equation—



and the gas produced is almost free from carbon monoxide.

The analysis of the raw gas obtained in this way from peat eoke gave the following result:—

	Per Cent.
Carbonic acid gas	26.1
Carbonic oxide	1.2
Hydrogen	62.0
Hydrocarbon gas	2.3
Nitrogen	6.5
Oxygen	1.5

This gas has a high calorific value, and when freed from carbon dioxide, consists chiefly of hydrogen. For absorbing the carbon dioxide from the crude gas, purifiers containing some moistened carbonaceous material impregnated with potassium carbonate or sodium carbonate are employed. This material readily absorbs carbon dioxide, and when saturated the bicarbonate which has been formed can be readily decomposed, and the carbon dioxide recovered and used for industrial purposes.

Lime, heated to a red heat in a suitable retort, may also be employed for removing the carbon dioxide from the crude water-gas; when the lime is spent the carbon dioxide is expelled by means of a current of steam.—F. S. K.

Improvements in Coke-Extinguishing or Quenching and Loading Apparatus. F. J. Collin, Dortmund, Germany. Eng. Pat. 8767, May 9, 1892.

In quenching coke by means of water-jets, as is usually done, the doors and side walls of the furnaces are damaged, and some of the coke burns away before the damping operation commences.

According to this patent the coke is received by a travelling band or apron, the speed of which can be regulated at will, and is immediately carried, first through a water reservoir, in which it is quenched, and then to the point of discharge or delivery.—F. S. K.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Contributions to the Chemistry of Brown-Coal Tar. F. Heusler. Ber. 25, 1892, 1665.

IN text-books the statement is frequently met with that the brown-coal tar oils consist essentially of aliphatic hydrocarbons belonging to the saturated and to the ethylene series. These statements are merely the consequence of reasoning by analogy, for the scanty literature on these oils hardly affords sufficient evidence for such conclusions. Nor do they accord with the fact that brown-coal seams are, as a rule, associated with large quantities of fossil resins which, on distillation, yield oils the nature of which points to their relationship to the aromatic hydrocarbons and especially the terpenes.

The oils which form the subject of the following notes were obtained from the well-known *Riebeck'sche Montanwerke*. Not only the commercial distillates were examined, but also the lowest boiling fractions, which in practice are allowed to escape as vapour.

The distillates were washed with dilute acid and alkali, to remove all basic and phenoloid substances. They were then fractionated by means of steam, carefully dried by potash, and at last repeatedly fractionated in copper stills. Both Linnemann's and Norton-Otten's dephlegmators were used, the latter yielding better results than the former. Mere fractionation seemed unlikely to yield pure substances, since above 180° a partial decomposition of the hydrocarbons appeared to occur.

The following methods were therefore resorted to:—

1. METHOD OF PARTIAL OXIDATION.

Wagner's process of oxidation of non-saturated hydrocarbons by means of an alkaline solution of potassium permanganate (this Journal, 1892, 135) was thought of for separating the saturated hydrocarbons from the non-saturated ones, the latter becoming changed into glycols. Before, however, Wagner's method was followed, the author tried partial oxidation by means of permanganate in an acid solution. The oxidation of the fractionated oils mixed with sulphuric acid seems to take place readily at first, but at last a stage is reached when the permanganate is only slowly decolourised. At this moment the further addition of permanganate is discontinued and the unattacked hydrocarbons are conveniently separated by distillation in a current of steam. There remains in the distillation-flask a resinous mass, whilst the hydrocarbons entirely differ in their behaviour from the original tar oils. In the first instance they are free from the peculiar, disagreeable smell of the brown-coal tar oils; next, their boiling point is found to have considerably decreased. Whilst the lower boiling crude oils are most violently acted on by nitric acid, the hydrocarbons left after the oxidation, as specified, may be easily oxidised—just like coal-tar hydrocarbons—yielding a heavy oil which is partly soluble in caustic soda with an intense reddish-brown colour. The insoluble part consists of the nitro-derivatives of aromatic hydrocarbons.

2. METHOD OF PARTIAL BROMINATION.

The crude oils were dissolved in absolute ether and bromine was added until an evolution of hydrobromic acid was noticeable. It may be assumed that at this moment all the non-saturated substances had directly absorbed bromine, and that a substitution in the molecule of the saturated substances had commenced to take place. On evaporating the ether and distilling in a current of steam, at first a light oil was obtained; later on a heavy oil—the bromo-addition product of the non-saturated hydrocarbons—passed over. The light oils are essentially a mixture of aromatic and saturated aliphatic hydrocarbons.

3. ACTION OF SULPHURIC ACID OF VARYING STRENGTHS.

Concentrated sulphuric acid acts on the brown-coal tar oils with evolution of large quantities of sulphurous acid. A diluted acid, however (two parts of R O V and one part of water), dissolves certain substances from the oil,

without giving rise to the formation of sulphurous acid. The author washed the tar oils twice with sulphuric acid. After siphoning off the acid solution, the residual oily layer was washed and distilled. The oils thus obtained had a lower boiling point than the original oils, and behaved towards nitric acid just like the oils recovered by the oxidation process. On shaking them with concentrated sulphuric acid at the ordinary temperature, sulphurous acid is evolved; on cooling, however, the liberation of sulphurous acid may be prevented. The remaining oils (after the washing with concentrated sulphuric acid) seemed to consist of aromatic and saturated aliphatic hydrocarbons. The substances soluble in acid yielded, on being subjected to dry distillation, large quantities of sulphurous acid. The author reserves the study of this reaction for further research: the possible presence of substances related to the thiophens is, however, hinted at.

Quantitative Estimation of the Aromatic Hydrocarbons belonging to the Benzene Series.—The hydrocarbons obtained by the processes 1 and 3 were examined more closely. An acid-washed fraction, boiling from 80°–93° C., was nitrated, and the resulting nitrobenzene identified by transforming it into dinitrobenzene. This fraction was found to contain about 34 per cent. of benzene which is, in the author's opinion, certainly too low. The nitric acid solution from which the nitrobenzene had been separated contained solid fatty acids, the greater part of which consisted of oxalic acid. A fraction of oils boiling between 100 and 110°—obtained by the first process—contained 45 per cent. of toluene, estimated by the crystallised dinitro-toluene. *m*-Xylene and mesitylene were found in higher boiling fractions and identified by the trinitro-*m*-xylene and the trinitromesitylene. The fraction of oils, boiling from 135°–140° C., contained about 39 per cent. of aromatic hydrocarbons. The author concludes that the percentage of aromatic hydrocarbons of the benzene series decreases with the rising of the boiling points.

Quantitative Estimation of the Aliphatic Saturated Hydrocarbons.—A careful examination of the oils unacted upon by nitric acid showed, on subjecting them to elementary analysis, that Markownikow's naphthenes were completely absent. The following table gives the percentages of saturated hydrocarbons in the oils which had been previously oxidised by means of permanganate.

Fraction.	Boiling Point.	Saturated Hydrocarbons.
		Per Cent
I.	70–100	14.50
II.	135–140	17.25
III.	140–145	18.00
IV.	145–150	19.75
V.	150–155	20.25
VI.	155–160	21.50

The amount of saturated hydrocarbons increases as the boiling point rises.

Terpenes could not be detected in the brown-coal tar oils although the author carefully searched for them, using the methods suggested in Wallach's researches on the terpenes. The author especially looked for pinene and dipentene (this Journal, 1889, 959; 1891, 788), but, as stated, in vain.

Indene and Cumarone, which have been shown to be present in coal-tar oils (this Journal, 1890, 275; 1891, 38) were also absent.

Naphthalene, however, was found in a fraction boiling from 180°–240° and identified by means of its picrate, from which pure naphthalene was isolated. The percentage of this hydrocarbon amounted to at least 4 or 5 per cent. The author continues these researches and predicts that they will throw important light on the nature of the hydrocarbons of the brown-coal tar oils.—J. L.

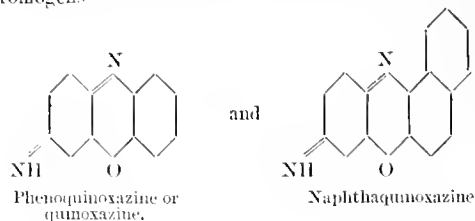
IV.—COLOURING MATTERS AND DYES.

On the Rate of Decomposition of Diazo-Compounds. Hausser and Muller. *Compt. Rend.* **114**, 1892, 760–763.

THE authors have found that the rate of decomposition of metadiazosulphobenzene, $C_6H_4(SO_3)(N_2)$ 1:3, depends upon the concentration, whereas that of the corresponding para-compound is independent of the concentration. The rate of decomposition of the latter is only about one-fourth that of its isomer. It thus appears that the diazo-molecule is more stable when the para-position with respect to it is occupied by the radicle SO_3 . In order to test whether this relative stability is due to the particular radicle SO_3 , or to the fact that it occupies the para-position, they have studied the rate of decomposition of methylsulphodiazobenzene, $C_6H_3(CH_3)(SO_3)(N_2)$ 1:2:4, in which the para-position, relatively to N_2 , is occupied by the methyl group. They find that in this compound also the para-position appears to confer the same properties; the rate of decomposition is slow and is independent of the concentration.—D. E. J.

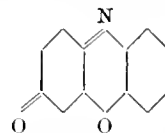
Oxazine Dyes. K. Mohlan. *Ber.* **25**, 1892, 1055–1066.

IN the first part of the paper the author suggests a rational system of nomenclature for the oxazine dyes. These compounds may be classed in two groups, which stand in the same relation to one another as the indamines to the indophenols. The members of the group which correspond with the indamines may be collectively named *quinoxazines*, as they may be regarded as derived from one of the two chromogens—



The following commercial dyes belong to this group:—Galloyanine, Prune, Meldola's blue, Muscarine, and Nile blue.

The members of the second group, which correspond with the indophenols may be termed quinoxazines, and regarded as derived from the as yet unknown chromogen—



Phenoquinoxazone or quinoxazone.

To this group belong resorufine and its derivatives, such as resoreinol blue; also resorufamine, oreirufine, and oreirufamine.

In the second part of the paper the author describes two new quinoxazone dyes which are formed by the oxidation of dialkyl derivatives of metahydroxyparaindo-aniline.

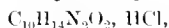
Nitrosodimethylmetamidophenol hydrochloride—



prepared by treating dimethylmetamidophenol with hydrochloric acid and sodium nitrite as described in the patent (No. 45,268) of the Badische Anilin und Soda Fabrik, is a crystalline compound soluble in water with a yellowish-red colouration. The free base, $C_8H_{10}N_2O_2$, melts at 169°, and is readily soluble in hot, but only sparingly in cold water; it combines with alumina forming a brownish-yellow, with chromium sesquioxide forming a yellowish-brown, and with

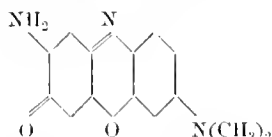
ferric oxide forming a light-brown lake; these lakes can be fixed on vegetable fibres, and the two last-named are fairly stable with regard to soap.

Nitrosodimethylmetamidophenol hydrochloride—



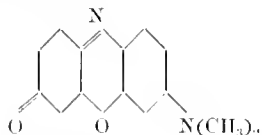
can be prepared in a similar manner; it is a yellow crystalline compound. The free base is readily soluble in hot water; it forms with the oxides of aluminium, chromium, and iron respectively brownish-yellow, brown, and yellowish-brown lakes, that containing chromium being stable as regards soap, whereas the iron lake is only moderately stable and the aluminium compound unstable.

Asymmetrical dimethyldiamidoquinorazone—



is prepared by dissolving 13 parts of nitrosodimethylamidophenol in 130 parts of water, and adding to the warm solution a mixture of 20 parts of stannous chloride and 20 parts of 32 per cent. hydrochloric acid; the solution, which now contains the hydrochloride of metahydroxyparamido-dimethylaniline, is cooled with ice, mixed with a slight excess of soda, and a current of air passed for several hours until oxidation is complete; as the dye is decomposed by alkalis it should not be left too long in the solution. It is purified by recrystallisation from alcohol, from which it separates in rhombic crystals melting at 223° ; it is only sparingly soluble in water, yielding a blue solution. In an acetic acid bath it dyes silk a violet shade which shows a brownish-red fluorescence; its solution in excess of a dilute mineral acid is orange-red, in concentrated sulphuric acid bluish-violet.

Dimethyldiamidoquinorazone—



is formed when an ice-cold solution of the preceding compound is treated with amyl nitrite and concentrated sulphuric acid in alcoholic solution, the mixture kept for half an hour, and then boiled until the evolution of nitrogen is at an end; the product is poured into water, the filtered solution saturated with ammonia, and the precipitated base recrystallised from dilute alcohol. It forms almost black lustrous crystals, melts above 250° , and imparts to silk in a boiling water-bath a beautiful carmine-red colour and a vermilion fluorescence. Dimethyldiamidoquinorazone can also be prepared by heating resorcinol with 1.1 parts of dimethylmetamidophenol and 4 parts of concentrated sulphuric acid on the water-bath until a reaction sets in; the product is mixed with water, the filtered solution saturated with ammonia, and the precipitate purified as already described. The yield is better by this method than by the preceding one.

Asymmetrical *diethyldiamidoquinorazone*, $\text{C}_{16}\text{H}_{17}\text{N}_3\text{O}_2$, can be obtained from nitrosodiethylmetamidophenol just as described in the case of the corresponding dimethyl-derivative; it forms lustrous yellow crystals, melts at 211° , and dissolves in boiling water with a violet-blue colouration; in an acetic acid bath it dyes silk a violet-blue shade which shows a brownish-red fluorescence.

Solutions of this base and of the corresponding dimethyl-derivative show very characteristic absorption spectra, and are in most cases fluorescent.—F. S. K.

Synthesis of Dehydrothiitoluidine. L. Gattermann and O. Neuberg. Ber. **25**, 1892, 1081—1085. (Compare Pfitzinger and Gattermann, this Journal 1889, 608, and Green, 1889, 383.)

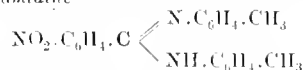
The constitution of dehydrothiitoluidine has been already determined by Pfitzinger and Gattermann (*loc cit.*), but owing to the increasing commercial importance not only of *primuline* itself, but also of other aromatic bases containing sulphur, it seemed desirable to obtain some further proof that the constitution assigned to dehydrothiitoluidine is correct. This the authors have succeeded in doing by synthesising dehydrothiitoluidine in the following manner:—

Paranitrobenzotoluide, $\text{NO}_2 \cdot \text{C}_6\text{H}_4 \cdot \text{CO} \cdot \text{NH} \cdot \text{C}_6\text{H}_4 \cdot \text{CH}_3$, is first prepared by the action of paranitrobenzoic chloride on paratoluidine; it crystallises in yellow needles and melts at 197° . This compound is then converted into the *dichloride*, $\text{NO}_2 \cdot \text{C}_6\text{H}_3 \cdot \text{CCl}_2 \cdot \text{NH} \cdot \text{C}_6\text{H}_4 \cdot \text{CH}_3$, with the aid of phosphorus pentachloride, and from the dichloride *thionitrobenzotoluide* can be obtained by the action of hydrogen sulphide in dry benzene solution, but the yield is small. On oxidising the thiamide with potassium ferrieyanide in alkaline solution it is converted into *nitrodehydrothiitoluidine*—



from which dehydrothiitoluidine can be obtained by reduction with tin and hydrochloric acid.

Dehydrothiitoluidine can also be obtained by treating the dichloride mentioned above with paratoluidine to convert it into the *amidine*—



and heating the latter with carbon bisulphide at 200° , when it is converted into the thiamide.—F. S. K.

Juloles. W. Kaiser and A. Reissert. Ber. **25**, 1892, 1190—1192.

WHEN ethyl ethylacetate is boiled with tetrahydroquinoline there is formed a crystalline substance which the authors name Keto-ethylmethyljuloline. On treating this substance with phosphorus pentachloride it yields an indigo-blue dye containing chlorine, which is probably an analogue of julole violet (compare Reissert, Ber. **25**, 121); the dye is readily decomposed with separation of hydrogen chloride, being converted into a compound having a similar shade, and which is insoluble in water.—F. S. K.

The Manufacture of Tetrabromofluorescein. C. Mühlhauser. Dingl. Polyt. J. **234**, 1892, 21—23 and 46—47. (See also this Journal, 1887, 283.)

FLUORESCIN is dissolved by means of caustic soda in the steam-jacketed pan A, and bromine is dissolved in a similar pan A₂ (see Figs. 1 and 2).

The resulting solutions are allowed to cool and are then siphoned into the wooden vat B, and diluted with water. Hydrochloric acid is run in from the barrel C, the whole is boiled with open steam, diluted and allowed to settle. The liquor is run off into the vat E, and after one or two washings the colour is finally brought on to the filtering trough D, where it is drained. The liquor in E is allowed to stand for about 12 hours and is then filtered through D₂. The colour in D₂ passing on to the succeeding batch, that from D being dried on the trays F. To obtain a soluble product several methods are adopted. Either gaseous ammonia is passed over the material (see previous abstract) or it is dissolved in caustic soda and the solution obtained evaporated; or else the product is dissolved in alcoholic soda and the sodium salt subsequently crystallised out. The last-mentioned method gives the purest product and is carried out as shown in Figs. 1 and 2. The tetrabromofluorescein is dissolved in warm alcoholic soda in the

Fig. 1.

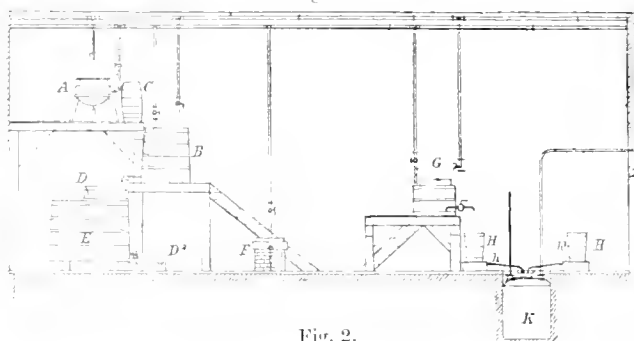
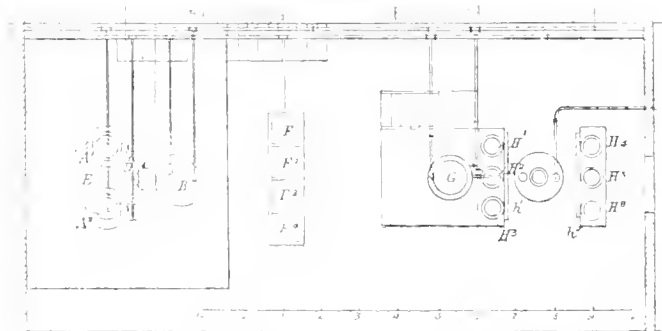


Fig. 2.



THE MANUFACTURE OF TETRABROMOFLUORESCIN.

Fig. 3.

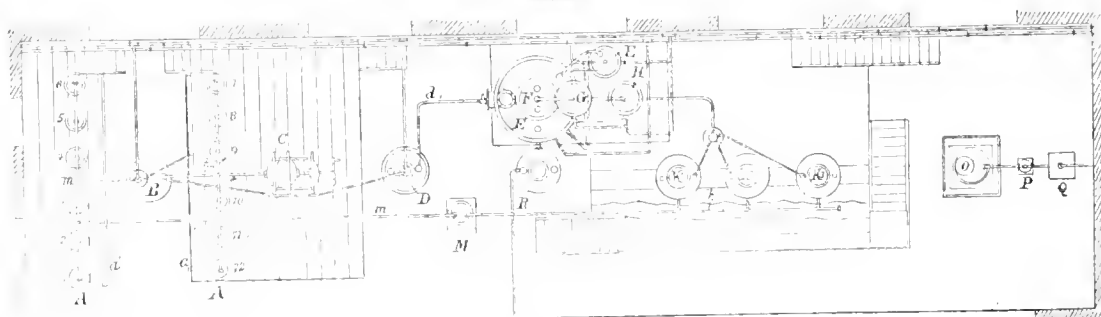
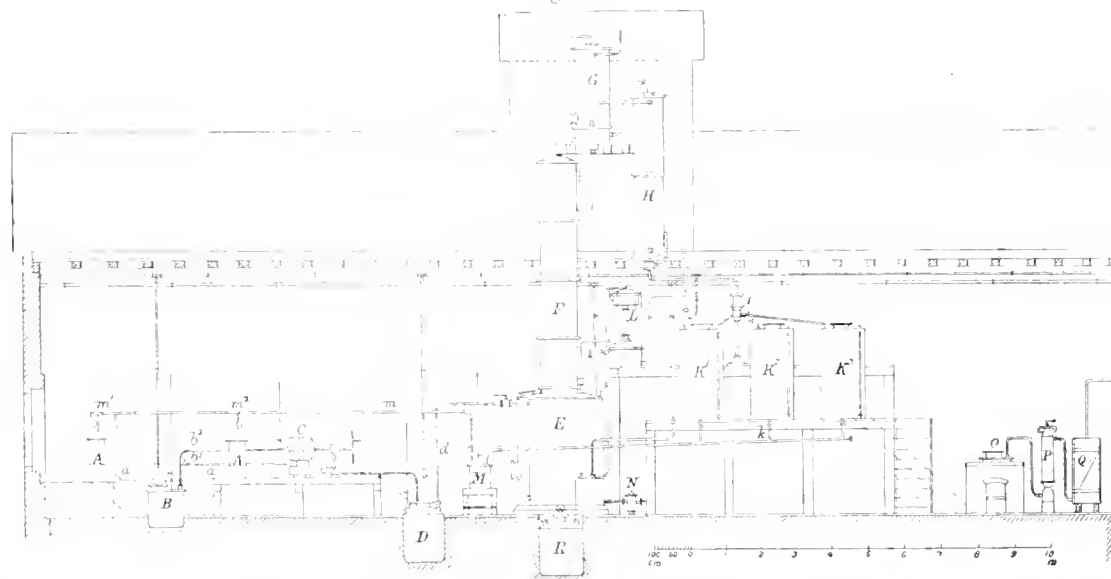


Fig. 4.

PLAN FOR MANUFACTURE OF TETRABROMOFLUORESCIN.

copper pan G provided with water-jacket and the solution thus obtained is run into the wooden vat H, where it cools. The sodium salt separates out in crystalline condition and the alcoholic molten liquor is then siphoned off into the trough *h*, whence it flows to the pressure cylinder K to be forced to the rectifying apparatus. The crystals obtained in the vats are drained on canvas filters.

In the preceding method of manufacture, bromination was performed without the aid of alcohol; in brominating however, in presence of alcohol, the plan sketched in Figs. 3 and 4 is used.

The whole plant consists of three parts (1) brominating cylinders, (2) apparatus for recovery of alcohol, (3) plant for transforming the product into a soluble salt. The necessary quantity of spirit is fed into three or more of the enamelled cast-iron pots A in the following manner: K₂ is a wrought-iron stock tank from which the spirit is run to the measuring vessel M whence it is forced to the pots A. Fluorescein is stirred in and bromine is added with continual stirring. After the whole has stood for several days the alcoholic liquor is run by aid of the troughs *a* to the cylinder B. A second quality of product is obtained from this liquor by adding water and then filtering through the filter-press C, the liquor running finally to D.

The colour in the pots A is washed with fresh alcohol, the washings running by way of *a* to B, whence the liquid is forced by air pressure to D. The eosin in the pots is transferred to woollen filters, and then pressed and the cakes dried on enamelled plates on the water-bath. The dried eosin is then converted into the ammonium salt by passing dry ammonia over it. The ammonia is obtained from the pan O, then dried by caustic soda in P and passed over the eosin spread upon wooden trays contained in Q. A specially good product is got by transforming tetrabromofluorescein into the sodium salt.

The acid alcoholic liquors in D are neutralised with milk of lime and forced through *d* to the rectifying apparatus, where it is worked up to 96–97 per cent. spirit. G is the dephlegmator, H the condenser; L serves for regulating the pressure, and I for parting of the distillates; first runnings pass into K, 96–97 per cent. product to K₂ and final distillate to K₃. After the distillation is completed, the bromide residues are run into R, whence they are forced to the bromine regeneration apparatus.—T. L. B.

The Manufacture of Fluorescein. Otto Mühlhäuser.

Dingl. Polyt. J. 283, 1892, 182.

In a former paper (Dingl. Polyt. J. 263, 49; this Journal, 1887, p. 283) the author described two methods for the manufacture of the mother-substance of the eosins. He describes now the plant employed in this process, which latter essentially consists in the treatment of phthalic acid and resorcinol, with or without zinc chloride, at a temperature of 180° C. The melt so obtained is purified by dissolving it in caustic soda, re-precipitating with hydrochloric acid, and subsequently drying the well-washed precipitate.

1. The melt is produced in a pan *a*, which is heated in an oil-bath *b*. The whole arrangement is heated in the furnace A (see Figs. 1 and 3).

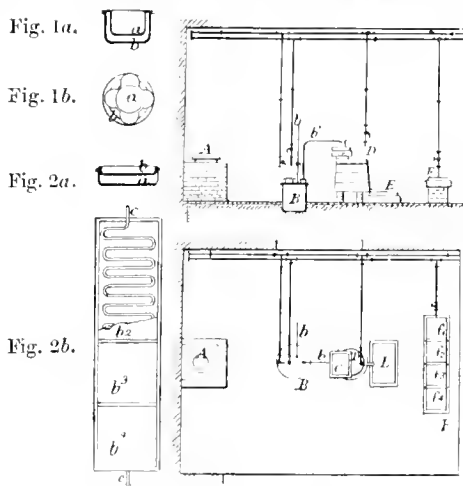


Fig. 3.

PLANT FOR PREPARATION OF FLUORESCIN.

2. The melt is dissolved in the apparatus B (Fig. 3), which is provided with a large aperture for working, and can be closed air-tight. Pipe *b* is in connexion with an air-compressor, and serves to force the contents of the apparatus over into C. Above the manhole of the apparatus steam and water connexions are arranged.

3. C is a filter-box for the filtration of the alkaline fluorescein solution.

4. D is a vat for the reception of the filtrate, and precipitation of the fluorescein.

5. E is a filter-box for the filtration of the contents of D.

6. F are drying-pans for the precipitated and washed fluorescein. The pans are constructed on the principle of a water-bath which is heated by steam.

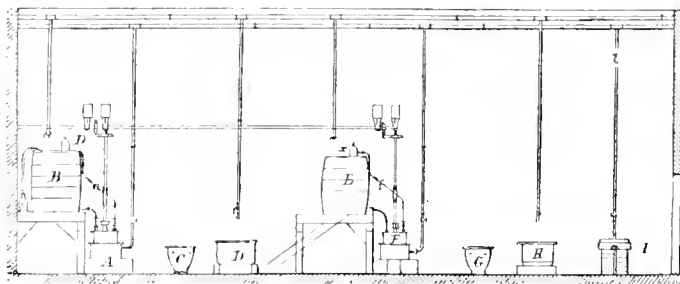
This plant is calculated for an output of 36 kilos. of fluorescein per day.—C. O. W.

The Manufacture of Eosin soluble in Alcohol (Ethyleosin)

Otto Mühlhäuser. Dingl. Polyt. J. 283, 1892, 219.

In a former paper (Dingl. Polyt. J. 263, 49 and 99; this Journal, 1887, p. 283) for the manufacture of tetrabromo-ethyl-fluorescein, which is the eosin soluble in alcohol of commerce, the bromination and etherification are performed in one operation by the treatment of a hot solution of fluorescein in alcohol with bromine. The apparatus employed for the process is represented in Figs. 1 and 2, and consists essentially of a steam-jacketed pan A and a condenser B. The inside of the pan A (Fig. 2) and also the agitator *a* are enamelled, and the lid of the pan is provided with the connections *b* and *c*, manhole, the stuffing-box *e* for the agitator, and a gauge-glass. On the bottom of the steam-jacket A' an outlet *i* for the waste steam is provided. The

Fig. 1.



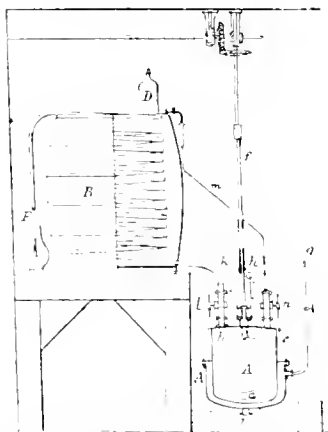
PLANT FOR THE MANUFACTURE OF ETHYLEOSIN.

lead coil of the condenser B is connected with pan A by means of the copper elbow *k* and the brass tap *l*. On the top of the condenser the glass bottle D, provided with a glass tap, is so arranged that the bromine contained in the bottle can be introduced into the pan A through the glass tube *m* and the brass tap *n*. Beneath the overflow of the lead coil the jug E is placed.

In working with this plant, the pan A (Figs. 1 and 2) is first charged with the required quantity of alcohol; then the agitator is started, and the fluorescein added through the manhole, which is then closed. As soon as the alcohol is boiling, the bromine contained in the glass bottle D is added, when a violent reaction takes place. Should any liquid be ejected from the end of the coil, it will be caught in the jug shown in Fig. 2. As soon as all the bromine has been added, the taps *l* and *n* are closed, and the mass heated for some time under a pressure of $1\frac{1}{2}$ atmospheres (23 lb.). The whole is then left to cool, subsequently the lid is removed, the supernatant acid alcohol siphoned off into the jars C (Fig. 1), and the remaining eosin acid thrown on to asbestos filters. The cake of eosin acid so obtained is washed in

succession with alcohol and water in the enamelled pan D (Fig. 1), filtered again, pressed, and dried on the steam pan I. In order to render the eosin-acid soluble, it is suspended in the pan F in a mixture of water and alcohol, heated to boiling, and the necessary quantity of caustic potash, which is contained in the bottle *x*, added to it. After a few days' standing the apparatus is opened, the mother-liquor siphoned off into the jars G, the green crystals thrown on a filter, pressed, washed again with water in the pan H, filtered and pressed again, and eventually dried on the steam pans I.—C. O. W.

Fig. 2.



APPARATUS FOR THE MANUFACTURE OF ETHYL-EOSIN.

Process and Apparatus for the Manufacture of Ammonium Salts. Otto Mühlhäuser. Dingl. Polyt. J. 283, 1892, 234.

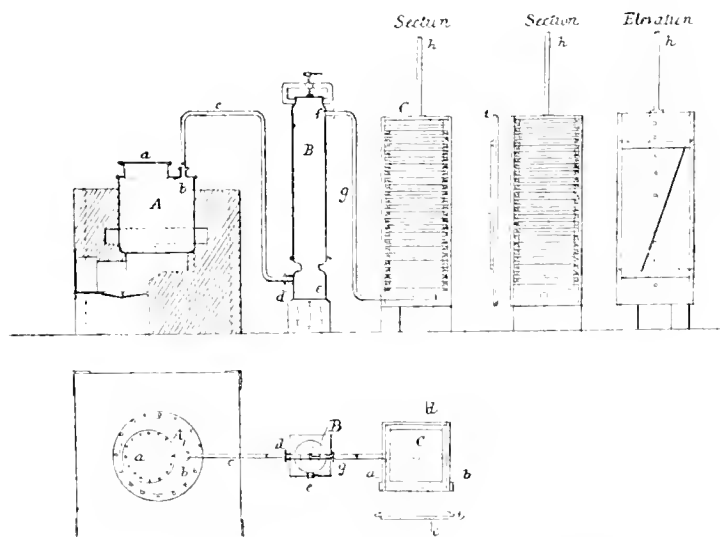
THE eosin acids can be converted into ammonium salts by passing over them a dry current of ammonia, and in a similar manner the ammonium salts of many other acids may be obtained. The acids employed must be perfectly dry, very finely powdered, and remain in this condition at the temperatures at which the reaction takes place. The apparatus used consists of three parts.

1. The ammonia still A with manhole *a* and flange *b*. The still A is fixed in a furnace, and by means of the pipes *c* connected with the drier B.

2. The drier B is provided with a manhole through which it is filled with the drying material, which consists of caustic soda in lumps. The wet gas enters the drier at *d*, and the dried gas passes at *f* into the pipe *g*, which conveys it to the box C. On the bottom of the drier a tap is provided, through which the liquid caustic soda is drawn off from time to time.

3. The box C contains 30 frames covered with cloth. The box is provided with a tight-fitting door *i*, containing a number of holes intended for drawing samples. These holes are closed with stoppers.

When the drier B is filled with lumps of caustic soda, the dry acid to be converted into an ammonium salt is spread upon the frames of the box C and the door of the latter closed. The ammonia still A is then filled with a mixture of milk of lime and powdered sal-ammoniac, the lid put on, and the fire lighted. The slow current of gaseous ammonia is dried in B and absorbed in C, and the operation in C interrupted as soon as the samples drawn are found to be completely converted into ammonium salts.—C. O. W.

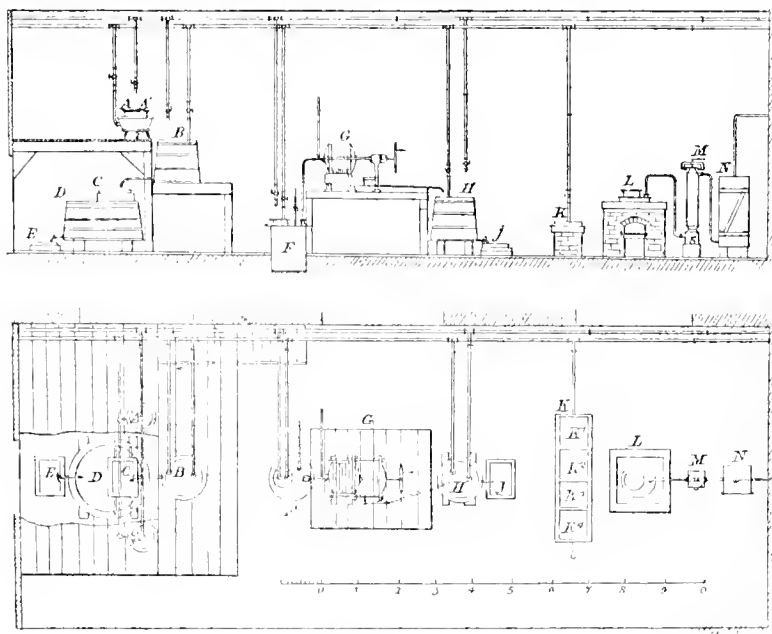


APPARATUS FOR THE PREPARATION OF AMMONIUM SALTS.

The Manufacture of Iod-Eosin. Otto Mühlhäuser.Dingl. Polyt. J. **283**, 1892, 258.

The iodising of the fluorescein is carried out very much in the same way as the bromination, but instead of hydrochloric acid acetic acid is used for completing the reaction. The fluorescein is dissolved in the water-jacketed pan A,

whilst in a similar pan A' (see plan) the iodine is dissolved in caustic soda, and the two solutions are mixed in a vat B. On addition of acetic acid, iod-eosin is precipitated. The supernatant liquor is siphoned off and the precipitate collected on a filter C. In D all the mother-liquors from the precipitate are collected.



For refining purposes the precipitated product is dissolved in a pan F in an insufficient quantity of alkali, when the pan is closed air-tight, and the contents, by means of compressed air, are pressed through the filter-press G into H. The eosin is now again precipitated with dilute hydrochloric acid, boiled, diluted with water, the supernatant liquor run off, and the precipitate collected on the woollen filter J. The filter-residue is subsequently dried in the drying pans K 1 to 4. After drying the eosin-acid is passed through a fine sieve, spread on frames, and in the box N exposed to a dry current of gaseous ammonia. This is evolved in L, M being the drying cylinder.

From the mother-liquor contained in the wooden vat D the iodine is recovered by adding, for every 24 kilos. of iodine used, 45 kilos. of sulphuric acid of sp. gr. 1.84, and a solution of 7 kilos. of bichromate of soda in 42 litres of water. The iodine is obtained in the shape of a greyish-black precipitate. After the precipitate has settled the supernatant liquor is run off and the iodine collected on the filter E. The iodine so obtained is washed on the filter, then pressed, and subsequently returned again into the circle of operations. Six kilos. of fluorescein require 24 kilos. of pure iodine; with the recovered iodine from a previous operation only $9\frac{1}{2}$ kilos. of fresh iodine are required.

—C. O. W.

Formation of Allocinnamic Acid from Phenylpropionic Acid. C. Liebermann and W. Schmolz. Ber. **25**, 1892, 950–951.

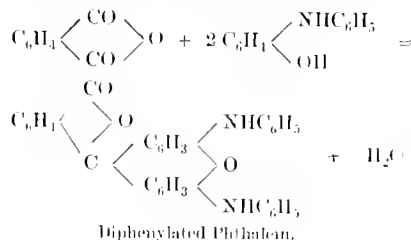
THE authors have obtained allocinnamic acid almost quantitatively from the “new” bromocinnamic acid of Michael and Browne (Ber. **19**, 1378, and **20**, 552)—one of the hydrobromic acid addition compounds of phenylpropionic acid—by boiling the same with zinc filings (2 parts) and absolute alcohol (10 parts). To isolate it, the alcoholic solution which contains it, apparently along with a small quantity of isocinnamic acid, partially in the form of zinc salt, was poured from the unattacked zinc, diluted with two volumes of water and evaporated on the water-bath to dispel the alcohol; the acid was then liberated with hydro-

chloric acid and extracted with ether, the ethereal solution evaporated, and the residue, which on cooling set to a mass of crystals of melting point 57° , purified by (1) conversion into the easily-soluble calcium salt; (2) crystallisation from light petroleum; (3) fractional precipitation from benzene by aniline (the aniline salt of allocinnamic acid melts at 83° , and that of phenylpropionic acid, which is less soluble in benzene, at 136° , whilst hydrocinnamic acid is not precipitated from benzene by aniline); and (4) decomposition of the aniline salt. The purified acid melted at 68° , and possessed the composition and characteristic properties of allocinnamic acid. The phenylpropionic acid hydrobromide used in the above experiment reduces alkaline solutions of potassium permanganate without formation of benzaldehyde, and must, accordingly, have its bromine atom attached to a β -carbon atom (Erlenmeyer, Ber. **23**, 8130). The authors, however, reserve their views as to the constitution of allocinnamic acid until they have determined the action of zinc on an alcoholic solution of the second hydrobromic acid addition compound of phenylpropionic acid described by Michael and Browne (*loc. cit.*).

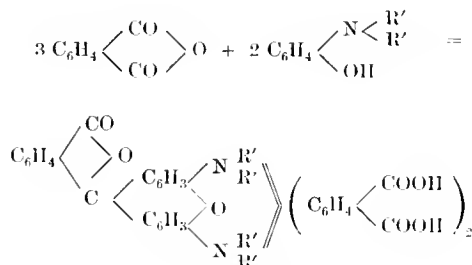
—E. B.

Anisoles, a Class of New Dyestuffs. M. P. Monnet. Bull. Soc. Chim. **7**–**8** [14], 523–527.

IN 1882 the first phthalein was prepared, derived from an amidophenol. Phthalic anhydride was for this purpose treated with *m*-hydroxydiphenylamine—



This phthalein is a violet colouring matter, soluble in alcohol. Its sulphate is soluble in water. More recently the rhodamines were discovered, and these are simply formed upon the above type, and are derivatives of the di-alkylised *m*-amidophenols and di-alkylised amido-cresols. The general formula representing them at the moment of formation is thus exhibited—

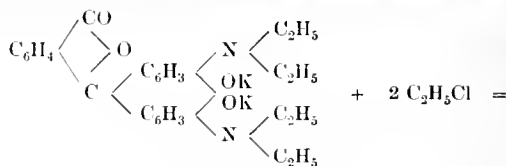


Rhodamine Phthalate.

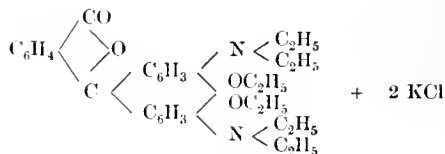
From this it will be observed that in this rhodamine structure there is an internal anhydride formed at the expense of two phenolic groups. The work of Baeyer has proved that fluorescein under the influence of an aqueous alkaline solution fixes one molecule of water upon the oxygen atom of the anhydride so as to reproduce the phenolic hydroxyls. These two newly-formed hydroxyls then promptly exchange their hydrogen atoms for the alkaline metal. The mode of formation of the anisoles is a further proof of the correctness of this interpretation of the constitution of the phthaleins. The anisoles are theoretically formed when we replace in the rhodamines the phenolic metallic groups by some simple alcoholic radicles, methyl, ethyl, amyl, &c., or substituted ones like benzyl, &c.

By the action of phthalic anhydride on anisolated *m*-amidophenol, the corresponding anisoles are not obtainable. But the case is different if after the reaction giving birth to the rhodamine, this latter be transformed into its potassium salt. In this case the two metallic atoms will be replaceable by two alcoholic radicles. Thus then, the formation of the anisoles means the destruction of this inner anhydride.

To illustrate the transformation of a rhodamine into an anisole, the simplest case is taken, that of the derivatives of the di-ethyl-*m*-amido-phenol. The preparation of the potassium salt is effected by dissolving at the boiling point 100 grms. of rhodamine hydrochloride in 500 grms. of water. This solution is then poured into another, also boiling, of 50 grms. of caustic potash dissolved in 200 grms. of water. The potassium salt is at once precipitated in the crystalline state, and less soluble hot than cold. It filters rapidly. Dried at 100°, it is anhydrous and forms a red powder; dried at a low temperature, it contains 2 mols. of water, and consists of beautiful small crystals with a beetle-green reflex. The transformation into anisole is effected thus:—10 grms. of the potassium salt dried at 100° are dissolved in 30 grms. of strong alcohol, the whole introduced into a glass tube, the latter cooled, 5 grms. of pure chloride of ethyl are added, and the tube sealed. The chloride can be replaced by an equivalent quantity of either bromide or iodide. The tube is now heated for four hours at 120° C. The product of the reaction is then poured into about 300 grms. of water, heated to 100° for about a quarter of an hour to expel alcohol and ethyl chloride in excess, and then treated with 5 grms. of concentrated hydrochloric acid. The solution of anisole hydrochloride obtained is then filtered off and precipitated with common salt in sufficient quantity. On cooling, the hydrochloride is deposited at the bottom of the vessel in a syrupy state. It is finally collected, drained, dried on the water-bath, and pulverised, when it appears as a green metallic iridescent powder, very soluble in cold water, and less in warm. Anisole is formed thus—



Potassium Salt of Rhodamine.



Anisole.

If benzylated anisoles are required, the temperature employed should be 140° C. The sulphonated derivatives are very easily formed.

The benzylated diethyl-*m*-amidophenolphthalein sulphonic acid is thus prepared. The phthalein in the state of base is treated cold in a glass balloon or bolt-head with two parts of ordinary sulphuric acid; the solution completed, little by little four parts of fuming acid with 20 per cent. of anhydride are added. The temperature is then gradually raised until a small sample of the mixture is perfectly soluble in a solution of caustic soda. This is usually effected by using a temperature of about 50°, and in no case is it necessary to pass 80° C. When the contents of the balloon are quite cool, they are poured into an excess of ice, and treated with chalk to absorb free acid. The sulphate of lime separated on filtration is several times washed. The solutions are reduced by evaporation, filtered hot, treated with carbonate of soda or potash, according to the salt desired, evaporated to dryness, after previous separation by filtering from calcium carbonate.

The sodium salt is a powder of a bright rose colour. Generally, the anisoles produce on dyeing shades of a more violet hue than those of the rhodamines from which they are derived.

They dye all textile fibres a magnificent violet red, and especially cotton, without the intervention of mordants. The resistance of the anisoles to light is superior to that of the greater portion of the aniline colours.—W. S.

PATENTS.

Improvements in the Manufacture of Colouring Matters.
H. H. Lake, London. From Kalle and Co., Biebrich-on-the-Rhine, Germany. Eng. Pat. 12,589, July 24, 1891.

CERTAIN products of the reaction of fuming sulphuric acid on phenylrosinduline are described in Eng. Pat. 15,259 of 1888 (this Journal, 1889, 877). According to the present invention, valuable products are obtained from the same base by the action of concentrated sulphuric acid. By heating 1 part of phenylrosinduline with 10–20 parts of concentrated sulphuric acid to 150°–170° C. the disulphonic acid mentioned in Claim II. of the above patent is produced. On further heating, this disulphonic acid is converted into a new disulphonic acid distinguished by the prefix β . It is very easily soluble in water and alcohol, and dyes wool a bluer shade than the disulphonic acid previously known. The salts of the new disulphonic acid when heated with water under pressure give a monosulphonic acid of rosindone of the formula $\text{C}_{22}\text{H}_{13}\text{N}_2\text{O}_5\text{H}$, whereas the disulphonic acid hitherto known, when treated in the same way, yields rosindone, $\text{C}_{22}\text{H}_{14}\text{N}_2\text{O}$. By further heating the mixture of phenylrosinduline and concentrated sulphuric acid a sulphonic acid is obtained, which is not precipitated from its aqueous solution by mineral acids in which reaction it differs from the β -disulphonic acid. The method given for the preparation of the β -disulphonic acid is as follows:—A mixture of 1 kilo. of phenylrosinduline and 15 kilos. of concentrated sulphuric acid is heated for about 12 hours to 170° C., until a sample precipitated with

water and filtered is easily soluble in pure cold water. The melt is then poured into 75 litres of water, the precipitate filtered off and dissolved in alcohol, when any α -disulphonic acid present remains undissolved. The alcoholic solution is then evaporated to crystallisation. The β -disulphonic acid gives a bright-green solution with concentrated sulphuric acid, thus showing a similar reaction to the sulphonic acids of phenylrosinduline already known. It appears to resemble the trisulphonic acid of Ger. Pat. B. 11,280 of April 9, 1891, but is somewhat less soluble. For practical purposes it is unnecessary to separate the acids as above. After pouring the melt into water, salt is added to produce the sodium salt, and the dyestuff thus separated is filter-pressed and dried.—T. A. L.

Improvements in the Manufacture of Azo-Colours. Read, Holliday, and Sous, Limited, Huddersfield, and A. G. Brookes, London. Eng. Pat. 11,395, July 4, 1891.

BENZENE-AZO- α -NAPHTHYLAMINE, or one of its homologues, such as *o*-toluene-azo- α -naphthylamine, or a sulphonic acid of the same, is capable of combining with a tetrazo-compound (one molecular proportion of each) to form an intermediate compound which will combine with a phenol or amine or their sulphonic or carboxylic acids to form new dyestuffs. The following proportions are given for the formation of a dark blue colouring matter, which dyes unmordanted cotton from a neutral bath containing salt:—34.9 lb. of benzene-azo- α -naphthylamine sodium monosulphonate are dissolved in 200 gallons of water and mixed with 100 gallons of a paste containing 39.2 lb. of tetrazostilbene-disulphonic acid. After stirring for about six hours, a solution of 14.5 lb. of α -naphthylamine and 14.5 lb. of hydrochloric acid of 22° B. in 100 gallons of water is added, and the whole, during constant agitation, is slowly treated with 20 lb. of sodium carbonate in 20 gallons of water. This operation takes about six hours and the stirring is then continued for 12 hours more. The dyestuff can then be precipitated with salt, filter-pressed, and dried. As the colouring matters contain an amido group they can be diazotised and will then combine with phenols or amines, &c. to form new dyestuffs, and this operation can be carried out on the fibre by passing the fabric dyed with the colouring matter through a bath containing nitrous acid, and after washing it, impregnating the fibre with a solution of an amine or a phenol, or a sulphonic or carboxylic acid of the same.—T. A. L.

The Manufacture and Production of New Sulpho-Acids, and of New Colouring Matters therefrom. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 14,294, August 24, 1891. (Second Edition.)

THESE colouring matters are produced by the action of diazo compounds on sulphonic acids of 1.1' dihydroxynaphthalene which has already been employed in the formation of dyestuffs (Eng. Pat. 6874 of 1890; this Journal, 1891, 249). About 10 kilos. of 1.1' dihydroxynaphthalene are slowly added to 40 kilos. of concentrated sulphuric acid, containing 95 per cent. H_2SO_4 , at about 10°–15° C. The temperature is then raised to 50° for about 45–50 minutes, or until a sample dissolves to a clear solution in water. After cooling the melt it is poured into 200 litres of ice water and neutralised with a saturated solution of barium hydrate. The barium sulphate is filtered off and well washed with hot water. The filtrates, which should only be slightly alkaline, are then boiled down to about 260 kilos. and the solution allowed to cool, when the barium salt of a sulphonic acid crystallises out. This is called barium salt I. The filtrate, together with the washings of the first crystallisation, is further evaporated to about 50 kilos. when a barium salt II. is obtained on cooling. The mother-liquor contains a barium salt III. All these barium salts can be converted in the well known manner into their sodium salts by dissolving them in boiling water and adding the necessary quantity of sodium carbonate or sulphate. The

sulphonic acids from the barium salts II. and III. are of value for the production of azo dyes, and are known respectively as 1.1' dihydroxynaphthalene disulphonic acid Y, and 1.1' dihydroxynaphthalene disulphonic acid R. In order to produce a colouring matter from the former acid, a solution of its sodium salt is titrated with diazobenzene chloride in presence of acetic acid, and the strength of the solution so adjusted that it contains about 20 per cent. of Y acid. 160 kilos. of this solution are mixed with 35 kilos. of sodium acetate and diazobenzene chloride solution added. The deep red solution deposits crystals on standing, but if too dilute it is advisable to raise it to the boil and add salt when the dyestuff crystallises out on cooling. In place of sodium acetate, the combination may be performed in presence of 14 kilos. of calcined soda, but care must be taken to avoid an excess of the diazo compound. The colouring matter is precipitated with salt, filter-pressed and dried, forming a brownish-red powder which dyes wool a bluish-red colour from an acid bath. The dyestuff from the disulphonic acid R gives a bluer shade of red.—T. A. L.

Improvements in the Manufacture and Production of Colouring Matters. The Clayton Aniline Company, Limited, and J. Hall, Clayton, Manchester. Eng. Pat. 15,494, September 12, 1891.

If one molecular proportion of a diazo compound be combined with one molecular proportion of *m*-phenylene or *m*-toluylene diamine a chrysoidine is formed. According to the present invention *m*-phenylene diamine is capable of combining with three molecules either of the same or of different diazo compounds, with the formation of brown colouring matters. The first or second or both molecular proportions of the diazo compounds should be in the form of sulphonic acids in order to give useful compounds. A colouring matter giving brown shades on wool is produced as follows:—91 kilos. of *m*-phenylene diamine hydrochloride are dissolved in water, made alkaline with sodium carbonate and treated with the diazo solution from 158 kilos. of sodium naphthionate dissolved in water, 100 kilos. of hydrochloric acid and 35 kilos. of sodium nitrite. After stirring for about 24 hours a solution of diazo-toluene chloride (from 53 kilos. of *o*-toluidine) is run in, and after a further stirring for 24 hours the same quantity of diazotoluene chloride is added. The solution is kept alkaline the whole time by the addition of sodium carbonate or caustic soda. The solution, after standing another day, is finally boiled up and the colouring matter salted out, filter-pressed and dried. By substituting for the second portion of *o*-toluidine a solution of tetrazodiphenylchloride (from 46 kilos. of benzidine) a colouring matter is obtained which dyes unmordanted cotton brown.—T. A. L.

Improvements in the Manufacture of Colours, specially applicable for Colouring Photographs. A. J. Boulton, London. From C. H. W. Bruns, Halberstadt, Germany. Eng. Pat. 3791, February 26, 1892.

110 GRMS. of borax are dissolved in 1,250 grms. of water. This solution is mixed with 1 kilo. of pure casein, heated near boiling point, and after skimming off any impurities which will have risen to the top, a few minutes boiling, and afterwards cooling in a water-bath finishes the operation.

The liquid so obtained is thoroughly mixed with the desired colouring matter.—C. O. W.

V.—TEXTILES: COTTON, WOOL, SILK, Etc

Rotatory Power of Silks of Various Origin. L. Vignon. Compt. Rend. 114, 1892, 129—131.

As the author has shown, the principal constituents of the silk of *Bombyx Mori*, examined in caustic soda and hydrochloric acid, show a considerable action on polarised light. The present article consists of a number of tables of results obtained with other silks, viz., *Bombyx Yamama-Mai*; *Bombyx Dori*, China, Japan, Madagascar, Bagdad (this Journal, 1892, 427).—T. L. B.

PATENTS.

Improvements in the Manufacture of Artificial Silk and Mixed Threads, and in Apparatus therefor. F. Vebner, Augsburg, Germany. Eng. Pat. 11,831, July 11, 1891.

A solution of collodion in ether-alcohol with addition of acetate of soda or salts of ammonia, is kept in a tank provided with a gauge glass and carrying on the bottom a tube which terminates in a thin glass tube. By means of very slight pressure the collodion solution is pressed through these tubes which terminate in a vessel containing turpentine, juniper oil, benzoin, benzol, petroleum hydrocarbons, or bisulphide of carbon, so that the thread, after emanating from the nozzle of the tube passes through these liquids. The ether-alcohol and "vegetable acid" which is in the collodion are dissolved by these liquids, and the remaining collodion is drawn into a silky thread. A certain number of the threads meet and pass through or over an eye or gatherer, and when a mixed thread is to be made they are here mixed with other threads coming from bobbins. The gathered threads are twisted by a flyer as in spinning, and afterwards wound upon drums.—C. O. W.

An Apparatus for Testing the Strength of Cotton, Wool, and other Fibres in the Raw or Unmanufactured State. E. Appenzeller, Alost, Belgium, and E. Fillenl, Alsace, Germany. Eng. Pat. 13,967, August 19, 1891.

The apparatus which forms the subject of this invention consists of two parts, the first of which is a gauge, serving to obtain small bundles or bunches of the fibre to be tested, of a determined sectional area and in the form of a flat wick. The second part consists of two vices with special corrugated jaws, in which the two ends of the above wick can be firmly secured. Attached to one of these vices is a weighted platform, bearing upon the bunch of fibres under test, weight being gradually added to the platform until the bunch breaks, when the breaking strain can be readily ascertained.—C. O. W.

Improved Process and Apparatus for the Treatment of Textile Fibres with Liquids and Vapours or Gases. E. Gessler, Metzingen, Wurtemberg. Eng. Pat. 11,657, August 29, 1891.

The invention relates to a process and apparatus for subjecting textile or spun fibres to the action of circulating currents of liquids, vapours, or gases. The apparatus consists of a vessel of circular or polygonal cross-section, and provided with a lid and perforated bottom, and a conical flange below the lid. By means of this flange the vessel can be fitted air-tight in a chamber. The top of the lid of the vessels carries a pipe, which can be connected with a suitable pump. The goods to be treated or dyed are placed in these vessels, and after the latter has been connected with the pump the gases or liquors required are forced through the materials contained in the vessels. When the operation is complete, the pump is stopped and the vessels are placed in a hydro-extractor. The final drying is effected by placing the vessels again in a chamber and forcing a current of hot air through them.—C. O. W.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

The Dyeing of Leather. Leather Trades Circular and Rev. 25, 1892, 590—591.

See under XIV., page 697.

PATENTS.

An Improved Solution for Use in the Dyeing of Silk Fabrics, Yarns, and Threads. E. B. Truman, Nottingham. Eng. Pat. 10,438, June 19, 1891.

THE discolouration to which dyed silk is liable when exposed to a damp atmosphere or a low temperature, is prevented by the addition to the dye-bath of $\frac{1}{1000}$ to $\frac{1}{10000}$ part of mercuric chloride, "increasing or decreasing the proportion of mercury according to the requirements of the material operated upon and the condition of the water used."—E. B.

Improvements in the Dyeing and Treatment of Cotton and other Textile Materials. E. and G. E. Sutcliffe, Halifax. Eng. Pat. 10,678, June 23, 1891.

THE mechanism employed for distributing the dye-liquor in the apparatus described in Eng. Pat. 8270 of 1890 (this Journal, 1891, 696), is replaced by a cylindrical or polygonal wheel or frame, divided by partitions into compartments for the reception of the material to be dyed, and mounted on a perforated, hollow shaft, through which the dye-liquor is directly discharged into the material.

Claims are further made for a combination of mechanism for successively conveying the raw cotton, &c. to the dyeing machine, dyeing, conveying to a hydro-extractor, hydro-extracting, drying, and scutching.—E. B.

Improvements in the Manufacture of Extracts from Logwood and other Dyewoods, also in Preparing Dyewoods for use in Dyeing. W. B. Espent, London. Eng. Pat. 11,472, July 6, 1891.

Logwood and other dyewoods are powdered with rough grindstones, against which they are pressed. The powdered wood is carried by a stream of water into a receiving cistern, from which the "woody matter with a sufficient quantity of water is taken to other cisterns in which it is stored and allowed to ferment if desired." It is then ready for use in dyeing. An extract may be prepared by "diffusing" in succession several quantities of the fermented wood with hot water, and when the liquor so produced is sufficiently concentrated, evaporating it down in a vacuum.—E. B.

Improvements in Machines for Printing Sarces, Scarves, Shawls, and the like. S. and J. Knowles, Tottington. Eng. Pat. 7184, April 14, 1892.

THIS invention relates to machines for printing headings or patterns intermittently, and has for its object the provision of means for arresting the rotation of the printing rollers whenever they are out of contact with the fabric on the impression cylinder and recommencing their rotation in exact register when they resume printing.—E. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Twenty-Eighth Annual Report on Alkali, &c. Works by the Chief Inspector. Proceedings during the Year 1891, presented to the Local Government Board and to the Secretary for Scotland. 1892. 6d.

THE number of works registered under the Alkali and other Works Regulation Act does not vary much from year to year. In England and Ireland during 1891 there were registered 113 alkali works and 798 other works, making a total of 911. Adding to these, 16 alkali works

and 121 other registered works in Scotland the total for the United Kingdom is 1,048, as against 1,034 in 1890 (see 27th Annual Report by Chief Inspector, this Journal 1891, 635).

Tables showing the number of works and also the number of separate processes under inspection are given, and then follows an interesting sketch, which indicates the nature of an inspector's duties when making his visit to one of the larger chemical works, and describes the *rationale* of the method adopted for finding the acidity of the mixed gases passing from flues and chimneys.

The following table shows the average results of the inspectors' tests of escaping gases.

TABLE OF AVERAGE AMOUNT OF ACID GASES ESCAPING FOR EACH DISTRICT.

	Dist. I. Ireland.	Dist. II. North of England.	Dist. III. Cheshire, N. Wales, and part of Lancashire.	Sub-Dist. Widnes.	Dist. IV. East Lancashire and Yorkshire.	Dist. V. South Mid- land.	Dist. VI. South- West of England and South Wales.	Sub-Dist. VII. Eastern Counties.	Average.		
									1891.	1890.	1889.
Hydrochloric acid in chimney gases. Grains per cubic foot.....	0.105	0.115	0.050	0.103	0.068	0.093	0.104	0.101	0.081	0.090	0.088
Hydrochloric acid. Amount escaping compared with that produced. Per cent.....	2.260	2.640	1.040	2.390	1.420	3.690	1.540	2.477	2.182	1.950	1.943
Acid gases escaping from sulphuric acid chambers given as SO ₂ . Grains per cubic foot.....	1.380	1.440	1.250	1.380	1.130	1.200	1.560	1.220	1.320	1.280	1.370
Acidity of chimneys given as SO ₂ . Grains per cubic foot.....	0.960	0.560	0.610	0.610	0.510	0.430	1.040	0.870	0.700	0.700	0.715
Acidity of gases from manure works given as SO ₂ . Grains per cubic foot.....	0.173	0.120	0.360	0.590	0.420	0.320	0.760	0.266	0.326	0.367	0.319

The figures in the above table are obtained by taking the average of the tests in each work and again averaging these to show the general result in each district; a final average of these results is then made which when compared with previous years may be taken as an indication of the progress or otherwise made in the country generally. It is seen that there is great uniformity in the averages for the three years given. The detailed reports of the various inspectors which are given in the Appendix show that the limits of acidity fixed by the Act are very rarely exceeded. The limit fixed for the amount of hydrochloric acid allowed to escape in the mixed gases of a flue or chimney is 0.2 grain per cubic foot of gases or 200 grains per 1,000 cubic feet, and the table shows that on the average actually only 81 grains per 1,000 cubic feet escapes. The limit fixed for the total amount of hydrochloric acid escaping compared with that produced is 5 per cent.; the proportion on the average that actually escapes is less than half this limit.

An increase in the general acidity of the chimney gases has doubtless been in part caused by a new regulation compelling the combustion of sulphuretted hydrogen coming from Claus kilns, and the consequent formation of sulphurous acid. This increase of acid is not apparent in the last table, because the acid gas does not often pass into the chimneys connected with the salt-cake department of the works, and it is these which are represented in the table.

In passing sulphuretted hydrogen mixed with a limited amount of air through a layer of heated oxide of iron, as in the Claus kiln, although the principal reaction taking place results in the oxidation of the hydrogen and deposition of sulphur, there is also a secondary reaction taking place simultaneously which reverses the process, and the sulphur vapour and water vapour react and form sulphuretted hydrogen and sulphurous acid. These gases when allowed to escape into the air were a great source of nuisance to

the neighbourhood owing to the offensive smell of the sulphuretted hydrogen. Many plans have been tried to remedy this defect in the Chance-Claus process, but none has been completely successful. The chief inspector found it therefore necessary to insist that in no case should sulphuretted hydrogen be discharged into the air, even if recourse must be had to the unsatisfactory plan of burning it in a fire. This method has been adopted in all but two of the works. The loss of sulphur due to this cause still goes on and in this way as much as from 10 to 15 per cent. of the sulphur in the tank waste is lost, probably amounting to not less than 4,000 tons a year. Much of the sulphurous acid thus generated may be arrested by absorption in a tower packed with limestone, down which water percolates. This plan has been put in operation at Messrs. Chance's works at Oldbury.

As in former reports some interesting statistics are given which illustrate the extent of the operations carried on in the various classes of work under inspection.

Salt decomposed in the Leblanc and ammonia-soda processes (including Scotland):—

	1891.	1890.	1889.
	Tons.	Tons.	Tons.
Leblanc process.....	567,803	602,769	581,203
Ammonia-soda.....	278,528	252,260	219,279
Total.....	846,331	855,029	800,482

It is seen that the ammonia-soda process still continues to gain ground against the older Leblanc process. A new ammonia-soda work is in course of erection in Cheshire.

Amount of sulphate of ammonia produced in the United Kingdom:—

	1891.	1890.	1889.
	Tons.	Tons.	Tons.
Gas works - - - - -	107,950	102,138	104,711
Iron works - - - - -	6,200	5,064	6,115
Shale works - - - - -	26,600	21,730	23,953
Coke and carbonising works - -	2,766	2,325	2,795
Total - - - - -	143,616	131,257	138,614

A considerable interest attaches to these figures as showing a great advance in the utilisation of what were once waste products. At present no commercially efficient process is known by which ammonia and its compounds can be made by the direct union of hydrogen and nitrogen. Until a recent date urine was the chief source of ammonia, and men not yet old can remember the urine tubs stationed at the street corners and behind the mill doors of Leeds and other woollen manufacturing towns. In the putrid urine thus collected was found the ammonia needed in the treatment of wool and its preparation for the loom. Now, almost the whole of the ammonia made is collected during the distillation of coal, a small quantity being obtained during the distillation of bones and other animal matter. The "ammonia-water" of gas-works yields our chief supply, next comes the distillation of paraffin oil shale, and following this rank the gases from blast-furnaces in which coal is used for smelting iron ores. Instead of allowing these gases to burn wastefully at the tops of the furnaces, as was formerly done, they are now conveyed in pipes to the boiler furnaces, where they are burnt to generate steam for the blowing-engines, &c., and to the heating stoves, where the heat of their combustion is utilised in heating the blast. "In so doing great inconvenience was experienced from the tar and liquor which tended to clog the pipes, so that a system of definite condensing and collecting of these matters had to be arranged. It was then found that this tar and ammonia had considerable value, and warranted the erection of large plant to collect them more completely. Great expense was incurred to this end. In one of the Scotch iron works as much as 18 miles of 3-in. iron condensing pipes are in use, together with mechanical scrubbers for separating the tar and ammonia from the gas before it is burnt. In some of the more extensive iron works as large a capital as 70,000*l.* has been expended in the erection of apparatus for the collection and manipulation of the tar and ammonia. To such an extent has this been found profitable that there are cases where more of the capital invested in an iron-smelting work is devoted to the collection and treatment of the tar and ammonia than to the production of the iron itself, and more profit is yielded by the former than by the latter, so that it may be said that a strange inversion has taken place, and that in some cases iron has become the by-product of an iron-smelting work, yielding the place of the main product to the ammonia, &c.

"The following figures will bear out this statement:—

"Taking first Scotland. The number of blast-furnaces at work is 77. Of these 57 are provided with condensing, scrubbing, and distilling apparatus for collecting the tar, ammonia, &c. I am informed that a blast-furnace of medium size costs, with its plant of blowing-engines and the like, about 7,500*l.*, and that the expenditure on the ammonia plant is in excess of this; so that in Scotland at present the apparatus for collecting the ammonia, tar, &c. from the gases of the iron blast-furnaces has cost over 444,600*l.* A goodly sum for collecting that which was formerly thrown away! And this must be on the increase, for if the outlay has proved remunerative when applied to 57 out of the 77 furnaces, one may expect the application to be still further extended.

"In England the tar and ammonia are saved in only one of the iron-smelting works. It is there applied to the gas coming from three furnaces, at a cost of 12,000*l.* per furnace,

which is an expenditure greater than that incurred in Scotland. The resulting profit has fully justified the outlay. The sulphate of ammonia produced is probably quite sufficient to pay for the interest on capital expended, while the naphtha, oils, and pitch obtained from the tar, bring up the profit account to a satisfactory figure."

The chief use for ammonia is agricultural, and there need be no fear that if the collection of ammonia were to become more general its price would decline and the process become unprofitable, because the demand for sulphate of ammonia as a manure is practically unlimited.

Tank Waste of the Alkali Works.—At Widnes alone, 500 acres of land are covered to a depth of 12 feet by heaps of old waste—ten million tons, all of which when fresh contained 15 per cent. of sulphur in a recoverable form. In its present state, owing to oxidation that has taken place, it is no longer according to our present knowledge commercially available. But in dealing with fresh waste, the Chance-Claus process has been largely and successfully applied. "To say that the process is not perfect would be true but ungenerous. It is the best hitherto proposed and has already proved a great boon alike to the manufacturers and the public. Already 80,000 tons of sulphur have been extracted from the tank waste at a cost which leaves a profit to the manufacturer. The present rate of production is about 900 tons a week and is fast increasing. The sulphur made is of the purest. I believe I may claim that the remarks made in my report for 1889 in anticipation of this large production have been verified; it has not brought down the price of sulphur, on the contrary, the price during the past year has been more than maintained. Doubtless the extra supply has been felt by the Sicilian producers. The amount sent here from Sicily has diminished. The recovered sulphur finds a ready market at home, and large quantities are exported to the United States and elsewhere." The desulphurised waste has still to be disposed of, but as after-treatment by the Chance process it consists chiefly of carbonate of lime, it can be deposited without fear of causing a nuisance. Attempts are being made to use the material in cement making.

In section 6, Alkali Act, it is declared that "alkali waste shall not be deposited or discharged without the best practicable means being used for effectually preventing any nuisance arising therefrom." In view of the success of the Chance method of treating the waste, the chief inspector thinks the time has now come when all producers of tank waste shall be called upon to desulphurise the waste, and when the depositing of untreated waste shall be considered an offence under the Alkali Act. In response to a letter addressed to the directors of the United Alkali Company, who are now the largest producers of tank waste, the chief inspector has received an assurance that the whole of the waste made at St. Helens shall be brought under treatment within six months, and that at Widnes it will all be under treatment by the end of 1892.

Chlorine.—No change has been made in the method of producing chlorine for making bleaching powder and chlorate of potash, but two works are in course of erection for making chlorine from hydrochloric acid by decomposing it with nitric acid instead of binocide of manganese. The one work is being built in Ayrshire where the process patented by W. Donald (see this Journal, 1887, 822; 1890, 1130) will be carried out, and the other work is in Cheshire, where the process patented by G. E. and A. R. Davis (this Journal, 1891, 463 and 546) will be operated. Should either of these processes prove successful it would give additional support to the Leblanc soda industry, because nearly the whole of the chlorine of the hydrochloric acid would be liberated instead of only one-half, as is the case when binocide of manganese is used as the oxidising agent.

Waste Pickle of Galvanising, &c. Works.—In order to cleanse the sheets or other articles of iron before immersing them in a bath of melted tin or zinc they are dipped in a bath of sulphuric or hydrochloric acid to remove the coating of oxide which would prevent the cohesion of the metal. The solution of ferrous sulphate or chloride thus obtained was until recently allowed to flow away. Now it has become common to allow the sulphate of iron to crystallise

from the pickling liquor and to use the acid mother-liquor over again in the pickling vats, with a further addition of sulphuric acid. Another process devised by T. Turner, of the Mason College, Birmingham, applies to the treatment of pickle containing chloride of iron. The acid liquor is made to flow slowly on the heated bed of a reverberatory furnace with access of air, when it is decomposed with the liberation of hydrochloric acid and formation of ferric oxide which can be used as a colour or as a fettling in puddling furnaces. The hydrochloric acid is condensed in towers and used over again in the pickling vats.

Nuisance from Chemical Works.—Complaints, especially in the Widnes district, are still made of offensive odours. At Widnes the old heaps of waste have been causing a considerable nuisance. Means have been taken by repairing the banks and covering them with a thick layer of inert material to diminish the nuisance. It is pointed out that the injury to vegetation in the neighbourhoods of both Widnes and St. Helens is due chiefly to the sulphurous acid in the coal smoke, and the following figures which refer to St. Helens show the quantity of acid gas annually discharged into the air. It is nearly all sulphurous or sulphuric acid. The hydrochloric acid from alkali works is taken as its equivalent of sulphur acids and added to the rest. The coal burnt is chiefly slack containing about $1\frac{1}{2}$ per cent. of sulphur.

	Tons Sulphur per Annum.
From copper and lead works	11,480
From glass works	7,500
From polishing powder furnaces	333
From coal, burnt ($1\frac{1}{2}$ per cent. of 1,010,000)	15,000
From Chance-Claus process	620
From sulphuric acid chambers	173
From alkali works	402
	<hr/> 36,108

Taking this sulphur as being burnt to sulphurous acid it amounts to 72,216 tons per annum. It will be seen that only about $1\frac{1}{2}$ per cent. of the whole comes under the supervision of the Alkali Act.

Comparing St. Helens with London, the comparison is much in favour of the latter. In London about 1,250,000 tons of coal, containing about 1 per cent. of sulphur, are burnt per annum, and nearly all burnt in household fires. In regarding the effect upon vegetation, however, the summer consumption must be taken, and this may be put at one-fifth the yearly consumption. The summer acidity is represented therefore by 1 per cent. of one-fifth part of the yearly consumption, or 2,500 tons of sulphur. This amount is spread over an area of about 15 miles square or 225 square miles, which gives a little over 11 tons per square mile during the summer months and 44 tons during the winter. At St. Helens the area is over only three square miles, so that there is there 12,036 tons of sulphur per square mile as against 11 tons in London.

Prosecutions under the Act.—There have been only three, two of which were for non-registration, and the third was the Northwich Gas Company for allowing the escape of sulphuretted hydrogen from the oxide of iron purifier.

Influenza.—It having been asserted that workers in chemical works enjoyed a greater immunity from influenza during the epidemic of last year than other people, some statistics have been collected, and a comparison drawn so far as the figures allow between the men actually engaged in chemical processes and those employed as outside labourers, artisans, or at steam boilers. A table is given showing the number of cases, also whether severe or slight, and the number of men employed in each description of work. On the whole it appears that the average number of cases among the labourers and artisan class was 16.35 per cent., as against 9.08 per cent. among the chemical workers. The figures given in the table seem to point to some protection from influenza in the case of men employed in chemical works.

In the Appendix, the separate reports of the district inspectors are given, which contain much valuable detail, for which readers must be referred to the originals.

Scotch Works.—There is a separate report for Scotland. The number of works registered during the year was 137, of which 16 are alkali works, and 120 are other works, comprising in all 180 different processes under inspection. Two alkali works were closed by the United Alkali Company during the year, and two new ones are in course of erection, one on the old lines of the Leblanc process, while at the other chlorine will be made, as already mentioned in the report for England and Ireland, by the oxidation of hydrochloric acid with nitric acid by Donald's process, instead of with binoxide of manganese.

No prosecutions under the Act for escapes of acid have been found necessary, the times when the legal limits were exceeded being very few, and due to accidental causes that were speedily remedied.

The consumption of brimstone for making the higher qualities of sulphuric acid has been greatly restricted by the high price of brimstone, and acid made from pyrites and afterwards purified from arsenic by sulphuretted hydrogen, or from pyrites containing little or no arsenic is being more largely manufactured, and is gradually displacing acid made from brimstone.

Chemical Manure Works.—Of these there are 47 in Scotland. The acid vapours arising from the decomposition of mineral phosphates by sulphuric acid, consisting largely of fluorine compounds, are condensed and washed in high towers, and the average of the year's working shows that 92.6 per cent. of the acid is thus removed and prevented from passing into the air. In many cases, too, the condensation of the fetid vapours arising from the steaming of bones, drying of fish, &c., and the burning of the residual gases has been recommended.—H. S. P.

The Boric Acid and Borax Industry. Scheuer. Zeits. f. ang. Chem. 1892, 241--248.

In 1870 Germany took up the borax and boric acid industry, and now produces enough of these articles to cover the home consumption. The consequent fall in the price of borax has been from 120 marks to 60 marks per 100 kilos., the latter figure being maintained by the German Borax Union.

Borax and boric acid are most extensively used for enamelling metal vessels, and to illustrate this application the author quotes the following recipes for the purpose:—

First Coat.—(1.) Free from lead: Quartz 9, soda $3\frac{1}{2}$, borax 7, stannic oxide 2, zinc oxide 1, magnesia 2. (2.) Containing lead: Silica 30, borax 16, lead oxide 4, ammonia-soda 5, saltpetre 11. (3.) Easily fusible: Borax 22, quartz 36, white lead 5, soda 2, magnesia 1.

Glaze.—(1.) Quartz 20, borax 12, white lead 4, soda 6, stannic oxide 13, ammonium carbonate 3, saltpetre 5, magnesia 3; 4—6 parts of magnesia and as much silica are added during the milling. (2.) Free from lead: Felspar 20, quartz 4, borax 21, stannic oxide 13, saltpetre 4, ammonium carbonate 1, magnesia $2\frac{1}{2}$, soda 7.

Other applications of boric acid and borax are:—(1) in glaze for porcelain; (2) for optical glass; (3) for fluxing metals; (4) in the laundry, in the form of "brilliant starch," a mixture of rice-starch and borax; (5) for stiffening (?) the wicks of stearin candles; (6) as a preservative, particularly for fish, which are best pickled in a solution of boric acid, and submitted to a pressure of six atmospheres, whereby 2 grms. of the acid are absorbed per kilo. of fish; (7) in medicine; (8) for making Guignet's green, and golden varnish for metals, the latter being a mixture of boric acid, picric acid, and shellac; (9) for preserving skins for the tanner; (10) in the form of manganese borate as a sicative for oils; 2 kilos. of finely-powdered manganese borate are heated to 200° in 10 kilos. of linseed oil with constant stirring, and the mixture poured in a thin stream into 1,000 kilos. of linseed oil heated to just below "boiling" and kept at that temperature for 20 minutes; (11) in calico-printing borax is used as a substitute for cow-dung;

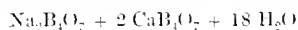
(12) as a substitute for gum arabic a mixture of borax and casein is employed.

The sources of refined boric acid and borax are (1) natural boric acid; (2) natural borax or tincal; (3) boronatrocalcite (Chili borate of lime); (4) Pandermite from Asia Minor (Turkish boracite); (5) Stassfurtite (Stassfurt boracite).

—	H ₂ O.	Insol.	NH ₄	Na ₂ O	K ₂ O	CaO	MgO	Fe ₂ O ₃ and Al ₂ O ₃	Cl	H ₂ SO ₄	B ₂ O ₃	Crystallised Boric Acid.
Tuscan	42.03	0.96	1.23	..	0.72	0.4	0.83	0.28	0.06	7.04	46.47	82.31
Californian	45.29	0.22	..	1.01	..	0.47	0.15	0.67	0.97	1.00	50.87	90.11

Thibet borax was originally refined in Venice, Holland, and France; it has now been well-nigh eclipsed by Californian borax. For a description of the Californian borax deposits see Hake, this Journal, 1889, 854. The output from the Californian deposits in 1889 was 8,946,171 lb., and in 1890 it was 12,000,000 lb. (See also this Journal, 1889, 590.)

Chili borate of lime—boronatro-calcite and alexite, occurs in white fibrous nodules, sometimes as large as the fist; the composition of the pure mineral is—



and the commonest impurities are calcium sulphate and sodium chloride; details as to the occurrence of this mineral will be found in this Journal, 1888, 748. It was exported from Chili in 1883 to the extent of 3,000 tons; in 1887 Hamburg absorbed 6,000 tons, of value 1,300,910 marks, from Chili, and 600 tons, of value 158,610 marks, from the Argentine. In Hamburg 100 kilos. of borate of lime, containing 40 per cent. of anhydrous boric acid, costs 28 marks, being valued at 35 pf. (*sic*) per 1 per cent. per 100 kilos. In Liverpool the market price per ton is also regulated on a basis of 40 per cent. The following analyses are quoted as illustrative of German and English custom in reporting on the value of this mineral; the first table is German, the second English:—

GERMAN ANALYSIS.

—	Ascaton.	Ascaton.	(Probably) Marienburg.
Water	19.86	16.14	21.02
Sand	1.95	5.35	14.14
Sulphuric acid	0.82	0.28	14.76
Chlorine	9.64	12.93	3.23
Ferrie oxide and alumina	0.24	0.55	2.35
Lime	12.31	16.38	13.11
Magnesia	0.37	10.19	6.91
Soda	15.91	0.85	9.11
* Boric acid	38.01	39.63	21.47
	102.17	102.34	100.73
O equivalent to Cl	2.17	2.50	0.73
	100.00	100.00	100.00

* Equivalent to:—

Crystallised boric acid	67.59	70.20	58.54
Crystallised borax	103.79	108.13	58.69

The establishment of artificial lagunes in 1818 and artificial soffioni in 1854 placed the manufacture of natural boric acid on a sound footing; the export from Tuscany was 700 tons in 1846, 2,000 in 1860, 2,225 in 1870, and 3,500 in 1887. Californian boric acid vies with the Tuscan article in purity, as the following analyses will show:—

ENGLISH ANALYSIS.

—	100 Tons ex G. A.	200 Tons ex G. A.	95 Tons ex G. P.
Biborate of lime	23.31	23.43	24.49
Biborate of soda	25.80	25.25	25.15
Sulphate of lime	1.62	1.63	1.73
Calcium chloride	3.66	3.13	4.00
Magnesium chloride	1.26	1.28	1.02
Sodium chloride	11.20	12.60	10.18
Alumina and ferric oxide	0.60	0.50	0.90
Insoluble	5.20	4.20	3.95
Water	26.80	27.27	28.56
	100.15	100.08	99.98
Anhydrous boric acid	33.07	32.78	33.40

Turkish boracite, pandermite ($\text{Ca}_2\text{B}_6\text{O}_{11} + 4 \text{H}_2\text{O}$) is marketed in the form of thick white fragments; it is tolerably hard, thus differing from the borocalcite of Iquique ($\text{CaB}_3\text{O}_7 + 6 \text{H}_2\text{O}$), which consists of soft, snow-white, crystalline needles. Pandermite was discovered in 1869; in 1890, 15,024 hectokilos, and in 1891, 16,835 hectokilos, were imported into France. Of the following commercial analyses, No. I. is of an earlier date than No. II.:—

I.

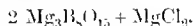
Boric acid	40.895
Lime	27.222
Magnesia	0.210
Calcium carbonate	6.818
Calcium sulphate	1.462
Calcium silicate	1.508
Sodium chloride	0.439
Magnesium chloride	0.086
Water	18.060
Residue	3.270
	100.000

II.

Boric acid	45.27
Lime	39.78
Magnesia	0.57
Sulphuric acid	2.11
Silica	2.47
Ferrie oxide	0.69
Water	18.20
	100.00

Stassfurt boracite (stassfurtite) occurs in the salt mines as roundish-white nodules, from the size of a barley-corn to

that of a bead, imbedded in the salt; its composition is approximately expressed by the formula—



Pinnoite and kaliberite accompany it. The following analyses are given:—

Boric acid.....	55.27	44.43
Magnesia	23.05	23.58
Magnesium chloride	13.24	12.43
Magnesium sulphate	0.06	..
Ferrie oxide.....	0.51	0.58
Insoluble matter	0.54	0.61
Water	7.33	7.34
	100.00	100.00

The output in kilos. was 159,000 in 1883; 179,897 in 1888, and 120,842 in 1889; the value in marks per 100 kilos. of the washed and dried mineral was 114 in 1870; 90 in 1882; 70 in 1883; and 40 in 1890.

The refining of Tuscan boric acid is effected by dissolving the crude acid in water heated by open steam, until the gravity of the solution is 6° – 8° B., and continuing the heat, after the addition of powdered, freshly-ignited animal charcoal, until a filtered sample appears quite colourless. The clarified liquor is then cooled in wooden crystallising vats.

It is very difficult to obtain refined boric acid from the low grade boronatrocalcite of Maricunga, but the Ascotan mineral is profitably worked by grinding and decomposing it with hydrochloric or sulphuric acid, while it is kept well stirred in water heated with open steam; the crystallisation takes place in wooden vats. Pandermite may be similarly treated after it has been finely pulverised. Stassfurtite is decomposed in the same way, save that sulphuric acid is preferable, inasmuch as it conduces to a better coloured product, and to the recovery of magnesium sulphate from the mother-liquor; well washed and dried boracite yields 80 per cent. of its weight of crystallised acid.

The large leafy crystals of boric acid, affected by some, are obtained by allowing a nearly saturated, hot solution to cool in earthenware vessels of some 150 litres capacity, kept covered and surrounded with non-conducting material in a place free from vibration; the crystallisation takes from 8 to 12 days.

Prior to 1870 nearly all European borax was made from boracic acid; the process is a very simple one when the following conditions are observed:—(1.) Borax crystallises best when some 5 parts of soda crystal per 100 parts of crystallised borax are added in excess. (2.) If the excess of soda be too great the neutral borate ($\text{NaBO}_3 + 4 \text{H}_2\text{O}$) will crystallise. (3.) If the hot liquor exceed the gravity 24° – 28° B. octahedral borax ($\text{Na}_2\text{B}_4\text{O}_{10} + 5 \text{H}_2\text{O}$) will crystallise. (4.) The best crystals can only be obtained by cooling the hot solution, of the correct strength, very slowly in large vats of at least 5 cubic metres capacity. Finely powdered borax is either made from the detritus of borax crystals, or by agitating the borax liquor in small crystallising vessels.

The preparation of borax from boronatrocalcite has been described by Witting (this Journal, 1888, 748).

The manufacture of borax from pandermite by heating it with soda has not been accomplished, probably because the lime and boric acid therein are not in the right proportions for conversion into borax. An English Patent (No. 2526, February 17, 1890) deals with this point. (See this Journal, 1891, 367.)—A. G. B.

Negrier's Method of Concentrating Sulphuric Acid. Eng. and Mining J., 1892 August 6, 123.

THE high price of platinum has caused a good deal of trouble among the firms in Europe who manufacture highly concentrated sulphuric acid of 66° B. Up to the present time platinum vessels were used for containing the acid during concentration, as this metal is capable of resisting the attacks of the acid better than any other material. During the last year or two the continuously advancing price of platinum has made it necessary to find some substitute. The most practicable of the new processes is that of M. Negrier, who employs a series of specially-made porcelain dishes. These dishes are placed in a row, each a little lower than the other, and they are arranged inside an oven, the interior of which is kept steadily at a temperature of 145° – 149° C. The acid at 58° – 60° B. coming from the chambers enters the first dish in the oven, and passes gradually down the series of dishes, and finally leaves the oven at a concentration of 66° B. In a plant already erected by M. Negrier there are four ovens, each containing two sets of eight dishes. Each oven produces 1,250 kilos. of concentrated acid a day, with a consumption of 24 kilos. of fuel per 100 kilos. of concentrated acid. Only five porcelain dishes out of 64 were broken in a month, and as each one cost about a dollar, the item of repairs and renewals is small enough compared with the interest on capital represented by the use of platinum retorts. The ability of the workman to avoid breakages of dishes and damages to the ovens are the chief points that affect the practicability of this process, but with a little practice economical results are obtained. On an average, one workman is able to turn out 10 tons a day. The porcelain dishes are manufactured in Limoges, France.

Kretschmar (Chem. Zeit. 16, 418) recommends the process highly, but he adds that the space required for the plant is much greater than that required for platinum apparatus, and superintendence is more irksome (this Journal, 1891, 46 and 639).—W. S.

The Solubility of Tricalcium and Bicalcium Phosphates in Solutions of Phosphoric Acid. H. Gausse. Compt. Rend. 114, 1892, 414–417.

Six solutions (numbered 1 to 6) of orthophosphoric acid were prepared, all having a volume of 100 cc., and containing respectively 5, 10, 15, 20, 25, and 30 grms. of orthophosphoric acid, H_3PO_4 . Whenever this strength was exceeded (whichever phosphate was being examined) monocalcium phosphate was deposited.

Solubility of Tricalcium Phosphate.—The six solutions were saturated by adding tricalcium phosphate in slight excess and allowing to stand for 24 hours. They were then filtered and the calcium was estimated as oxalate, and the phosphoric acid determined by titration with a solution of uranium. The following results were obtained:—

Solution.	Anhydrous Phosphate dissolved.	Monocalcium Phosphate formed.
No.		
1	3.85	8.05
2	7.28	16.59
3	9.45	19.79
4	12.50	21.57
5	13.79	31.44
6	15.10	34.42

A comparison of these numbers shows that the largest proportion of the tricalcium phosphate is converted into monocalcium phosphate in solution No. 2, which contains 10 per cent. of phosphoric acid.

Solubility of "Bicalcium Phosphate."—In the same way the author prepared and examined six saturated solutions of

"bicalcium phosphate" (corresponding to the formula $\text{CaHPO}_4 + \text{H}_2\text{O}$), with the following results:—

Solution.	Anhydrous Bicalcium Phosphate dissolved.	Monocalcium Phosphate Formed.
No. 1	4.30	7.60
2	7.15	12.30
3	9.30	16.00
4	11.86	20.40
5	13.40	23.00
6	15.10	26.00

In this case the amount of monocalcium phosphate formed is greatest in solution 1, which contains only 5 per cent. of orthophosphoric acid.—D. E. J.

PATENTS.

Improvements in the Production of Caustic Alkali and Chlorine. F. M. Lyte, London. Eng. Pat. 8692, May 21, 1891.

It is now proposed to decompose sodium nitrate with ferric oxide, instead of calcium carbonate, as suggested in a previous patent (Eng. Pat. 5352; this Journal, 1891, 1006). —H. A.

An Improved Method of Recovering Carbonic Acid Gas from Lime Kilns and Furnaces, and Apparatus in connection therewith. W. Walker, London. Eng. Pat. 9561, June 5, 1891.

It is proposed to absorb the carbonic acid contained in lime kiln or flue gases in sodium carbonate, with or without the aid of pressure, and allowing the indifferent gases to escape. The temperature is then raised and a vacuum applied, when carbonic acid is given off from the bicarbonate and sodium carbonate reformed, which may be used for a fresh operation.

The apparatus consists of a series of spherical cast-iron retorts made in halves. The gas enters at the top and finds exit at the bottom of each retort, after having passed through a layer of sodium carbonate spread over a filter cloth, the edges of which are held tightly between the flanges of the hemispheres. The filter cloth is also supported by a perforated shelf placed on a coil of steam-piping. The outlet of the last retort dips into a column of water.

In working the process, the weak carbonic acid from the above sources is washed and passed through the apparatus until sufficient has been absorbed. The nitrogen which fills the apparatus is then replaced with pure carbonic acid from a gasholder, and the temperature of the retorts raised to 170° F. by admitting steam or hot water in the coil of piping. The bicarbonate is hereby decomposed and pure carbonic acid given off, and is drawn off by means of an aspirator. When the evolution of carbonic acid ceases, the temperature is reduced to 70° F. by causing cold water to circulate through the coil of piping, and the sodium carbonate hydrated (in which state it absorbs carbonic acid more readily) by admitting into the retorts a spray of water.

Potassium carbonate may be used in lieu of sodium carbonate. The carbonic acid produced in either case may be compressed in cylinders for sale.—H. A.

Improvements in the Manufacture of Carbonic Acid Gas and Apparatus for Use therein, and in Tubes for containing Carbonic Acid Gas. D. Rylands, Stairfoot. Eng. Pat. 9732, June 9, 1891.

The improvements refer to the production of pure carbonic acid from limestone or chalk in closed retorts, by applying to the same "the proper heat" and a partial vacuum. Fine or rough limestone may be used; a thin layer of the former is charged in a horizontal or a somewhat inclined retort, whilst the rough limestone is preferably charged in vertical retorts provided with a charging door on top, and discharging doors on the bottom. The carbonic acid evolved is scrubbed and then compressed in steel or glass tubes.—H. A.

Improvements in obtaining Chromates and Bichromates of Potash and Soda. T. Goodall, Glasgow. From S. Peacock, Bridgeton, U.S.A., and H. A. Galt, Philadelphia, U.S.A. Eng. Pat. 11,311, July 3, 1891.

In the calcination of chrome ore with potash salts, as much as 15 per cent. of the latter are volatilised or mechanically lost. This may be avoided by not using the potash salts until after the calcining stage. Thus 500 parts of chrome ore are roasted with a mixture of 500 parts of caustic lime and 60 parts of soda ash. The resulting mixture of calcium and sodium chromate separated with water, and the residue of calcium chromate decomposed by repeated boiling with the required quantity of a solution of potassium sulphate or a mixture of the same with sodium sulphate. In an alternate method, the calcined material may be converted into soluble bichromates by treatment with carbonic acid gas.—H. A.

Improvements in the Manufacture of Anhydrous Chloride of Magnesium, and the Apparatus used therein. T. H. Bell, Middlesbrough. From T. Schloesing, Paris, France. Eng. Pat. 11,469, July 6, 1891.

In a previous patent (Eng. Pat. 11,821, this Journal, 1888, 626) it was proposed to concentrate a magnesium chloride solution to form "chloride of magnesium in grains," to dehydrate this by heating in a current of hydrochloric acid gas, and finally decompose it by means of heat and a current of air. It is now found of advantage to finish off the concentration of a magnesium chloride solution in a covered cast-iron pan provided with a mechanical stirrer. The combustion gases from an adjacent furnace pass over the charge, entering through openings pierced in the top of the rim and leaving by holes on the opposite side.

The complete dehydration of the "magnesium chloride in grains" so formed is effected at a dull red heat in a series of, say, three horizontal cast-iron cylinders placed vertically over one another and provided with spiral blades for the forwarding of the material, which enters the top cylinder and passes by means of spacious bends into the cylinder below, leaving at the lowest cylinder. In the same time hydrochloric acid gas passes through the cylinders and the bends in the opposite direction to that of the material.

—H. A.

Improvements in the Manufacture of Chlorine, and in the Apparatus used therein. T. H. Bell, Middlesbrough. From T. Schloesing, Paris. Eng. Pat. 11,470, July 6, 1891.

This is an apparatus for carrying out the operations described in the preceding patent. A gas retort is provided, with an earthenware grid a short distance from the bottom, which carries a charge of granulated magnesium chloride. The retort is heated to redness, and air is admitted on the surface of the charge, which is oxidised, chlorine being evolved, and, being heavier than the residual nitrogen, descends and leaves by a lateral opening below the grid. When using "magnesium chloride in grains," and admitting steam instead of air, hydrochloric acid will be formed, which, being heavier, descends in the way described before.

The same apparatus may be used for dehydrating "magnesium chloride in grains," by introducing hydrochloric acid gas from below the grid; the aqueous vapours formed being the lighter of the two, the gases will assume an upward flow.

—H. A.

Improvements relating to the Refining of Sulphur and the Distillation of Sulphur and other Ores, and to Apparatus therefor. L. L. Labois, Paris, France. Eng. Pat. 11,484, July 6, 1891.

THE material to be treated is introduced into one or more retorts which are open at both ends. One of the extremities terminates at the front of the furnace in which the retorts are placed, and the other in a small chamber provided between the retort and a condenser which is continually cooled. After charging the retorts and closing them at the front of the furnace, they are heated by means of a furnace receiving a blast or preferably by the gases from a "gasogene supplied with a blast," so that the burnt gases shall pass to the interior of the retort rather than to the outlet, by reason of the porosity of the products vaporised therein. By this arrangement the loss by escape during the distillation is materially reduced. Moreover, for augmenting the preponderance of the external pressure over that in the interior of the retort, the distilled products are carried over by means of an exhausting apparatus used with the condenser. For entirely preventing escapes, the retorts are made of two walls, the inner wall consisting of cast iron and the outer wall of refractory material, which not merely precludes the flame impinging against the iron, the refractory material serving as a screen, but also prevents any considerable loss of vapour in case of serious damage done to one of the walls.

The apparatus is said to present the following advantages:—(1.) Great diminution of the loss caused by filtration of the vapours through the walls of the retorts. (2.) Continuous distillation due to the arrangement of the channels of the retorts with the condensing chambers enabling the bottom of the retorts to be hermetically sealed, thus effecting a complete isolation of the retorts from the condensers and rendering it possible to carry out the process in the condensers without any necessity for previously cooling the retorts; in fact the temperature of the latter may be fully maintained. In the case of refining, the operation is made continuous by an arrangement of upper melting vessels, and in the case of working sulphur ores by providing, at the head of the retorts, vertical channels descending into pits for collecting the spent residues without access of air below the ground of the works, and without having to remove them from the furnace. (3.) A large output and facility of conducting the working of the furnace obtained by the general arrangement and by the appropriate distribution of the retorts; and (4.) Continuous condensation obtained by cooling in a metallic receptacle which is constantly sprinkled.—D. B.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Action of Carbon on Sodium Sulphate in Presence of Silica. Scheurer-Kestner. *Compt. Rend.* **114**, 1892, 117—120.

It is generally admitted that the reactions taking place in the manufacture of glass or soluble silicates, when alkaline sulphates, carbon, and silica are heated together, may be represented by the following equation:—

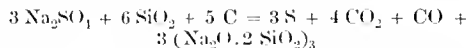


The proportion of the carbonaceous reducing agent is of great importance. If insufficient, the glass is incompletely formed, containing portions of alkaline sulphate enclosed;

if excessive, the glass is sulphurous. The solution, in the case of silicate of soda, blackens lead salts. But it is a fact that has for long attracted the attention of the author, that the quantity of carbon necessary considerably exceeds that indicated by the above equation. There are theoretically required for 100 parts of sodium sulphate, for example, 4.22 parts of carbon, and threefold this proportion may be used in practice without the formation of sulphide of sodium, and it is necessary to employ more than double the theoretical proportion named in order to ensure the complete decomposition of the sodium sulphate. The author has studied the reaction in analysing the gases produced.

As the result of numerous experiments he finds that the sulphur of the sulphate of sodium is in the first instance liberated as sulphur vapour, mixed with much carbon dioxide and a small quantity of carbonic oxide. Even in presence of a large excess of oxidising material (sulphate), the proportion of carbonic oxide is an important factor, forming one-sixth part of the total gaseous products. It is probable that this carbonic oxide is the final consequence of a decomposition giving rise to sulphurous acid, which latter is itself decomposed by carbon at a high temperature. Berthelot has shown in 1883 that by this latter reaction oxysulphide of carbon is formed, and that the heat transforms this into carbonic oxide. The following *rationale* is given of the reactions taking place in the preparation of a silicate:—

Silica partially decomposes the sodium sulphate, SO_3 being set free, and as quickly decomposed and transformed into SO_2 and O . The carbon, in reacting upon the first products of the decomposition, forms with them a mixture of sulphur, CO_2 , and CO . It had been formerly concluded with regard to SO_3 , among the gaseous products emitted from glass-works, that this was an immediate product of the decomposition of sodium sulphate. However, it is only the final product, the result of the contact of sulphur vapour with the combustion gases, *i.e.*, with an oxidising atmosphere. Thus the formation of silicate of soda is translated as follows:—

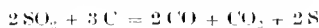


and this is an equation which requires 14.8 of carbon for 100 of sodium sulphate, and furnishes a gas containing 25 per cent. of CO , but it is only an approximate formula.

The presence of sulphide of sodium in the silicate or the glass prepared with too large a quantity of carbon is probably due to a secondary reaction. In introducing into the mixture too large a quantity of powdered charcoal, the contact between the sulphate and the silica is rendered less immediate; the phenomena of reduction are certainly accelerated, and there are formed here and there small quantities of sulphide of sodium, which resist the action of the silica, for the quantity of sulphur formed is not in exact accord with the excess of carbon; it increases in a much smaller ratio.—J. C. C.

The Decomposition of Sulphur Dioxide at High Temperatures by Carbon. Scheurer-Kestner. *Compt. Rend.* 1892, **114**, 296—298.

EXPERIMENTS in this direction were carried out on account of results obtained in the analyses of gases evolved in the manufacture of glass or silicates of the alkalis (see preceding abstract). The question was discussed for temperatures not above a red heat by Berthelot (*Ann. de Chim. et de Phys.* [5] 1883, 554), when it was shown that carbon monoxide, carbon dioxide, carbon bisulphide, and carbon oxysulphide were formed. In the present case, however, the experiments were performed at a white heat, with the result that only sulphur and the oxides of carbon could be noticed as products, the reaction being sufficiently accurately represented by the equation—



—T. L. B.

PATENTS.

Improvements in Kilns for Heating and Burning Pottery and the like. T. Severn, Heanor, Derbyshire. Eng. Pat. 11,617, July 8, 1891.

THE object of the invention is to economise fuel and to effect more perfect combustion, and relates to kilns in which the fire-holes run longitudinally. Separate chambers or flues are built parallel with the fire-holes, with which they communicate, and introduce atmospheric air in quantities regulated by dampers. The air is supplied at the tops of the fire-holes.—V. C.

Improvements in Plate Glass, in the Art of Rolling same, and in Machinery therefor. E. Walsh, jun., St. Louis, U.S.A. Eng. Pat. 9428, May 18, 1892.

THE usual practice in producing plate glass is to roll on a plane surface with a plane roller. Corrugations or other particular forms of surface are given by using a second roller whilst the material is still in a semi-fluid condition, the surface of the roller having the reverse configuration of that which is imparted to the plate. The second surface of the plate is left flat.

In this invention a plate is produced similarly surfaced on both sides in one operation. For a corrugated plate the bed is longitudinally grooved, and the roller is grooved round its circumference. The two systems of grooves work together as male and female parts. The roller can be accurately adjusted laterally and vertically. The greatest advantage possessed by plates formed in the new way is that they can be properly annealed, which is impossible with plates flat on one side and corrugated on the other. They are also, weight for weight, much stronger.—V. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

PATENTS.

Improvements in the Manufacture of Portland Cement and Similar Materials, and in Apparatus therefor. T. H. Lodge, Normanby. Eng. Pat. 11,618, July 8, 1891.

THE apparatus consists of a kiln with a dividing arch, in which are set gas retorts, the product of which is used for heating and lighting purposes, or for the production of power in the works, or for supplementing the supply of fuel to the kiln, as well as for lighting the drying chamber when its contents are to be raked out. The coal is fed into the retorts by a scoop, and withdrawn in like manner. The scoop used for removing the coke and transferring it to the kiln is made of two sheets of metal separated by slag wool, which may be "caused to absorb water for cooling purposes." The hot gases from the kiln pass over a "pre-heating incline," upon which the dried slurry is deposited from a hopper. It is perforated and provided with a flue conveying the gas to drying vaults and floors charged from the top of the drying chamber by slurry pipes, the slurry being allowed to flow from one plate to another until the chamber is filled. The dried slurry is raked by hand out on to a floor, whence it is transferred to the hopper mentioned above. The distribution of the slurry in the kiln is effected by the dividing arch, portions of slurry being raked from the "pre-heating" incline so that they fall on the nearer or farther side of the division as desired. A draught through the kiln is produced by a fan (with a water-cooled spindle) driven by a gas engine and provided with a governor, or by a steam jet. Over-heating of the drying chambers is prevented by the use of a fusible wire supporting a weight and covered with wet slurry, so

arranged that on the slurry becoming dry and allowing the wire to fuse, the weight is released and the damper closed. The explosion of any mixture of air and gas in the gas flues on starting the kiln may be prevented by displacing the air with carbon dioxide.—B. B.

Improved Process of Manufacturing Hydraulic Cement. G. Williams, Winnipeg, Canada. Eng. Pat. 13,016, July 31, 1891.

CALCIUM carbonate is calcined to caustic lime and put into a steam-tight tank, into which steam, generated in a boiler containing a solution of 1 part of silicate of soda in 100 parts of water, is admitted at a pressure of at least 20 lb. to the square inch. Instead of causticising the carbonate of lime, it may be treated direct with a solution of silicate of soda instead of with steam from a solution of that substance. In either case the strength of the solution may be varied. The boiler containing silicate of soda solution may serve a double purpose, the steam being led away for the first method of treatment, and the solution for the second. The product is mixed with clay or similar material containing alumina and silex, and a thin paste composed of calcium chloride, 1 part; quicklime, 10 parts; and warm water, 156 parts added. The resulting mass is moulded, dried, and burnt.—B. B.

An Improved Process and Apparatus for Producing Hydraulic Mortar. C. Bloemendal, Berlin, Germany. Eng. Pat. 13,616, August 12, 1891.

THE process consists essentially in mixing hydraulic cement and sand in a closed vessel, with water from which air has been expelled, under conditions whereby the air entangled in the cement and sand is driven out during the process of mixing. The apparatus patented for this purpose consists of a cylindrical vessel with conical bottom and slightly domed top, in which the cement and sand are placed, and into which water that has been previously boiled is introduced, and then pressure exerted by a pump. A stirrer brings about the admixture of the contents of the vessel. The stirrer has a hollow shaft carrying hollow blades provided with filtering faces through which the water and residual air are forced by the pressure produced by the pump, over into a reservoir, in which they are separated, and whence the water is again drawn and put into circulation. By repeated use of the same water, it becomes saturated with the soluble constituents of the mortar, and lixiviation is prevented.

—B. B.

Improved Process of Producing Imitation of Terra-Cotta. W. Schieming, Berlin, Germany. Eng. Pat. 13,738, August 14, 1891.

"TERRA-COTTA chips, ordinary bricks, fireproof bricks, clinkers, &c. in powdered form," coarse or fine, according to the size of the articles to be made, are mixed with "burnt powdered gypsum and burnt slaked lime and water," made into a mortar and moulded. The process of hardening may be hastened by adding "burnt powdered or effloresced lime." The articles are impregnated with baryta water to convert the calcium sulphate into the barium salt, the lime formed uniting with carbonic acid which may be that naturally present in the air or may be introduced as "smoke-gases," or by treatment with a solution of ammonium or potassium carbonate. Ornamental articles not subject to rough usage may be moulded without pressure, in which case the moulds may be made of wax, glutinous substances, gutta-percha, and the like. The proportions of the ingredients may be varied according to the purpose in view.—B. B.

Improvements in and relating to the Construction of Bricks.
C. Borrger, Philadelphia, U.S.A. Eng. Pat. 8352, May 3, 1892.

The bricks are provided with projections and depressions to form bands between each adjacent pair of surfaces. The projections may be in the form of studs or ribs, and corresponding depressions or grooves, which are arranged equi-distant from each other; those nearest the sides or ends of the brick are at a distance from the edge equal to one-half the distance between adjacent projections or depressions, so that the bricks may be laid upon each other lengthwise or transversely without affecting the precision with which the projections and depressions fit into each other. The use of grooves can be adopted to allow of the withdrawal of a brick without disturbing its neighbour. The form of brick patented is especially adapted for furnace linings, as displacement during use is prevented by the system of bonding adopted.—B. B.

X.—METALLURGY.

Iron and Steel Institute.

THE President (Sir Frederick Abel), during the delivery of his address (26th May 1892), bore witness to the extraordinary rapidity with which steel had to so large an extent superseded iron during the last 25 years. He said that in 1867 only 160,000 tons of Bessemer steel were produced in the United Kingdom, while open-hearth steel was not then a staple product. In 1890 more than 2,000,000 tons of Bessemer steel and 1,250,000 tons of open-hearth steel were made.

A paper on "Experiments with Basic Steel" was then read by Mr. W. H. White, C.B., F.R.S., Director of Naval Construction, in which the author gave a summary of the results of an inquiry which had been carried on by the Admiralty during the last six years as to the quality of basic steel. The tests made up to 1887 on rolled steel were recorded in the paper read before the Institution of Naval Architects by the author in that year. He then suggested that experiments on rivetted work were desirable, as the rivetted specimens of Bessemer steel supplied up to then had not been at all equal to those of open-hearth steel, although under tensile, percussive, and forge tests, as well as in capacity for welding and comparative loss of strength consequent on punching, the steels were equal.

The first series of experiments recorded in the present paper was made with Bessemer basic steel, but the results were not satisfactory. Subsequent experiments were made with open-hearth basic steel, and the results were as satisfactory as those previously obtained with acid open-hearth steel, there being no loss of ultimate tensile strength per square inch of sectional area of plate when rivets with countersunk points were used. The Admiralty had therefore decided to admit basic open-hearth steel for ship-work on the same terms as acid open hearth steel.

The results for the different kinds of steel were given by Mr. White in a tabular form.

Mr. P. Gilchrist, in complimenting the author of the paper, said that ordinary pig iron was often used in making steel, and when this was the case the steel was not of first-rate quality, whether the acid or basic process were used.

Mr. Arthur Cooper said that the facts contained in the paper were fully confirmed by the experiments on basic steel undertaken for Lloyd's. He was sure the Admiralty would have no cause to regret their decision.

Mr. Riley thought that the present favourable position of the mild steel manufacture in England was largely due to the sympathetic attitude maintained by Mr. White as representing the Admiralty, and by Mr. Martell as representing Lloyd's. On the whole he thought basic open-

hearth steel was more likely to be of good quality than basic Bessemer steel, although the opinions he had expressed in 1885 were now somewhat modified.

Sir Arthur Hickman, who was a maker of basic steel by both processes, said that to secure perfect certainty and uniformity of product he should give the preference to Bessemer steel.

Col. Dyer remarked on the importance of registering the exact parts of the ingot from which the samples tested were taken, and especially when oxygen was present.

Mr. Edward Riley agreed with the last speaker, and mentioned a case of bad horse-shoe nails where he found 5 per cent. of the nails were quite free from carbon, the result of too long annealing in a covered pan.

Mr. Martell acknowledged Mr. Riley's appreciative remarks, and spoke of Mr. White's beneficent influence at the Admiralty in making known the valuable experiences acquired at the public expense. He had never known any steel made from Cleveland pig by either the Bessemer or open-hearth acid process which would stand the tests required by Lloyd's. Yet he had known good "angles" for shipbuilding made from material containing 1.5 per cent. of phosphorus by the open-hearth basic process, and he saw no reason why "plates" should not turn out equally satisfactory.

Sir Lowthian Bell said that by the acid process the great difficulty was to get out the last traces of the phosphorus, but there was no such difficulty when the basic process was used. He also spoke of the great value of a close touch between users and producers.

Mr. Hardisty said that, so far as his experience went, basic was superior to acid steel. More than half that produced at Sir Lowthian Bell's works was supplied to the Indian State railways, for which very severe tests were required.

Mr. Ellis thought it somewhat invidious to institute comparisons between acid and basic open-hearth and Bessemer steels, as each material was specially suitable for some purpose.

Mr. Wrightson remarked that the Admiralty tests called especially for steel of great tensile strength, but for bridge building a milder steel of greater ductility was often still more suitable.

Mr. White, in reply, said that his former chief, Sir Nathaniel Barnaby, had always thought that nothing but good could come from consultations between the Admiralty, as steel users, and the producers. Experiments had been made on plates as much as 1 in. thick, and on basic steel made from pig iron containing as much as 2.7 of phosphorus. In answer to Col. Dyer, he could not say from what part of the ingot the steel for the samples tested came, but all the samples were taken from similar parts of the plates. With reference to Mr. Wrightson's remarks he could only say that the requirements for ships and for bridges were very different.

The next paper read was by Col. H. Dyer "On the Production of Pure Iron and Steel."

The author described some attempts to produce pure iron and steel in the basic furnace, with results which approached so nearly to a solution as to afford hope that success was not far distant.

In experimenting on the production of pure iron, the best results were obtained from a charge of 50 to 80 per cent. of good scrap, the remainder being good Swedish pig, worked very quickly. Analysis of the product gave the following results.—

Combined carbon	Trace
Silicon	0.005
Manganese	Trace
Phosphorus	Trace
Sulphur	0.015

With the greatest care only small forgings could be made, so that no satisfactory mechanical tests had been made.

A second series of experiments was undertaken to ascertain whether a steel with a high percentage of carbon and a low percentage of phosphorus could be produced from ordinary scrap steel in the basic furnace. A layer of

coarsely broken limestone was placed on the hearth of an ordinary basic Siemens furnace, and on this a layer of coke. A charge of scrap steel was then placed on top of the coke, and the whole melted down as quickly as possible. To the melted charge manganiferous ore and limestone were added as required. A good furnace working well required about 9 cwt. of coke to 14 tons of metal. The coke reduced the oxide of iron formed in melting, and carbonised the steel. Nine different qualities of steel were produced from as many consecutive charges, and these contained from 0.11 to 0.5 per cent. of combined carbon. The breaking strengths ranged from 22.7 to 45.3 tons per square inch, and the elongation from 41 to 14.5 per cent. The paper contained a tabular statement of analyses, and of the results of the various tests. The author thought that if carbonaceous material free from sulphur could be obtained, the sulphur in the metal might be decreased or altogether eliminated.

Mr. Edward Riley said he had often made practically pure iron by the basic process, *e.g.*, a metal containing 99.9 per cent. of iron and hardly any phosphorus or carbon. At Seraing some thousands of tons of steel were produced by the basic process from hematite iron, in which the phosphorus was as low as 0.01 per cent.

Mr. Snelus said he had often advised Sheffield manufacturers to make iron by the basic process from English hematite rather than pay high prices for Swedish material.

Sir Lowthian Bell pointed out that pure iron meant iron in which there was not a trace of anything else. The electricians at the Post Office had been in search of that material for 10 years. For telephonic purposes it was desirable to obtain iron without a trace of carbon.

Mr. Snelus said that Col. Dyer had stated that his pure iron could not be worked. He thought this was due to the presence of oxide of iron, which was very difficult to estimate accurately, and had so far proved very difficult to remove when present. He was at present making experiments on this point, and hoped shortly to place the results before the Institute.

The secretary then read a communication from Mr. Powell, the general manager of the Newton Works, who had succeeded in making a bar of pure iron by the basic process, but was not sanguine as to success on a practical scale. The red-shortness, which was probably due to the presence of oxide of iron, could be remedied by adding steel. He recommended a basic lining for ladles.

A communication from Mr. Alex. Tucker was also read, in which he gave results of analyses of steel made in basic converters by the Staffordshire Steel Company. In some cases the phosphorus was as low as 0.04 per cent., and the sulphur 0.1 per cent. This metal worked perfectly.

The president remarked that Colonel Dyer's results seemed to be of great importance, and that he had induced Dr. Hopkinson to inquire into the magnetic properties of the iron, which seemed to be of a remarkable character.

Mr. Hardisty gave particulars of his attempts to make a very soft steel for telegraphic wires. The metal produced had a tensile strength of 20.9 tons per square inch, with an elongation of 36 per cent. The limit of elasticity was very high, about 16.4 tons per square inch, or over 80 per cent. of the breaking stress. He had obtained steel containing only 0.1 per cent. of phosphorus, commencing with 0.5 per cent. He recommended a basic lining for the ladles as Mr. Powell did. He thought steel, such as he had sometimes made, having a breaking strength of 40 tons per square inch and an elongation of 18 per cent., compared favourably with Colonel Dyer's pure iron.

Col. Dyer, in reply to the discussion, said that where a large quantity of oxide was present it increased the deleterious action of the other impurities in a marked degree.—J. H. C.

Action of Carbonic Oxide on Iron and Manganese. Guntz. *Compt. Rend.* 114, 1892, 115—117.

SLAMMER first observed that a considerable quantity of carbon is separated on passing carbonic oxide over oxide of iron at a temperature below that at which glass softens. Schlutzenberger has since pointed out, contrary to the opinion of Gruner, that with pure iron the decomposition of carbonic oxide can be effected without material formation of carbon dioxide. The author has recently been engaged on work requiring the electrolytic preparation of amalgams, and from these amalgams pure metals have been obtained which have been subjected to the action of carbonic oxide. In the case of iron, carbon began to separate when a dull red heat was attained; a very small quantity of carbon dioxide was formed; at the same time the iron seemed to absorb carbonic oxide. More satisfactory results were obtained with manganese. The metal was heated at about 400° in a glass tube, through which a current of carbonic oxide was being passed. After a while action begins between the manganese and the gas, and heating may be discontinued. The carbonic oxide seems to be totally absorbed. The reaction which takes place, according to the author, is the following: $Mn + CO = MnO + C$. From analogy it would seem as though the reaction, in the case of iron, might be represented thus: $Fe + CO = FeO + C$. The completeness of the reaction in the case of manganese is accounted for by the resistance of the oxide of manganese to reduction by carbonic oxide at all temperatures, and in this it differs from iron.

At high temperatures the suboxides of iron and manganese when heated with carbon give the metal and carbonic oxide, that is to say the action is the reverse of that taking place at about 500° C. The reaction here considered is held by the author to explain how in one particular zone of the blast furnace the iron encountering carbonic oxide is oxidised with separation of carbon, and how in another zone this oxide of iron is reduced by carbonic oxide with formation of carbonic acid, and how in passing through the furnace the iron takes up carbon from the finely-divided material with which it is in contact.

—T. L. B.

The Preparation and Estimation of Pure Platinum.

F. Mylius and F. Foerster. *Ber.* 25, 1892, 665—686.

THE authors having recounted the known methods devised by Deville and Stas for the analysis and purification of the metals of the platinum group, and having substantiated the accuracy of the separations of the metals on which they depend, comment on certain disadvantages that these processes possess. They have devised a method by which the platinum may be volatilised from other metals present in small quantity, and with this object in view they have investigated the volatility of such metals as are likely to be present, as well as that of platinum itself when heated in a current of chlorine mixed with carbon monoxide. The formation of volatile compounds of platinum under these conditions has been lately investigated anew by Pullinger (*J. Chem. Soc.* 1891, 598), and by the authors themselves, and its applicability was tried by them in the following manner:—Five to 10 grms. of platinum, preferably in the form of "sponge," contained in a porcelain boat, was heated in a thin walled tube drawn out to a long neck at one end and attached to an apparatus for generating chlorine and to a gas-holder filled with a mixture of carbon monoxide and carbon dioxide produced by the action of sulphuric acid upon oxalic acid. The further end was closed by a cork and carried a tube dipping into caustic soda to absorb objectionable fumes. The part of the tube containing the boat was heated to about 238° C. At first chlorine alone was passed over the metal under treatment, and afterwards a mixture of chlorine and carbon monoxide. Excess of the former was found to be inadvisable, as dark coloured sparingly volatile products were formed, which however were easily sublimed by subsequent treatment with carbon monoxide. Ten grms. of platinum could be volatilised in this way in six or eight hours. The process was found to be unsuited for the analysis of platinum alloys, as the presence of about one per cent.

of iridium caused the distillation to proceed very slowly, and considerable quantities of platinum remained in the residue. With sensibly pure platinum, however, no such difficulty occurs, and even thin sheet can be used. The platinum can be easily recovered from the sublimed compounds with chlorine and carbon monoxide by solution in strong hydrochloric acid and decomposition of this solution by the addition of water. The determination of the platinum by this method is not to be recommended, but it may be indirectly estimated by the loss in weight of the contents of the boat. The behaviour of the metals likely to be present in platinum of commercial purity was then ascertained. Iridium gave a sublimate strongly resembling that yielded by platinum, and separation of a trace of iridium from a large quantity of platinum could not be effected. Palladium alone gave no sublimate, but volatilised in the presence of an excess of platinum, only a trace being left in the non-volatile residue. Rhodium was not appreciably volatile; 1 mgrm. could be recognised in 10 grms. of platinum. Ruthenium, osmium, and gold were all volatile. Silver, copper, lead, and zinc were non-volatile, while iron easily sublimed. The method was therefore shown to be available for the metals rhodium, silver, copper, lead, and zinc. The process can be used to supplement the Deville-Stas method, in the following way:—The aqua regia solution of platinum containing rhodium and lead obtained in the course of the standard method, is freed as far as possible from excess of acid, neutralised with ammonia, excess of formic acid added together with some ammonium acetate, made up to 500 cc., heated on the water-bath to 70°–80° C. until the carbon dioxide which is freely evolved at the beginning slackens somewhat, and then boiled in conjunction with a vertical condenser for 24–30 hours. The precipitated metal is washed with dilute hydrochloric acid and dried over sulphuric acid and caustic potash. The dried metal is heated cautiously in hydrogen, weighed, and treated by the carbon monoxide and chlorine process already in outline described. The non-volatile residue is extracted with nitric acid to remove the lead, while the rhodium is separated from the small quantity of platinum remaining in the boat, by fusion with bisulphate of potash. Small amounts of impurities in platinum are therefore best determined by the following method:—Three distinct portions are taken; the first is tested for palladium, iridium, and ruthenium by the ordinary lead method of Deville and Stas; a second portion is dissolved in aqua regia and the filtrate examined for iron after the reduction of the platinum by means of formic acid; the third is volatilised by the new carbon monoxide and chlorine method, and rhodium, silver, copper, and lead looked for in the residue. The following quantities can be detected if 10 grms. of platinum be used for each operation: Iridium, 0.003; ruthenium, 0.005; rhodium, 0.004; palladium, 0.01; iron, 0.001; copper, 0.002; silver, 0.002; lead, 0.002 per cent. respectively.

Preparation of Pure Platinum.—Commercial platinum is not even approximately pure. Appended are two analyses, the first of a platinum crucible, the second of a sample of "purified" platinum:—

	Platinum Crucible.	"Purified" Platinum.
	Per Cent.	Per Cent.
Platinum	96.90	99.28
Iridium	2.56	0.32
Rhodium	0.20	0.13
Palladium	Trace	..
Ruthenium	0.02	0.04
Iron	0.20	0.06
Copper .....	..	0.07
	*99.58	99.90

* 99.58 in original.

The need for pure platinum for the preparation of standard weights and measures made from a platinum-iridium alloy of known composition, was the first cause that led to a serious attempt being made to purify platinum beyond the limits here indicated, and success in this direction has been achieved by the well-known firm of Johnson and Matthey, who use the lead process of Deville and Stas. The authors have detected in the purest samples from this firm 0.01 per cent. of rhodium and 0.01 per cent. of silver, both impurities being among the list of those for the detection of which the carbon monoxide and chlorine method is especially suitable. Lately W. O. Heräus has engaged in the production of pure platinum, which is stated to be preferable to the English material, as no lead is used in the process of purification. A sample examined by the authors contained only a trace of iridium, not quantitatively determinable, and no detectable amount of palladium or rhodium. The amount of iron present did not exceed 0.001 per cent. Finkener's method for purifying platinum was adopted. It consists essentially in the conversion of the platinum into the double sodium chloride salt and the recrystallisation of this salt from a solution made alkaline with soda. The solution of platonic chloride, freed from oxides of nitrogen, was evaporated with the calculated amount of sodium chloride (free from iron) to dryness, and well stirred while cooling. The mother-liquor was removed from the crystals, and the latter were washed with a strong solution of sodium chloride and dissolved in a 1 per cent. soda solution. A very small quantity of a dark precipitate containing iridium remained. The salt separated by the cooling of the filtered solution, was repeatedly recrystallised from slightly alkaline solution without the formation of any similar precipitate. The purified salt thus obtained was dehydrated at 120° C., and reduced in hydrogen at a low temperature, the resulting platinum sponge washed repeatedly with water, dried and ignited, the ignited metal being also washed with dilute hydrochloric acid, dilute hydrofluoric acid, and again with water.

With regard to the purity of the platinum thus prepared, it appeared probable that the maximum limit for the total quantity of foreign matter was 0.01 per cent., that is to say, there was present 99.99 per cent. of platinum. The conclusion arrived at by this investigation is that platinum is a metal which can be brought to a high state of purity with ease and certainty.—B. B.

Chemistry of Thomas-Slag. M. A. von Reis. Zeits. f. ang. Chem. 1892, 229–231.

THOMAS-SLAG leaves the steel works either in blocks or slabs, the former being produced by allowing the liquid slag to solidify in the truck, the latter by pouring the slag. The essential difference between these two methods is in the rate of cooling; the blocks have cooled slowly and seem to be thereby rendered far more friable than the slabs, which are much harder, having been cooled quickly, frequently with the aid of a sprinkling. This difference in hardness is a very real one to the slag-miller; the blocks can often be crumbled in some parts of their surfaces between the fingers, while the energy necessary to mill the slabs is very costly. The blocks, however, are not uniform in texture; if allowed to spontaneously crumble, as they do in time, they disintegrate to a more or less coarse powder containing hard smooth nodules, which are difficult to grind.

The author has sought a chemical explanation for this physical difference between block- and slab-slag. Slags from four steel works were analysed, and of these, descriptions and analyses are given below—

I. From works A.—Slab; dark brown, thick, hard, and difficultly milled.

II. From works A.—Block; grey, schistose, friable, and easily milled.

III. From works B.—Block; slate-grey, compact, and easily milled.

IV. From works C.—Block; grey, compact, blistered, and not very easily milled.

V. From works D.—Slab; dark brown, thick, hard, and difficultly milled.

VI. From works D.—Block; brown, thick, hard, and difficultly milled.

Sample.	SiO ₂	P ₂ O ₅	Al ₂ O ₃	Fe ₂ O ₃
I.	6.77	16.92	1.68	0.96
II.	16.41	11.75	1.58	10.41
III.	6.69	17.75	0.95	5.70
IV.	4.88	19.25	0.59	5.14
V.	8.07	18.18	1.40	3.45
VI.	6.00	18.39	1.37	2.87
VII.	7.07	22.59	0.80	5.27

VII. From works D.—Block; grey, friable, and easily milled.

FeO	MnO	CaO	MgO	Milling Quality.
10.77	7.16	51.00	3.01	Difficult.
10.55	11.91	31.00	2.08	Easy.
10.65	7.71	48.42	2.05	Easy.
12.49	6.23	18.17	2.38	Not very easy.
10.13	9.35	46.70	2.03	Difficult.
11.43	7.28	50.77	1.57	Difficult.
6.49	7.81	47.36	1.67	Easy.

From this table it will be seen that the general chemical composition of the slag has little or no influence on its physical properties, but the proportion of Fe₂O₃ to FeO seems to be connected with the milling quality of the slag. The following are the ratios of Fe₂O₃ to FeO (columns 5 and 6) in the above samples, given in the same order: 1:11.2, 1:1.0, 1:1.9, 1:2.5, 1:3.0, 1:4.0, 1:1.2. If these ratios be compared with the milling qualities, it will be noted that when Fe₂O₃:FeO < 1:3, the slag is easily milled, but when it exceeds this the milling is more difficult.

For additional evidence as to the influence of the ratio Fe₂O₃:FeO, four blocks were fractionally analysed:—

Block 1.—This consisted of about 25 per cent. of brown hard slag (I.), the remainder being brown hard nodules (II.) embedded in a grey schistose, friable slag (III.); the analyses show that whereas the acid radicles in the different parts are constant, and have no apparent effect on the milling qualities, the ratio of Fe₂O₃ to FeO varies and has considerable influence:—

	SiO ₂	P ₂ O ₅	Fe ₂ O ₃	FeO	Fe ₂ O ₃ :FeO	Milling Quality.
I.	9.18	21.70	2.64	9.20	1:3.6	Difficult.
II.	9.34	21.35	2.40	9.36	1:4.1	Difficult.
III.	9.02	22.00	8.16	4.54	1:0.5	Easy.

Blocks 2, 3, and 4, were analysed in strata:—

	Fe ₂ O ₃	FeO	Fe ₂ O ₃ :FeO	Milling Quality.
Block 2. Superficial layer.....	10.80	2.37	1:0.2	Easy.
.. Second layer.....	9.80	1.83	1:0.2	Easy.
.. Third layer (very friable).....	8.39	0.21	1:0.03	Very easy.
.. Fourth layer (compact, brown; block proper).....	2.69	9.07	1:3.5	Difficult.
Block 3. Brown, brittle crust from the cover.....	7.22	7.12	1:1.0	Easy.
.. Superficial layer.....	6.36	10.05	1:1.5	Easy.
.. Second layer.....	7.92	11.00	1:1.5	Easy.
.. Third layer.....	19.50	0.32	1:0.02	Very easy.
.. Compact, grey block.....	5.80	11.44	1:2.0	Easy.
Block 4. Superficial layer.....	15.0	8.3	1:0.5	Easy.
.. Second layer.....	21.9	0.22	1:0.01	Very easy.
.. Compact, brown block.....	5.5	15.8	1:3.0	Moderately easy.
.. Thin layer from between the block and the wall of the cover.....	19.7	3.35	1:0.17	Very easy.

Some nodules remaining on a heap of slag which had been formed in the early days of the Thomas process were found to be exceedingly hard and difficult to mill; they were ellipsoidal in shape and some 10 to 15 cm. long. An analysis of two of them gave:—(1) Fe₂O₃ 1.43, FeO 18.38, Fe₂O₃:FeO 1:13, (2) Fe₂O₃ 1.75, FeO 16.20, Fe₂O₃:FeO 1:9.3.

It is pretty evident that the larger the quantity of ferric oxide in the slag, the more easily the slag is milled; but this only applies to slowly cooled blocks; in the rapidly cooled slabs the ferric oxide, when present, has much less influence. The author surmises that in liquid slag there exist, besides phosphates and silicates, calcium ferrate and manganate; during the cooling of the slag these compounds decompose more or less completely according to the time

occupied, and if this be very short they may not decompose at all before the slag is solid; the decomposition results in the liberation of ferric and manganese oxides which disseminate through the molten slag and prevent it from setting so hard as it otherwise would; this dissemination will be less perfect if the slag be quickly cooled, and a harder product will result. That this explanation is probably correct, is evidenced by the fact that difficultly milled slags leave little or no residue when treated with dilute hydrochloric acid (1 part of HCl of sp. gr. 1.19+5 parts of H₂O), whereas the softer samples leave a residue which consists almost entirely of ferric oxide, and is proportional to the ease with which they have been milled.

—A. G. B.

On Certain Ternary Alloys. Part VI. C. R. Alder Wright. Proc. Roy. Soc. 1892.

IN this paper are described the results of experiments made with ternary mixtures of molten metals containing aluminium as the lighter "immiscible" metal, lead (or bismuth) as the heavier one, and tin (or silver) as the "solvent" metal, the observations being made in precisely the same way as those previously described (this Journal, 1890, 944; 1892, 245). Incidentally it is mentioned that the aluminium now obtainable commercially in quantity is considerably purer than that supplied at some eight times the price upwards of four years ago, when the experiments were first commenced; in 1887—88 so-called 99 per cent. aluminium invariably contained much more than 1 per cent. of matter not aluminium (at least so far as numerous samples were concerned obtained by the author from different makers for the purpose of the investigation); silicon and iron are still the chief impurities, the former existing in conditions closely analogous to those observed in the case of carbon in cast iron, &c.; i.e. partly dissolved in the aluminium (when fused) apparently in the amorphous form, and partly undissolved in the graphitoidal form. On solution in diluted aqua regia the former variety of silicon becomes oxidised and more or less completely dissolved in the acid fluid, whilst the latter is mostly unattacked and undissolved; much as the dissolved amorphous carbon in cast iron, &c. is volatilised in combination with hydrogen in solution in hydrochloric acid, whilst the undissolved admixed graphitoidal carbon remains unaffected by the acid.

The "critical curves" obtained at the temperature of about 800° C. with the ternary mixtures aluminium-lead-tin and aluminium-bismuth-tin and at near 870° C. with the mixtures aluminium-lead-silver and aluminium-bismuth-silver are described and graphically represented; on comparison with the four corresponding curves where zinc replaces aluminium, it is noticeable that in every case the curve obtained with aluminium as light immiscible metal is situated *outside* the corresponding curve where zinc was used, notwithstanding that a somewhat higher temperature was employed; whilst the curve obtained with bismuth as heavier immiscible metal invariably lies *inside* the corresponding curve where lead is used, the temperature conditions being the same. The examination of the general contours of the curves and the directions of slope, &c. of the tie-lines lead to the conclusion that whereas zinc and silver form definite compounds, Ag_2Zn_3 and Ag_4Zn_5 , the formation of which produces peculiar bulges (inwards and outwards) at certain portions of the critical curves when these two metals are present, no such results are traceable in the case of aluminium and silver. On the other hand, the configurations of the tie-lines with zinc-lead-tin and aluminium-lead-tin alloys are alike, but different from those observed in all other cases, leading to the inference that the cause is the tendency towards the formation of certain definite compounds, Pb_3Sn on the one hand and Zn_3Sn and Al_3Sn on the other.

The positions of the "limiting points," or vanishing points of the systems of tie-lines deduced in the four cases, are such as to show that whilst the proportions in which the two immiscible metals are present at the limiting point is always pretty close to that indicating some definite atomic ratio, yet this ratio differs widely with the nature of the "solvent" metal; thus with the four combinations the atomic ratios were approximately those indicated by the formulae—

Aluminium-lead-tin	Al_2Pb_2
Aluminium-lead-silver	AlPb_4
Aluminium-bismuth-tin	Al_3Bi
Aluminium-bismuth-silver	AlBi_2

All four aluminium-containing alloys are freely oxidisable when molten; even when the atmosphere surrounding the crucible is rendered reducing as far as possible, and access of air prevented as much as practicable by directing a jet of coal-gas into the crucible, a notable amount of oxidation takes place during the admixture of the metals by vigorous stirring; the effect of this is that the mixtures "flour" considerably, so that a large portion of the metals originally used is lost, being pulverised and left behind with the scoria

in the mixing crucible, when the fluid mixture is poured off into long, narrow, clay test-tubes, in which the mass is kept molten for some eight hours.—C. R. A. W.

Note on the Density of Nickel and Iron. J. Hopkinson. Proc. Roy. Soc. 50, 302, 121—122.

IN Proc. Roy. Soc. 12, December 1889, January 16, 1890, and May 1, 1890, the author described certain properties of alloys of nickel and iron containing respectively 22 per cent. and 25 per cent. of nickel. In addition to the curious properties already described, the author has discovered that these alloys are about 2 per cent. less dense when in the magnetisable than when in the non-magnetisable state. Two rings were tested containing respectively 25 per cent. and 22 per cent. of nickel with the following results, the densities being given without correction in relation to the density of water at the then temperature:—

	Nickel. 25 Per Cent.		Nickel. 22 Per Cent.	
	Density.	Temperature.	Density.	Temperature.
After heating, non-magnetisable.	8.15	15.1	8.13	16.5
After cooling, magnetisable.	7.99	14.5	7.96	15.6
After heating again, non-magnetisable.	8.15	18.0	8.12	18.2
After cooling again, magnetisable.	7.97	22.0	7.95	21.8

The rings were each time cooled from 100° C. to 110° C. by carbonic acid and ether *in vacuo*.—G. H. R.

Note on the Analysis of Slag of Metallic Appearance from the Manufacture of Phosphorus in Electrical Furnaces. J. C. Chorley. Chem. News, 63, 301.

See under XXIII., page 711.

PATENTS.

Improvements in the Manufacture of Ferro Bronze and other Alloys. J. E. Bott, Eyam, Derbyshire. Eng. Pat. 795, January 15, 1891.

THE rationale of this process consists in heating iron sulphide with zinc, whereby an iron-zinc alloy is produced at a low temperature and with small loss of zinc, and then fusing this alloy with copper to form ferro-bronze. The iron sulphide is produced by placing iron rods in molten sulphur, the product being tapped from the bottom of the crucible as fast as it is formed. If it is required for the ultimate production of a ferro-bronze which can be rolled or forged, wrought iron is used, but if a hard tenacious ferro-bronze is required, suitable for bearings, propellers, &c. titanic iron or sand is made use of. If still denser ferro-bronze is required tungsten or chrome ore, with or without wrought iron, is employed. The next stage is the production of ferro-zinc, ferro-titanic-zinc, ferro-chromic zinc, ferro-manganic-chromic zinc, or ferro-tungstic zinc by fusing the above simple or compound sulphides with metallic zinc in a covered iron crucible. Lastly the ferro-zincs so produced are fused with copper to produce ferro-bronzes as stated above. By this process the difficulty of introducing iron into copper is avoided and the proportion of the latter element may be greatly decreased with the production of stronger and more ductile alloys.—H. K. T.

Improvements Relating to the Treatment of Sulphur Ores, Crude Sulphur, Ozokerites, Heavy Oils of Petroleum, and other Materials for Extracting, Purifying, or Refining Purposes, and to Apparatus for Use therein. L. Labois, Paris, France. Eng. Pat. 9781, June 9, 1891.

The inventor proposes to extract by centrifugal action or removal of the liquid with the aid of high-pressure steam, substances which can be separated in the liquid state by elevation of the temperature of the gangues, ores, or raw materials in general which contain them.—D. B.

Improvements in Alloys and Compositions for Use in Covering or Coating Surfaces of Iron and Steel, and the Surfaces of other Materials, in order to prevent Corrosion and Fouling thereof when submerged. J. O. Day, Blackheath. Eng. Pat. 9417, June 3, 1891.

This invention is an improvement on a previous one (Eng. Pat. 16,107, October 10, 1890), which consisted in the production of alloys by melting together zinc and antimony or zinc and copper, or zinc, antimony and copper, these alloys being then pulverised, mixed with a fluid medium and used as an anti-fouling composition. The present invention relates to the production of similar alloys by melting lead with zinc and antimony or zinc and copper or zinc and antimony and copper or simply substituting lead for zinc in the alloys mentioned in the first patent, the alloys being afterwards pulverised and used as before.

In substituting lead for zinc the weight of the lead must be three times that of the substituted zinc if the galvanic relationship of the alloy to iron or steel is to be maintained the same. For instance an alloy of—

	Parts.
Zinc	30
Lead	15
Antimony	100

will have the same galvanic relationship to iron or steel as an alloy of—

	Parts.
Zinc	35
Antimony	100

—H. K. T.

An Improved Method of forming Magnetic Oxide (Fe₃O₄) upon the Surface of Wrought or Cast Iron. P. H. Bertrand, Paris, France. Eng. Pat. 10,144, June 15, 1891.

This invention relates to a method for producing a layer of magnetic oxide of iron upon articles of wrought or cast iron or steel for the purpose of preserving the same, and consists in coating the iron or steel by electro-deposition with some metal or alloy which is capable of being volatilised at a temperature of 1,000° C., such as copper, bronze, brass, nickel, gold, &c., and then introducing it into a furnace heated to 1,000° or less according to the volatility of the covering metal. The iron becomes oxidised, but only to the magnetic oxide stage, and the metallic coating volatilises, the operation being completed in four or five minutes. Instead of coating by electrolysis the articles may be simply scratched with a wire brush made of any of the above metals.—H. E. T.

Improvements in or Connected with the Production of Purple Ore, Bricks, or Blocks, suitable for Use in Blast or Equivalent Furnaces for the Production of Iron, and for other Purposes. H. Bird, Plymouth. Eng. Pat. 10,420, June 19, 1891.

This is a process and apparatus for converting "purple ore," the residue left after the wet extraction of copper from burnt cupreous sulphur ores, into blocks or briquettes to be used for the production of iron. The ore after removal

from the tanks is left for 24 hours and is then ground in a mill to a slurry which is tipped into moulds supported on a floor heated from below by steam. When the blocks so produced are sufficiently dry they are placed in a kiln, and heated to a red or white heat for 46 hours and then allowed to cool, when they are ready for use. Drawings are given describing the moulds, drying floors, and kilns. The latter may be of the Hoffman description or two down draught Staffordshire kilns may be used so arranged that the waste heat from one may be used to dry fresh bricks contained in the other. If free acid exist in the ore after washing a little lime may be added before forming the briquettes, and manganese ore may be incorporated if the briquettes are to be used for making steel. In this process as usually carried out neither water nor other matter is added, hence the amount of water to be evaporated and consequent consumption of fuel is small.—H. K. T.

An Improved Method and Appliances for the Production of Litharge from Metallic Lead. A. Gutensohn, London. Eng. Pat. 12,895, July 29, 1891.

THE litharge is produced by injecting air or furnace-gas under the surface of molten lead which is contained in a peculiarly formed crucible having a tall conical hood, air or steam being also forced upon the surface of the litharge so produced. A by-product of finely-divided metallic lead collects on the inner surface of the hood.—J. H. C.

Improvements in Treating Lead for Purifying it, and for obtaining Litharge, or for Separating Lead from the Precious Metals contained in it. B. Rösing, Friedrichshütte, Upper Silesia. Eng. Pat. 13,068, August 1, 1891.

THE molten lead contained in a vessel having a basic lining is oxidised by means of a blast of air or oxygen. The first portions of the litharge so produced will contain most of the oxidisable impurities contained in the original lead.

By continuing the blowing the major portion of the lead may be oxidised, so leaving any precious metals which may be present in a concentrated state.—J. H. C.

Improvements in Carburising Fluid Iron or Steel. J. E. Stead, Middlesbro'-on-Teer. Eng. Pat. 13,888, August 18, 1891.

THE improvement consists in forcing carbon beneath the surface of the molten metal, which is gradually absorbed thereby.—J. H. C.

Improvements in the Treatment of certain Mattes or Ores for the Separation of Nickel and Cobalt from Copper. H. L. Herrenschmidt, Petit Quévilly, près Rouen, France. Eng. Pat. 14,290, August 24, 1891.

THE mattes are crushed, and a portion being roasted, the metals therein are brought into solution as sulphates or chlorides in the ordinary way. These solutions are then made to act upon the unroasted portion of crushed matte, by which means the whole of the copper may be precipitated as metallic copper, while the whole of the cobalt, nickel, and iron go into solution. The iron is then precipitated, preferably by a solution containing persalt of nickel or persalt of cobalt, thus producing a liquor practically free from iron. The nickel and cobalt are then separated by the ordinary methods.

When the original matte contains no cobalt, the solution, after precipitating the copper, may be evaporated to dryness and the residue calcined, by which means only the salts of iron are decomposed. The nickel salt may then be separated by lixiviation with water.—J. H. C.

Improvements in the Burning of Pressed Blocks of Purple Ore, and in Apparatus and Kilns therefor. T. H. J. Eskuchen and H. A. Haarmann, Osnabrück, Germany. Eng. Pat. 15,444, September 11, 1891.

THIS invention relates to a furnace for burning purple ore, and consists of an arched kiln furnished at one end with fire-bars for burning coke, the products of combustion passing through the briquettes of purple ore to the chimney at the further end. Beneath the furnace are brickwork channels or flues into which are admitted combustible gases (blast-furnace or similar gases) and air, and the burning gases which are produced issue into the furnace behind the fire-bars, and pass, together with the hot gases from the coke, through the briquettes to the chimney. At starting only the coke fires are used until the ore is dry; the gas and air are then turned on and the combined heating by coke and gas continued until the ore is burnt, that is to say, for several days.—H. K. T.

Improvements in the Manufacture of Briquettes of Purple Ore. T. H. J. Eskuchen and H. A. Haarmann, Osnabrück, Germany. Eng. Pat. 15,482, September 12, 1891.

THE invention consists in the addition of furnace-dust from blast-furnaces as a binding material in making the briquettes.—J. H. C.

A Process and Apparatus for Extraction of Metals from Ores. J. J. Shedlock and T. Denny, London. Eng. Pat. 16,348, September 26, 1891.

THE process consists in subjecting the pulverised ore to violent agitation by jets of air or steam while it is heated by jets of gas; and in grinding it in presence of a fluid amalgamating or alloying metal, which may be either mercury or molten lead or other suitable alloy.—J. H. C.

An Alloy. E. W. Cooke, Chicago, U.S.A. Eng. Pat. 8834, May 10, 1892.

THE alloy consists of steel, aluminium, and copper, at least 25 per cent. being steel, and the aluminium being in excess of the copper. The steel is melted under a suitable cover or flux, and the other components are then added. The alloy is of exceedingly fine and hard grain, and will cut the hardest steel or glass without any tempering.—J. H. C.

Improvements in or relating to the Manufacture of Cast Steel. J. E. Filassier and J. Fauré, Paris. Eng. Pat. 9523, May 18, 1892.

THE improvements consist in melting, preferably in a crucible, scrap steel, with or without the addition of scrap iron, with magnetic iron ore containing titanium.—J. H. C.

Improvements in Metallurgical Furnaces for Steel-making or Cementation Purposes. J. E. Filassier and J. Fauré, Paris. Eng. Pat. 9522, May 19, 1892.

THE substances to be treated are uniformly heated to a high temperature in a closed receptacle or muffle out of contact with air or with combustion products. The muffle is preferably made rectangular and of fireclay, in tongued and grooved sections or panels, so that it is capable of being taken to pieces. It is heated from below by one or more fireplaces. Openings are provided for the insertion of a pyrometer.—J. H. C.

Process for Rendering Iron, Steel, and similar Metals Homogeneous. J. C. Fraley, Philadelphia, U.S.A. Eng. Pat. 9859, May 24, 1892.

THE metals are exposed while in a heated condition within a magnetic field, which is repeatedly varied while they are cooling. The magnetic field may be suitably produced by a coil of wire which is covered with an insulating coating of refractory material, and which is in circuit with a storage battery or other suitable source of electricity. The metal to be acted upon is placed within the coil, and while the temperature is still high the current is varied by means of an alternator or other suitable contrivance.—J. H. C.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Simultaneous Electrolytic Deposition of Copper and Antimony. W. Hampe. Chem. Zeit. 16, 1892, 417—418.

ALL samples of electrolytic copper examined by the author contained small quantities of antimony, varying from 0.007 to 0.02 per cent. It would thus seem as though the two were simultaneously deposited, and consequently laboratory experiments in this direction were made. A sample of copper sulphate containing 25.09 per cent. of copper and 0.0083 per cent. of antimony was electrolysed by a current from six Meidinger-Pinens cells, and a sample of copper was produced containing 0.007 per cent. of antimony; furthermore, an alloy of copper and antimony was treated with nitric acid, and the solution and residue so obtained were evaporated together with concentrated sulphuric acid until fuming took place; water and 20 cc. of nitric acid were now added, and the residue of antimonious acid was filtered off. Electrolysis was effected with the result that with 45.275 grms. of copper there was deposited 0.009 grm. of antimony, that is, the metal deposited contained 0.0198 per cent. of antimony. The original alloy contained 99.44 per cent. of copper, 0.529 per cent. of antimony, and a minute quantity of iron.—T. L. B.

A Study of the Planté Lead-Sulphuric Acid-Lead Peroxide Cell, from a Chemical Stand-point. Part I. G. H. Robertson. Communicated by H. E. Armstrong. Proc. Roy. Soc. 50, 302, 105—108.

THE investigation, the results of which are recorded in this paper, was instituted at Dr. Armstrong's suggestion, as McLeod's observations on the electrolysis of sulphuric acid solutions led to the supposition that the changes occurring in the acid were probably less simple than was commonly supposed. This supposition was verified. The first section of the paper deals with the nature of the lead salt formed during discharge. In the second section the electrolyte is dealt with, and after referring to the work of Berthelot, Richarz, Schöne, Traube, and others, on the electrolysis of sulphuric acid solutions, the author describes experiments made to test the effect of the addition of sodium sulphate to the electrolyte as recommended by Mr. Barber Starkey, as it seemed probable it had a catalytic action on the "peroxides" always found in electrolysed acid of the strength used in batteries.

In conclusion, the author points out:—

That neither chemical nor electrical tests give any ground for supposing that any other sulphate than the ordinary white PbSO_4 is concerned in the interactions occurring in the cell;

That were the sudden lowering of E.M.F. caused by a change in the nature of the chemical compounds formed on the plates, it is very difficult to account for the very rapid recovery of the E.M.F. exhibited by an apparently discharged cell;

That peroxides are found in appreciable quantities in the electrolyte during charge and discharge;

That their influence must not be neglected in considering the behaviour of the Planté cell;

And that it is to the electrolyte, rather than to the plates, that attention must be directed if any considerable improvement is to be effected.—G. H. R.

A Study of the Lead-Sulphuric Acid-Lead Peroxide Cell, from a Chemical Stand-point. Part II. A Discussion of the Chemical Changes occurring in the Cell. H. E. Armstrong and G. H. Robertson. *Proc. Roy. Soc.* **50**, 302, 108.

The authors arrive in this paper at the following conclusions:—

1. That the cooling observed in the Planté cell can only be explained as resulting from the dissociation of the dilute sulphuric acid;

2. That the observed loss in efficiency cannot be due to temperature changes, as these arise through actions occurring out of circuit.

3. That it is difficult from a comparison of calculated with observed values of the E.M.F. to arrive at any final conclusion as to the exact changes which take place in the cell. On the assumption that sulphating occurs at both plates in circuit and under the influence of H_2SO_4 , the calculated value is considerably too high, while, if sulphating occur only at the lead plate, the value calculated is far too low.—G. H. R.

Note on the Density of Nickel and Iron. J. Hopkinson. *Proc. Roy. Soc.* **50**, 302, 121—122.

See under X, page 693.

Some Separations by Electrolysis. E. F. Smith and D. L. Wallace. *Ber.* **25**, 1892, 775—782.

This paper contains an account of work done at the University of Pennsylvania in continuation of the authors' experiments on electrolysis which have already been published (*Ann. Chem. Pharm.* **13**, 417, and *Proc. Chem. Soc. Fr. Inst.* **3**, 20), which showed that a perfect separation could be effected by the electrolysis of a solution of the double cyanide of gold. The experiments recorded were undertaken in order to determine the effect of the presence of an excess of potassium cyanide. The temperature was found to have an important bearing on the rate of deposition of the gold, and the authors reserve the study of this for a future investigation.

In the case of arsenic, the presence of a large quantity of potassium cyanide hinders the deposition of the gold, and on increasing the strength of the current arsenic is deposited with it. If, however, the solution is in about the following proportions, viz., 10 cc. chloride of gold solution (= 0.1240 gm. gold), 10 cc. arsenic solution (= 0.1000 gm. arsenic), and 0.75 gm. potassium cyanide in 150 cc. water, results accurate enough for all ordinary analyses are obtained, and the deposit is free from arsenic.

Similar results were obtained in the case of molybdenum, and of tungsten, if the tungstic acid was first dissolved in potassium hydrate and then added to the gold solution. The separation of gold from osmium, and of the latter metal from cadmium, silver, and mercury, is also readily effected in a corresponding solution; but in the case of cadmium, if very accurate results are required, the amount of cyanide of potassium must be reduced. Since the deposition of gold was found to be checked by the addition of caustic potash to the bath, while that of silver was unaffected, this appeared to afford a means of separating these two metals, but experiment showed that they plated out together from a mixed solution. In the case of cadmium and nickel, however, the addition of caustic potash enables a separation to be effected electrolytically. The electrolysis of a solution of gold in ammonium sulphide gave too low results, and an attempt to separate gold from tin in a similar solution failed. The currents employed are described as liberating from 1.8 to 2 cc. of mixed gases per minute, but the temperature and pressure are not stated.—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Testing of Boiled Linseed Oil. W. Fahrion. *Zeits. f. ang. Chem.* 1892, 171.

LINSEED oil ought to contain as little of the fatty hydroxy acids as possible in order to dry quickly. The boiling of linseed oil induces polymerisation, oxidation means the formation of hydroxy acids, therefore in either case the iodine equivalent will be lower than in the natural oil. Polymerised linseed oils possess a degree of stickiness which is entirely absent in oxidised oils, and whereas the latter easily emulsify in water, this property is entirely absent in the former. This property of the linseed oil to polymerise is not only perceptible in boiled oils, but is also found in the case of oils standing for some time, and is, in fact, to be met with in all oils containing unsaturated fatty acids. Therefore the age will have to be taken into account in the estimation of the iodine-absorption of oils containing large quantities of unsaturated fatty acids.—C. O. W.

The Valuation of Feeding Stuffs and Foods. E. Kinch. *Trans. Surveyors' Inst.* **24**, 1891-92, 297—344.

See under XVIII., page 701.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

PATENTS.

Improvements Relating to the Manufacture of White Lead and to Apparatus for Use therein. L. Labois, Paris, France. Eng. Pat. 9526, June 5, 1891.

This invention is based upon the observation that the first fraction of the precipitate of white lead obtained in the Clichy process is in covering power and all other respects practically equal to white lead produced by the Dutch process. Accordingly the inventor proposes to interrupt the treatment of the solution of tribasic lead acetate with carbonic acid at the moment when the solution ceases to be rich enough to give a white lead with good body. For the carrying out of this process the inventor uses a special turbine in which the whole process of precipitation and of resaturation of the lead liquor can be carried on almost continuously.—C. O. W.

Improvements in the Manufacture or Treatment of Varnish, Oils, and the like, and in Apparatus therefor. O. Hageman, Sydenham Hill, and T. C. Palmer, London. Eng. Pat. 10,837, June 25, 1891.

This invention relates to the clarification of varnishes, oils, and similar products, and also to their separation in a clear state from the sediments forming in them, and known as flocs or bottoms. This clarification or separation is effected by treating the above-named products or residues in a centrifugal machine, when the impurities form a layer against the peripheral wall of the machine, leaving the clear oil or varnish in the centre, whence it can be drawn off in the usual manner.—C. O. W.

A Compound Preparation to be used as a Substitute for Gutta-Percha and similar Products for Insulating and Waterproofing Purposes. C. N. Jackson, Hornsey Rise, Middlesex. Eng. Pat. 10,822, June 25, 1891.

THREE parts of bitumen and one part of hard paraffin wax are combined in a vulcaniser, or other convenient apparatus, at a temperature of from 300° to 400° F. Four parts of the resulting combination and one part of india-rubber are then treated together in a masticator at a temperature not exceeding 220° F., until converted into a perfectly homogeneous mass, which, after being formed into rolls or sheets, is ready for subsequent use.—C. O. W.

Improvements in the Manufacture of Pigments. G. W. Seolley, New York, U.S.A. Eng. Pat. 6516, April 5, 1892.

THIS invention refers to the production of red pigments from burnt pyrites, commonly known as blue billy. For this purpose the burnt pyrites is heated with sulphate of ammonia, or any other salt containing oxygen, and which can be decomposed by heat or any substance containing free or combined oxygen. Also the "blue billy" may be converted into sulphate of iron, which, on decomposition by heat yields a red pigment, and the acid driven off may be reconverted into sulphuric acid. If the conversion of the blue billy into a pigment is effected by means of sulphate of ammonia, the free ammonia which is disengaged in the first instance may be recovered and recombined with the sulphuric acid which is subsequently given off.—C. O. W.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

The Dyeing of Leather. Leather Trades Circular and Rev. 25, 1892, 590—591.

THE tendency of leather to fix the aniline colours without the aid of mordants, renders these dyes particularly applicable in leather dyeing. Fine-grain leather cannot stand treatment with alcoholic solutions, so that the aqueous dyes are preferable, and if alcoholic solutions have to be used they should be diluted to the verge of precipitation. Acid colours are more important than basic. Tanned leather must generally be bleached by drawing it several times through a strong, warm, sumac decoction, or leaving it immersed therein for a few hours. Dyes which do not take uniformly on the leather must be mordanted; in nearly all cases they are best applied by painting them on. The most important of the saline mordants, in this branch are the different soaps. A good, hard, white, soda-soap is generally the best, Castille being recommended.

When the skin has been painted it is rinsed with cold water while upon the table, and well stretched with a brass slicker; another coat of the dye is applied, and again washed off with cold water; the skin is then rubbed until the water runs off clean. Colours that require to be darkened are brushed over with a solution of Salzburg vitriol (ferroso-cupric sulphate), a mixture of ferrous and cupric sulphates, 25·3 grms. of which are dissolved in 3 litres of water. The skin is finally washed with clean water, and dried.

Dark brown.—Eight parts of fustic, one part of logwood, two parts of Brazil wood, one part of sanders, and $\frac{1}{2}$ part of quercitron are boiled with soft water for one hour and strained through linen. The vitriol treatment serves to darken the shade; for light brown this is omitted and the skin primed with dilute potash.

Olive brown.—Two parts of Hungarian fustic, one part of quercitron, and $\frac{1}{2}$ part of logwood are boiled, and the solution applied upon a strong potash priming; vitriol treatment follows.

Cutch brown.—A decoction of $\frac{1}{2}$ kilo. cutch, 60 grms. of copper sulphate, and 40 litres of water is applied upon a feeble priming.

Chestnut brown.—The moistened leather is primed with a solution of one kilo. of copper acetate in 50 litres of water, slicked out and then painted with a solution of yellow prussiate of potash in feeble acid water.

Chocolate brown.—Brazil wood ($1\frac{1}{2}$ parts) is boiled with water (45 parts) for two hours, and a little iron acetate added, according to shade.

Red.—Cochineal in a linen bag is boiled with water containing about 2 per cent. of aqua ammonia.

Alizarin red.—A feeble flesh colour is produced by brushing the leather with a solution of alizarin in dilute soda, and then rinsing with soap water.

Scarlet.—Zaffer extract, diluted with 60 parts of water containing one part of tartar, is painted on a feeble annatto bottom.

Ordinary red.—A decoction of sanders wood is used upon a feeble priming of alum free from iron.

Dark green.—Quercitron (four parts) and logwood (one part) upon a strong priming of vitriol.

Light olive green.—A decoction of fustic (one kilo.), arehil ($\frac{1}{4}$ kilo.), and water (20 litres) is painted on a light bottom of Prussian blue. For *picric green* an aqueous solution of picric acid is substituted for the fustic and arehil.

Lemon yellow.—Turmeric (one part) is digested in alcohol (four parts) for 24 hours, diluted with water and applied upon a feeble potash bottom.

Barberry yellow.—One kilo. of barberry-root, 30 kilos. of water, and 200 grms. of iron-free alum.

Orange.—A red priming is given by Brazil wood and fustic applied to impart the yellow. Seventy-five of the former to 25 of the latter produce a red orange, equal parts an ordinary orange, and 25 to 75 a yellow orange.

Chrome yellow.—"The dye is first applied with a solution of 30 grms. red chromate of potash in one-half litre of water, and is next fixed by 30 grms. acetate of lead in one-half litre of water."—A. G. B.

PATENTS.

A New Plastic Composition and the Process for Manufacturing the Same. J. Menzies, London. Eng. Pat. 9434, June 3, 1891.

THIS is a composition which can be used for the manufacture of power-loom pickers and shuttles, toys, statuettes, soles and heels for boots and shoes, and for electrical insulating purposes. The composition is made from equal parts of the solid residuum obtained on the distillation of heavy petroleum and another product, being the last product obtained in tar distilling, known as roofer's wax. In place of the latter compound an equal quantity of para rubber or gutta-percha can be used. To this mixture, when in the heated liquid state, shreds of leather, wool, cotton, or other fibrous material, together with carbon or plumbago are added, and at any suitable stage of the process the compound may be coloured by the addition of aniline dyes or pigments. These substances, being mixed in a suitable vessel, are, while warm, put into moulds or dies, and pressed or formed into desired shapes, or are rolled into sheets.

—C. O. W.

Improvements in or relating to the Manufacture of Artificial Chamois Leather. L. Thiry, Brussels. Eng. Pat. 9889, May 24, 1892.

THE hides or skins are suspended in a "drying and fermentation chamber" with double walls; this chamber is tightly closed and provided with an arrangement for permanently heating it, preferably by steam. After a time the skins are removed and spread out on the floor of the factory for them to absorb moisture. They are then rolled, treated with oil in a fulling machine and again placed in the fermentation chamber. This series of operations is repeated several times. "It will be found that in six or seven days the toughest sheepskin will have thoroughly acquired the nature of chamois leather." The speed of the process is due to the fact that fermentation sets in from the first day in the drying chamber, and to promote this there should be no opening in the chamber which would permit an escape of vapour.—A. G. B.

XV.—MANURES, Etc.

The Solubility of Tricalcium and Bicalcium Phosphate in Solutions of Phosphoric Acid. H. Gause. Compt. Rend. 114, 414—417.

See under VII., page 685.

Natural Phosphates. J. L. Wills. Ottawa Naturalist, May, 1892, 1—16.

IN Ottawa the term phosphates usually implies apatite, but in the present paper natural phosphates generally are discussed. The demand for phosphates as manure is of comparatively recent date; crushed bones were not employed until the beginning of the century and then only on account of their organic constituents. As regards the relative importance of guano and mineral phosphates, the former has reached its period of greatest importance both as to quality and amount, and will ultimately have to give way to mineral phosphates. Bird guano is very liable to change under ordinary atmospheric conditions, as its composition clearly shows; thus, a deposit of it on limestone gradually loses its nitrogen, and becomes more and more phosphatic, the under-lying rock becoming eventually converted into more or less pure calcium phosphate, according to the purity or otherwise of the limestone. Such was the origin of the Aruba rock phosphates. Other sources of phosphates are bones; those of birds contain the most phosphoric acid; those of animals less, and those of fishes and amphibia the least. The shell remains of certain shell-fish consist chiefly of calcium phosphate.

Guanos.—Nitrogenous guanos occur in Peru, Ichahoe, Patagonia, and Falkland Islands; phosphatic guanos include those of the Pacific Islands, Sidney, Phoenix, Starbrueck, Baker, Howland, Jarvis, Enderbury, Malden, Laepecede, and Axbrohols Islands. Some of the deposits are more or less exhausted, whilst new islands are from time to time worked. Bat guano is sometimes sent to market as a rich manure; it has a characteristic dark-brown colour and contains the undigested part of beetles' wings, &c. It is found in Cuba and in North Borneo.

Bone Beds occur in nearly all sedimentary strata, but in especially large quantities in the Peruvian system: they have, however, contributed but little to commercial supplies of phosphates except those of Bordeaux, Carolina, Florida, and Sombbrero.

Shell Beds have existed from the Cambrian age. The Silurian Lingula beds have already been mentioned as a probable abundant source of phosphates. Specimens were

obtained from the Dutch West Indies containing 75 to 80 per cent. of tribasic calcium phosphate, and sometimes exhibiting a mass of shells of recent origin.

Coprolites.—This term, which should be applied only to the fossil exuviae of animals, now includes many rolled or gravelly products, chiefly found in the Cretaceous formation. In England they have been worked to a large extent in Bedfordshire and Cambridgeshire, where they appear between the chalk and the subjacent Jurassic system. The commercial products contain 45 to 55 per cent. of calcium phosphate. The Suffolk coprolites occur in the Tertiary, and are poorer in calcium phosphate and more ferruginous. Deposits occur also at Bellegarde, on the Swiss frontier, and at Montpellier and Avignon.

Nodular, Concretionary, and Arenaceous Phosphates, by far the most important of natural phosphatic reserves, include the S. Carolina deposits, the deposits of the Somme, Ardennes, and Meuse, and the Belgian fields of Mons and Liège. So-called Bordeaux phosphates are in reality from the region of Quercy. The Russian deposits, between the rivers Desna and Don, are nodular. The Nassau or Lahn concretions in the clay are Tertiary, and are generally believed to be of animal origin; they attain to 60—75 per cent. of calcium phosphate, but are too ferruginous. The Belgian (Ciply) deposits which have yielded over 150,000 tons per annum are nodular, although the grains are sometimes so fine as to be considered arenaceous. The deposits discovered at Amiens in 1886 are arenaceous, and contain 65 to 80 per cent. of phosphate; the yearly production amounts to 200,000 tons.

Conglomerates and Breccias occur in the Cambridgeshire coprolite fields, in the Ardennes, and in Belgium (Ciply); sometimes the cementing material is the phosphatic element, sometimes the enclosed fragments are the valuable portions.

Phosphatic Limestone and Marl are found in most strata from the Silurian to recent times. The formation of phosphatic limestone from the action of the air and water on guano deposits on limestone has already been referred to. The value of the phosphate is increased by the solvent action of water containing carbonic acid which removes more carbonate than phosphate. A new field has recently been opened up in the department of the Pas de Calais, and seems to be of the same nature as that of the Somme.

Apatite does not occur in workable deposits before the Laurentian system. In Ontario and Quebec apatite is found bedded in the pyroxenic rocks, and has true veins of posterior origin. In Norway, where deposits were discovered in 1854, they occur in similar rocks to the Canadian. Brogger and Kensch suppose the deposits to be of eruptive origin, inasmuch as the surrounding rocks are free from phosphoric acid, but the question is very doubtful. Owing to the peculiarity of the occurrence of the mineral in veins in hard rock, and to the fact that a cheap mode of extracting has not yet been worked out, the Canadian industry has not yet progressed to the same extent as many other phosphatic fields, but future demands are certain to increase.—N. H. J. M.

Manufacture of Superphosphate from Ferruginous Phosphate. O. Jaehne. Zeits. f. ang. Chem. 1892, 231—232.

IN view of Schuecht's remarks (this Journal, 1892, 255), the author publishes this account of the manufacture of superphosphate by his method (this Journal, 1891, 649). 100 hectokilos. of ground coprolite containing 45·8 per cent. of calcium phosphate (21 per cent. P_2O_5), 10 per cent. of calcium carbonate, 16 per cent. of ferric oxide, 1 per cent. of alumina, 20 per cent. of silica, and 7·2 per cent. of other matters, were mixed with 150 hectokilos. of sodium bisulphate (the residue from the nitric acid works, containing some 30 per cent. of "free SO_3 "), and 60 hectokilos. of water. The calcium sulphate was filtered off in a press, and the liquor evaporated in vacuo, whereby 131 hectokilos. of the damp, yellow, soluble "superphosphate salt" were obtained. This dried up by itself and contained 14·5 per cent. of P_2O_5 . The calcium sulphate weighed 100 hectokilos. and contained 0·3 per cent. of soluble P_2O_5 ; it was

washed and the washings used for the manufacture of a further batch. If the calcium sulphate is mixed with the "superphosphate salt" a product containing 8.3 per cent. of P_2O_5 , and applicable as an absorbent for farmyard manure, is obtained. By replacing a portion of the sodium bisulphate with sulphuric acid, it is possible to obtain a richer "superphosphate salt"; but 17 per cent. of P_2O_5 is the limit beyond which the salt remains pasty. The salt consists of sodium sulphate, monocalcium phosphate, and phosphoric acid.—A. G. B.

PATENT.

Improvements in and in the Method of Manufacture of Fertilizers. T. M. Smith, Baltimore, Maryland, U.S.A. Eng. Pat. 8859, May 10, 1892.

ANIMAL substances, such as leather scrap, hair, bones, muscles, and horn are placed on a perforated false bottom in a boiler containing a small quantity of water underneath this bottom. The proportion of water used must vary with the amount contained in the animal substances; as an example, 50 galls. of water were sufficient for 2,000 lb. of hair containing 6 per cent. of moisture. The boiler is surrounded by superheated steam passed into the jacket at a pressure of 60 to 80 lb. per sq. in. After some 20 or 30 minutes the substances will have become thoroughly softened, and when turned out will cool to a hard but friable mass, which can be readily distributed, and contains all the fertilising constituents which it originally possessed.—A. G. B.

XVI.—SUGAR, STARCH, GUM, Etc.

PATENTS.

Improvements in and relating to the Manufacture of Sugar and in Apparatus therefor or connected therewith. R. Harvey, Glasgow. Eng. Pat. 11,874, July 13, 1891.

THE usual process for obtaining refined sugar from the concentrated syrup is to allow the latter to cool and crystallise and then separate the crystals from the mother liquor by centrifugal machines or simple drainers.

Instead of this the inventor runs the concentrated syrup into a steam-jacketed pan which is provided with rotatory agitators and scrapers. As the syrup is dried by the heat the agitators and scrapers granulate it, and a dry granular sugar is obtained without the production of any syrup.

The specification contains a detailed description of the apparatus to be employed, and suggestions for fitting up a complete sugar refinery.—A. L. S.

Improvements in the Process and Means for Manufacturing Crystallised Sugar in Refineries. T. Drost, Breslau, Germany. Eng. Pat. 13,260, Aug. 5, 1891.

THE inventor avoids the waste of pure sugar involved in the process of refining raw sugar by means of "steam" or "clear casing," by employing in a particular manner, refinery syrup of 90°–93° purity. Such syrup is produced in all refineries during the ordinary course of operations. According to this invention the said syrup is boiled down in a vacuum pan until it has a density of 1.15–1.325 (57°–66° Balling) so that it will neither deposit nor dissolve sugar-crystals at the temperature at which it is to be used. The raw sugar to be treated is first mixed with low-grade syrup and thoroughly "jigged" in a centrifugal machine. The resulting product is then cased with 8–10 per cent. of its weight of the above concentrated syrup, care being employed that the casing syrup be not higher in temperature than that in the space of the casing vessel; and that the

symp be finally centrifugalled out of the sugar as completely as possible. By this process loss of crystal sugar by solution in the centrifugal machine is avoided, and a finished product of at least 99.5 polarisation is obtained; whilst on the score of cheapness and convenience the method is said to offer distinct advantages.—H. T. P.

Improvements in the Manufacture or Production of Yeast. K. Schlagenhauser and J. Blumer, New York, U.S.A. Eng. Pat. 9344, May 17, 1892.

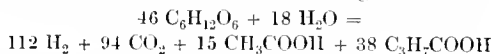
THIS process, which has reference to the production of pressed yeast, differs from the ordinary process in so far that only the sugars, &c. but not the starch contained in the raw materials employed, are utilised. For this purpose the grain, &c. after milling, is systematically extracted with water, or spent wash, or water containing a trace of acid or alkali, preferably at a temperature of 10°–15° C., and in no case exceeding 50° C. until the extract is sufficiently concentrated (sp. gr. 1.02–1.04). The starch thus remains unacted upon, and after filtration from the liquid, may be used for the production of pure starch, glucose, &c. The liquid containing the sugars, &c. is sterilised by heating to 65°–130° C., filtered to remove the coagulated albuminoids, and then pitched with a small quantity of yeast, and fermented at 25°–35° C. The yeast crop obtained is finally washed and pressed in the usual way. By this method the conversion of large quantities of starch into alcohol and the recovery of the latter by distillation are avoided; and it is claimed that the yeast produced is of great purity, and possessed of excellent keeping properties.—H. T. P.

XVII.—BREWING, WINES, SPIRITS, Etc.

A Ferment Producing Amyl Alcohol from Starch. L. Perdriz. Zeits. f. Spiritusind. 14, 177.

THE bacillus in question was obtained from Paris drinking-water. It grows only out of contact with air, and is easily cultivated in an atmosphere of hydrogen, carbon dioxide, or nitrogen, the most favourable temperature being 35° C., and the maximum limit 43° C. Under favourable conditions it forms spores, which remain for 10 days at a temperature of 50°, and 10 minutes at a temperature of 80° without perishing.

Bacillus Amylozymiens ferment the sugars, and has considerable action on starch materials, but none on cellulose and calcium lactate, wherein it differs from Pasteur's *Vibrio Butyricus* and from Van Tieghem's *Amylobacter*. It produces acids, and the action becomes a complete one if the acid be kept neutralised. The author, from analyses made by him, considers the following equation to represent the fermentation of glucose:—



Furthermore, analyses showed that during the first three days acetic and butyric acids are formed, but from the third to the ninth day the fermentation resembled the butyric fermentation. With saccharose both acids are produced for five days, after which only butyric acid is formed.

Similar results were obtained with lactose. The bacillus transforms starch into a sugar akin to glucose, and, on neutralising the acid formed, it ferments this sugar, whereby are obtained ethyl and amyl alcohols. The sugar may be directly converted into alcohol by the aid of yeast, without previously killing off the bacillus. From 1 kilo. of potatoes 105–110 cc. of alcohol can be obtained, so that by simultaneous action of bacillus and yeast it is possible to obtain 90 per cent. of the theoretical amount of alcohol

from starch. Owing to the fact that some amyl alcohol is formed from starch by the action of this bacillus, the author hazards the opinion that such a bacillus as this may account for the presence of amyl alcohol in commercial alcohol.—T. L. B.

PATENTS.

Improvements in Apparatus Employed in the Brewing of Beer. T. White, Rotherham, Yorkshire, and J. Lee, Burnsley, Yorkshire. Eng. Pat. 11,237, July 2, 1891.

This is an apparatus for extracting the "essence" from malt, hops, or other ingredients, and mixing it with water.

—J. C. C.

An Improved Mode of Manufacturing Yeast. A. Walker, Glasgow. Eng. Pat. 12,606, July 24, 1891.

A wort is prepared by making a mixture of 50 per cent. or more of green malt and the remainder of some raw grain, preferably rye or maize. The green malt and soaked grain is crushed between rollers and mashed at 144° F. The resulting wort is slightly acidified and collected in the fermenting vessels at a specific gravity of 1.033 and a temperature of 86° F.; it is pitched with yeast at the rate of 2 lb. per 100 lb. grain, and the temperature kept constant by attenuators. Throughout the fermentation, air is pumped through the liquor until fermentation has nearly ceased; the yeast is then allowed to deposit, and is washed, and pressed.

The fermented liquor and the yeast washings are distilled.

If peated malt whiskey is to be obtained, the green malt is previously exposed to the smoke of peat.—A. L. S.

Improvements in Apparatus for the Manufacture or Brewing of Beer. V. Denamur, Ghent, Belgium. Eng. Pat. 12,659, July 25, 1891.

THE apparatus consists of a boiler, in which the wort is boiled, and provided with an arrangement for injecting air into the boiling wort; a refrigerator, by means of which the wort is cooled by passing through a tube immersed in a vessel of cold water; a fermenting vessel provided with a skimming apparatus and a perforated tube for injecting sterilised air; and a yeast receiver.

The different vessels are connected together with suitable tubing, and they are all provided with covers, which are kept hermetically sealed; air filters are placed on these where required, so that only filtered air is allowed access to the wort or beer at any stage.

The operations of brewing are carried out in the usual manner, the principal feature of the invention being the carrying out of the whole process in closed vessels.—A. L. S.

Improvements in the Preparation of Cattle Foods. D. Tallerman, Dublin. Eng. Pat. 13,212, August 5, 1891.

By this process it is intended to convert brewers' grains and distillers' wash into a cattle food possessing good keeping qualities and, by reason of its compactness, suitable for economical transport. To this end, the grains, first dried as much as possible by great pressure, are minced or chopped up by suitable machinery and spread out to dry on wire gauze trays arranged in a chamber through which hot air is passed. When dry, the grains are ground to powder, more or less fine, as may be required. The wash and the liquor squeezed from the grains are filtered through canvas bags, and the solid matters thus separated are submitted to moderate pressure to remove the surplus water. A mixture is then made of—

- 65 parts of the dried grains powder,
- 20 parts of the solid residuum from wash,
- 8 parts of bone meal,
- 5 parts of finely-chopped fat,
- 2 parts of ground saltpetre.

The whole is thoroughly blended, and moulded into flat cakes, which are rendered compact by hydraulic pressure, and finally dried in an oven if necessary.—H. T. P.

A Machine for the Preparation of Brewers' Finings, and the Combination of Gelatinous and Saccharine Substances. B. Brooks, Manchester. Eng. Pat. 14,529, August 28, 1891.

THE machine consists of a series of graduated sieves of a semi-cylindrical shape placed one above the other and enclosed in a wooden case.

Revolving shafts work in the axes of the sieves, and to these shafts brushes are fastened which press against the sides of the sieves.

The upper sieve has the coarsest mesh. The materials to be compounded are fed into the uppermost sieve and the brush shafts being revolved they are forced through the sieves and reduced to the proper degree of fineness.

For the preparation of finings for beer the inventor finds that two sieves are sufficient, the upper one being made of No. 9 and the lower one of No. 4½ perforated copper.

—A. L. S.

Method of and Apparatus for Producing Clear Wort. G. Sobotka, New York, U.S.A., and A. Kliemetschek, Baltimore, Maryland, U.S.A. Eng. Pat. 5059, March 15, 1892.

A MASH is prepared in the customary manner and after standing the usual time is forced into a filter-press. The clear wort runs over a refrigerator into the fermenting vessel, the pressed grains are discharged into a special vessel, mixed with hot water and pumped into a second filter-press, the pressings from this are run into the mash tub and mixed with the next mash; the pressed grains are used as a cattle food.—A. L. S.

Improved Method of or Means for Treating Beer for Improving its Qualities and Colour. G. M. Johnson and E. de Cock, Brussels, Belgium. Eng. Pat. 6555, April 5, 1892.

THIS invention relates to the manufacture of ferruginous beer. For this purpose some salt of iron is dissolved in the beer which will not impair its colour or flavour. Hypophosphite of iron is the most suitable, and is preferably added to the finished beer, the colour and flavour of which it is said to improve, apart from the valuable medicinal properties it confers. The amount of iron salt employed may range from a mere trace to 25 to 80 mgrms. per litre, or even more in the case of strong beers.—H. T. P.

Improvements in the Manufacture or Production of Yeast. K. Schlagenhauser and J. Blumer, New York, U.S.A. Eng. Pat. 9314, May 17, 1892.

See under XVII., page 790.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOODS.

The Proteids of the Corn or Maize Kernel. R. H. Chittenden and T. B. Osborne. Amer. Chem. J. **13**, Nos. 7 and 8; **14**, No. 1.

THE maize kernel contains several distinct proteids, of which there are three globulins, one or more albumins, and an alcohol-soluble proteid.

The globulin, obtained by extracting the maize-kernel with 10 per cent. sodium chloride solution, and separating by dialysis, or by precipitation with ammonium sulphate, followed by dialysis, is a mixture of two or more different globulins. It can be approximately separated into two constituents by fractional heat-coagulation, or by "recrystallisation" from warm dilute salt solution; in the former process a small amount of proteose-like bodies is formed, presumably by hydrolysis of the less resistant globulin.

These two globulins are a myosin-like body and a vitellin-like body. They exist as such in the maize kernel, and are not mere cleavage products of the substance extracted by 10 per cent. salt solution.

The myosin-like globulin contains about 16.8 per cent. of nitrogen and 1.2 per cent. of sulphur, agreeing closely in composition with animal myosin. Its coagulating point (in 10 per cent. salt solution) is, however, about 70°.

The vitellin-like globulin contains about 18.1 per cent. of nitrogen and 0.85 per cent. of sulphur, agreeing closely with the generally accepted composition of phyto-vitellin. It is, however, almost non-coagulable by heat when dissolved in dilute salt solution, except in the presence of acetic acid. It is more soluble in warm salt solutions than in cold, and when separated from the former by cooling, or on dialysis, almost invariably appears in the form of small spheroids.

Direct extraction of finely powdered corn meal with water yields a dilute salt solution which dissolves the myosin-like globulin, leaving the bulk of the vitellin-like substance undissolved. The character of the salts present in the kernel probably plays an important part in this separation; from the solution the myosin can be separated in a fairly pure state by the usual methods. Extraction of the residue from the aqueous treatment, with 10 per cent. salt solution dissolves the vitellin-like globulin, which can be separated from the solution by the customary methods.

The third globulin in the maize-kernel is characterised by extreme solubility in very dilute salt solutions, especially phosphate and sulphates, which it separates only by prolonged dialysis. It coagulates in a 10 per cent. salt solution at about 62°, and contains 15.2 per cent. of nitrogen and 1.26 per cent. of sulphur.

By long continued action of water, and also of strong salt solutions, the last-mentioned globulin and the myosin-like globulin are changed into insoluble modifications, soluble, however, in 0.5 per cent. sodium carbonate solution, from which they are precipitated by neutralisation, apparently as albuminates. These modifications are characterised by a relatively high content of carbon.

An aqueous or sodium chloride extract of corn meal contains, besides the globulins, two albumin-like substances, more or less coagulable by heat, but unlike in composition.

After the globulins and the albumins have been entirely removed from the extracts, a certain amount of proteose can be detected, but this is mainly, if not wholly, an artificial product of the hydrolysis of one or more of the preceding substances.

Especially noteworthy is the presence in the maize-kernel of a peculiar proteid called maize-fibro or zein, soluble in warm dilute alcohol but not in water. It has a high content of carbon, resists the action of dilute alkalis, and is easily converted into an insoluble modification when warmed with water or very weak alcohol. The soluble and insoluble form are identical in composition and respond to the ordinary proteid reactions.—A. G. B.

The Valuation of Feeding Stuffs and Foods. E. Kinch. Trans. Surveyors' Inst. **24**, 1891—92, 297—344.

THE author attempts to find out what determinable factors are at present available for use in valuing a food, in the same sense as that in which a manure is valued, viz.:—By the unit value and the availability of its constituents.

The following table (Table I.) shows the consumption of oil-cakes and oil-seeds in this country, as estimated by subtracting exports from imports. There is practically no export of oil-cake and cotton-seed, so the numbers given are imports only. By far the predominating proportion of these cakes and seeds is used as cattle food, the remainder being applied as manure. The table does not, however, represent all the imported cattle food, inasmuch as a considerable quantity of the imported cereals and leguminous seeds is also used for cattle.

The following percentages of the above cakes and seeds came in 1890 from the countries mentioned:—*Oil-cake*. U.S.A. 77.9, Russia 9.1, France 4.6, Germany 2.8, India 1.9, Sweden, Egypt, Spain, and Brazil, each less than 1. *Cotton-seed*. Egypt 90, Brazil 5, Turkey and U.S.A. each over 1. *Linseed*. India 50.5, Russia 41.6, Argentine 3.5, Holland and Turkey each more than 1. *Seeds unenumerated*. India 59.9, Russia 15.9, Germany 10, Holland 6.9, Turkey 1.6. *Rape seed*. India 55.3, Russia 31.1, Roumania 5.4, Belgium 3.1, Germany 2.6, France 1.4.

After reviewing the general composition, digestibility and albuminoid ratios of various feeding stuffs in a series of tables, which, although not entirely new, are carefully brought up to date, the author proceeds to discuss the possibility of arriving at a definite "food-unit" as a basis for the valuation desired, confining himself to the food of farm animals.

By general consent only the nitrogenous matter, the fat and the carbohydrates (including digestible fibre) are to be given a monetary value in a food, the other constituents, although by no means useless, being generally present in sufficient quantity in all foods, or being so easily supplied as to be of very minor importance monetarily. The functions fulfilled by digested fat and digested carbohydrates in the animal body are much the same, and the relative value of their constituents is fairly accurately determined by physiological and calorimetric experiments. It is otherwise with the albuminoids, which are incapable of comparison as far as flesh-forming capacities are concerned, although comparable with fat and carbohydrates in respect of their heating and fat-yielding values; even in the latter case their after-, or maturial value complicates the matter.

TABLE I.

—	Oil-cake.	Cotton Seed.	Linseed.	Rape Seed.	Seeds un- enumerated, for expressing Oil.	Nuts and Kernels for expressing Oil.
	Tons.	Tons.	Quarters.	Quarters.	Quarters.	Tons.
1886	296,480	254,613	1,891,117	361,491	72,877	.. ..
1887	264,849	275,627	2,223,047	361,555	47,652	.. ..
1888	257,748	257,172	2,387,113	248,252	64,339	.. ..
1889	255,918	277,894	2,028,282	386,482	56,911	.. ..
1890	282,616	314,050	1,836,983	185,607	16,891	22,551

Physiologically albuminoids might be valued at 6—7 times as much as carbohydrates, for the albuminoid ratio of an adult's food is 1:6 or 7, that is, one part of albuminoid will enable 6 or 7 parts of carbohydrates to carry on their functions in the animal. Commercially this is not the proportional value.

Market values of the separate ingredients are no criteria. Thus in the case of oils the pure article has an enhanced value on account of its industrial uses, and of the cost of production; notwithstanding this, a comparison of the prices of cakes rich in oil and poor in oil, other things being balanced, shows that the extra amount of oil in the rich cake costs more than if it were purchased in the free state. Starch in potatoes at 48s. per ton costs about 1d. a lb.; crude sugar is sometimes as low in price as this, though generally higher. Albuminoids can hardly be said to be marketed in a separate state; calculating the value of the nitrogen in them when nitrate of soda is 9l. a ton, the amount in one lb. would be worth nearly 1d., but allowing 50 per cent. as the manurial value this is reduced to $\frac{1}{2}$ d.

The most recently obtained results for the so-called isodynamic values, or quantities which can produce the same amount of heat or of energy, of some of the chief food constituents are:—Fat 100, cane sugar and gum 235, grape sugar 255, starch 229, milk sugar 243, muscle 213—235, cellulose 267, bread 336, asparagin 469. Taking the heat-producing power of starch as unity, these numbers become:—Starch 1, fat 2.29, muscle 0.97, cane sugar 0.97, milk sugar 0.94, glucose 0.90, cellulose (about) 0.86, asparagin 0.49. Generally and broadly, when consumed in the animal one grm. of fat produces 9.3 calories, and one grm. of albuminoids or one grm. of carbohydrates (starch) 4.1 calories.

Except for the facts that fat might have a slightly enhanced value owing to its being more condensed than carbohydrates, and that it possibly has some special value, as the experiments of Cooke seem to show (*Jour. Royal Agric. Soc.* 1890 [2] 35, 407), the ratio between the market prices for these two constituents should undoubtedly approximate to that between their physiological values, 1:2.29; the author has adopted the ratio 1:2.5.

The following numbers show the ratios between the values assigned to the three food constituents by different persons at different times, sometimes by contemplation and sometimes by calculation over the market values:—

	Carbo- hydrates.	Fat.	Albumi- noids.
Grouven and Schultze, in grain and its products, and in roots.	1	3.3	2.7
Grouven and Schultze, in oil-cakes.	1	3.3	2
Grouven and Schultze, in green foods.	1	1.3	1.7
Grouven and Schultze, in hay and straw.	1	1.3	1.3
Wolff, in 1871	1	2.5	6
Versuchs-Stationen, in crude foods, 1891.	1	5	5
Wolff, in digestible matters, 1891 ..	1	2	3
König, calculated 1874-79, in men's food.	1	3	3
König, calculated in 1879-80, in men's food.	1	3.7	3.5
König, in vegetable foods, about...	1	2.3	4-5
Wolff, Indiana Experiment Station. On digestible constituents, 1889.	1	3.7	3.7
Jenkins, in 1889, on total constituents.	1	4.37	1.66
Collier, in 1890, on total constituents.	1	2.5	2.5
Connecticut station in cereal products and in cotton and linseed meals, calculated 1888.	1	4.3	1.7
Ditto, ditto, 1890	1	2	1

The difference in the last two cases was probably due to rise in the price of starchy cereals, and fall in that of nitrogenous oil-cake meals, in 1890.

The ratios 1:5:5 applied to crude constituents are used at some of the German stations in estimating compensation to be allowed when a food is not up to sample.

The author has made a calculation by the method of least squares in which the composition and market price of 26 articles of food were taken into consideration. Weights were given to each equation to endeavour to approximate to the relative amount of consumption of the article concerned. The foods used were 6 linseed cakes to which a total weight of 15 was given; 4 decorticated cotton cakes with a weight of 8; 2 undeorticated cakes with a weight of 10; 10 miscellaneous cakes and seeds, namely:—rape, hemp, coecanut, palm-kernel, and earth-nut cakes, rice meal, a mixed cake, locust beans, cotton seeds and linseed, each with a weight of 1; beans, with a weight of 8; peas, with a weight of 4; barley and oats, each with a weight of 10; and maize with a weight of 20. Three series of results were calculated and the following figures represent the cost in shillings of a unit of digestible albuminoids (x), digestible fat (y), and digestible carbohydrates (z), respectively in each series:—

(1.) When the cakes and seeds had a total weight of 43, the cereals of 40, and the pulses a weight of 12, $x=2.58$, $y=3.06$, $z=1.56$.

(2.) When the cakes, oil seeds, and legumes only are calculated from, $x=2.02$, $y=3.58$, $z=1.59$.

(3.) When cereals only are considered, $x=2.83$, $y=7.76$, $z=1.21$.

The author points out that one reason why others have obtained such variable results by this method, is that care has not been taken to give each of the separate original equations its proper relative weight. The weights here given are by no means perfect, through lack of statistics. The numbers apply to the more concentrated foods only, inasmuch as coarse fodders have been omitted. The market price of concentrated food is more largely controlled by the amount of fat than by other constituents.

As a mean result of his calculations, the author adopts as the ratios for the values of the digestible constituents, 1:2.5:2.5 = carbohydrates:fat:albuminoids and amides; the inclusion of the amides causes a slight error, which however, is counterbalanced by the exclusion of the manurial value of the undigested nitrogen. The value per pound and per unit of each of the considered constituents are on this basis:—

	Per Lb.	Per Unit per Ton.
Digestible carbohydrates	$d_{\frac{1}{2}}$	$s_{1.24}$
Digestible fat	$1\frac{1}{2}$	3.11
Digestible albuminoids and amides	$1\frac{1}{2}$	3.11

The following table (Table II.) is calculated with these figures.

The ordinary numbers in columns 3, 4, 5, and 6, give the crude composition, those in brackets show the digestible composition. The figures in brackets in column 8, are the number of "food units" in the food; these are obtained by multiplying the percentage of digestible albuminoids and amides by $2\frac{1}{2}$, and the percentage of fat by $2\frac{1}{2}$ and adding these to the percentages of digestible carbohydrates and fibre. To obtain the estimated value in shillings of the food per ton, the food units must be multiplied by 1.24.

The table shows that on the values of the food constituents which are taken, these food constituents can be purchased more cheaply in some foods than in others; it must be remembered, however, that certain considerations, such as palatability, portability, flavour and mechanical condition, which have a very real influence on the application of a food, cannot possibly be reduced to figures. The table only serves to decide what food is cheaper *ceteris paribus*.

A few remarks on the manure value of food in relation to the compensation tables of Lawes and Gilbert (*Jour. Roy. Agric. Soc.* [2] 21, 591) conclude the paper.

The discussion contains no remarks of value; objection was taken by Dr. Voelcker to the omission of ash constituents in the calculation.

TABLE II.

	Water.	Albumi- noids.	Oil.	Soluble Carbo- hydrates.	Fibre.	Ash.	Price July 31st, 1891.	Cost per "Food Unit" per Ton.
Linseed cake, English	11.30	31.69 (27.3)	14.67 (13.2)	29.57 (25.6)	7.17 (3.1)	5.60	£ s. d. 9 5 0 (130)	s. .. 1.42
" " 95 per cent.	11.12	30.13 (25.9)	12.74 (11.5)	30.36 (24.3)	7.27 (3.2)	5.28	8 7 6 (121)	.. 1.38
" " " " " "	11.45	25.39 (21.7)	12.67 (11.4)	35.61 (28.4)	9.13 (4.0)	5.84	8 2 6 (115)	.. 1.41
" " " " " "	11.13	32.44 (27.8)	11.97 (10.8)	30.43 (14.3)	8.49 (3.7)	5.63	8 0 9 (121.5)	.. 1.28
" Russian	13.04	30.57 (26.3)	12.02 (10.8)	31.99 (25.6)	6.74 (2.9)	5.64	7 12 6 (121)	.. 1.26
" " " " " "	13.24	30.57 (26.3)	15.86 (14.2)	28.41 (22.7)	6.21 (2.6)	5.68	8 5 0 (126.5)	.. 1.34
" American	10.92	36.33 (31.0)	8.54 (7.7)	31.80 (25.4)	7.05 (3.0)	5.36	6 12 6 (125)	.. 1.06
" " " " " "	10.96	31.01 (26.6)	8.02 (7.2)	38.55 (30.8)	6.18 (2.7)	5.28	6 10 0 (118)	.. 1.10
Cotton cake, undecorticated	13.96	23.23 (17.4)	5.51 (4.9)	31.76 (17.1)	20.74 (2.0)	4.80	4 17 6 (75.3)	.. 1.29
" " " " " "	13.45	27.47	5.18	28.85	19.65	5.10	4 17 6 (81)	.. 1.29
" decorticated	7.93	43.61 (37.0)	11.74 (10.3)	26.33 (25.0)	7.20	3.19	7 5 0 (113)	.. 1.01
" " " " " "	6.24	45.20 (38.4)	11.03 (9.7)	27.35 (25.9)	2.90	7.28	7 7 6 (116)	.. 1.01
" " " " " "	7.84	42.05 (35.7)	16.20 (14.3)	24.34 (23.0)	6.57	2.90	7 15 0 (118)	.. 1.05
" " " " " "	6.80	43.94 (37.4)	12.10 (10.6)	25.49 (24.2)	5.27	6.19	6 17 6 (144)	.. 0.96
Cotton seed	9.55	22.37 (18.8)	21.30 (19.1)	24.63 (12.3)	16.85 (3.3)	5.30	6 10 0 (110)	.. 1.18
Kape cake	10.48	34.56 (27.9)	8.65 (6.8)	20.35 (26.2)	9.64 (0.8)	7.32	6 5 0 (124)	.. 1.02
Hemp cake	13.60	31.02 (21.7)	6.44 (5.4)	15.70 (9.4)	25.16 (6.3)	8.08	6 0 0 (83.5)	.. 1.43
Cocoanut cake	8.40	29.37 (15.5)	11.36 (11.3)	40.61 (32.5)	12.97 (8.0)	6.29	6 15 0 (107.5)	.. 1.25
Palm nut kernel cake	9.12	15.50 (14.2)	12.50 (11.3)	35.45 (31.9)	23.69 (17.7)	3.74	5 15 0 (113)	.. 1.02
Earth nut cake (decorticated)	9.75	48.06 (43.7)	10.10 (8.7)	21.74 (20.2)	4.85 (0.8)	5.50	5 17 6 (151)	.. 0.78
Mixed feeding cakes .....	..	..	..	..	..	..	6 12 6 to 7 10 0	1.29 .. 1.44
Rice meal	9.88	13.90 (10.7)	10.12 (8.9)	56.07 (56.0)	6.26 (1.1)	3.77	5 17 6 (99)	.. 1.19
Locust beans	14.65	7.03 (4.7)	1.08 (0.5)	68.02 (64.6)	6.34 (1.7)	2.88	6 10 0 (82)	.. 1.58
Barley .....	..	.. (8.2)	.. (2.0)	.. (55.8)	..	..	6 5 0 (81)	.. 1.53
Oats .....	..	.. (10.1)	.. (5.0)	.. (12.1)	.. (2.0)	..	6 15 0 (84.3)	.. 1.60
Maize .....	..	.. (7.5)	.. (1.3)	.. (65.8)	.. (1.5)	..	6 6 0 (96.8)	.. 1.39
Linseed .....	..	.. (13.0)	.. (32.0)	.. (10.8)	.. (4.2)	..	11 10 0 (142.5)	.. 1.61
Peas .....	..	.. (13.9)	.. (1.5)	.. (18.8)	.. (1.2)	..	7 12 0 (107)	.. 1.12
Beans .....	..	.. (22.4)	.. (1.4)	.. (12.7)	.. (6.8)	..	7 0 0 (97)	.. 1.14

First Report to the Water Research Committee of the Royal Society on the Present State of our Knowledge concerning the Bacteriology of Water, with especial reference to the Vitality of Pathogenic Schizomycetes in Water. P. F. Frankland and M. Ward. Proc. Royal Soc. **51**, 183—279.

AFTER detailing and discussing exhaustively all the more important work which has been done in connexion with the bacteriology of water, the following points are noticed especially in the summary. Natural waters vary in composition very greatly, and the usual method of classifying them into river-water, spring and well-water, distilled water, &c. is not sufficiently accurate when considering them from the bacteriological standpoint. The schizomycete is a very small organism and requires correspondingly minute amounts of food; also that it is a very delicate organism, and is a variable factor itself, possessed of a variable organisation.

In bacteriological research work the matter is still more complicated when a given schizomycete is turned into a water already peopled by other species; "the whole teaching of bacteriology shows that the competing organisms cannot exist side by side without affecting the welfare of each." The water itself, the dissolved gases, the suspended and dissolved substances, the temperature all certainly influence the micro-organisms present, and certain rays of light and mechanical disturbances very possibly do so likewise. In the course of any practical inquiry, distilled water is hardly a suitable medium to operate in, since it is unknown in nature. When operating in sterilised water, most of the authors are unanimous that pathogenic germs enjoy a longer existence than in the same water before sterilisation.

The sterilisation of waters may be conducted, (1) by heat, (2) by filtration. The former method causes certainly material changes in the composition of the water, e.g., precipitation of dissolved substances, explosion of gases, and change or destruction of organic matters. Whilst filtration does not cause such material alterations as the above, the proportions of dissolved gases are certainly altered.

Referring to the results obtained by different authors, the following notes are made:—(1.) The numerical results obtained by means of the gelatin-plate culture are generally too low. (2.) Too high a temperature has frequently been employed. (3.) Many of the results are vitiated through the introduction into the waters of concentrated food with the organisms at the time of infection. (4.) Experiments with distilled water are of little practical value, but pathogenic organisms appear to live a shorter time in this medium than in ordinary water. (5.) Results obtained by operating in either sterile or unsterile water should be confirmed by different investigators attacking the problem in different ways before they are received as conclusive. (6.) Both mineral waters, as well as snow, hail, and ice may become means of conveying pathogenic organisms. (7.) The periods through which pathogenic organisms may exist in waters depend on a great variety of circumstances; but in all ordinary waters they die out, sooner or later.

Regarding specific forms the following notes are made:—

Spirillum cholera asiatica has been shown to live and multiply in drinking waters; the results as to its length of life in such media are very conflicting, some observers having found it dead at the end of two days, whereas others have found it alive at the end of a year. The points of agreement between different observers are that it can live in waters, and that, as a rule, it is not very resistant towards the competing forms.

Bacillus typhosus appears to have a greater resisting power than the cholera spirillum, and most observers record that it may remain active for three months.

Bacillus anthracis. The vegetative rodlets of this organism are less able to hold their own than the spores. The spores of anthrax may undoubtedly live in sterile water for months without injury, provided the temperature be not too high.

The *Streptococcus of erysipelas* appears to be remarkably susceptible to immersion in water, being immediately destroyed in distilled water, and survived only five days in sterile sewage and drinking water.

Micrococcus tetrageneris maintains itself for some days in various waters.

Bacillus tuberculosis may live for 100 or more days in river water.

Staphylococcus pyogenes aureus is said to live more than 19 days in river water.

The bacillus of glanders may live more than 50 days; the micrococcus of fowl-cholera, 30 days; the bacillus of swine-plague, 17 days; and that of mouse-septicæmia, 20 days in water.—J. W. L.

PATENT.

Improvements in the Preparation of Cattle Foods. D. Tallerman, Dublin. Eng. Pat. 13,212, August 5, 1891.

See under XVII., page 700.

(B.)—SANITARY CHEMISTRY.

Absorption of Carbon Monoxide by Blood. N. Gréchant. Compt. Rend. **114**, 1892, 309—310.

EXPERIMENTS are described in which dogs are made to breathe air containing carbon monoxide, the proportions of carbon monoxide subsequently separated from the blood agreeing perfectly with the composition of the atmosphere breathed. From his results the author affirms that carbon monoxide is dissolved by the blood in obedience to the law of Dalton. The use to which the method has been put is for the estimation of carbon monoxide in the case of the air in coaches heated by stoves fed with charcoal briquettes.

—T. L. B.

PATENTS.

An Improved Means for or Appertaining to Fumigating and Disinfecting Dwelling-houses, Assembly Rooms, Hospitals, Churches, Theatres, Ships, and the like, as well as for Extinguishing Fires therein; applicable also for Smoking and Curing Fish, Hams, and other Food. J. Robertson, London. Eng. Pat. 10,129, June 15, 1891.

A PORTABLE iron stove is provided with an evaporating or burning pan, in which is placed the chemical or substances to be evaporated or burnt, and is connected with a fan, by means of which air is drawn through the apparatus and the evolved gases driven through a hose or flue to the place where they are to be utilised.—F. H. L.

Improvements in the Manufacture of Blue Bleaching Materials for Washing Purposes. T. H. Rees and W. P. Blackham, London. Eng. Pat. 13,041, August 1, 1891.

THE invention relates to the manufacture of blue or bleaching materials in cakes, or cubes, or cylinders with hollow centres, or with a hole of any suitable size, diameter, or shape through the centre, whereby the drying or dissolving surface for use of the cakes or cubes is almost doubled. The inventors also propose to fill the cavities in the centre of the cakes or cubes with antiseptic or disinfecting materials.—C. O. W.

Improvements in Apparatus for Treating Foul Air and Noxious Vapours or Gases. J. Makinson, St. Helens, Eng. Pat. 14,038, August 19, 1891.

THIS apparatus is simply a furnace constructed to burn the most convenient sort of fuel, connected with a high chimney shaft, and with its ashpit, which may be closed by a door,

in communication with the sewers, or other places where the noxious gases are collected. The flues delivering the gases into the furnace are fitted with dampers for regulating the supply, and the most convenient method of erecting the whole plant is shown in detail in the two sheets of drawings accompanying the specification.—F. H. L.

Improvements in or relating to the Treatment of "Sewerage" and other Contaminated Liquids. W. D. Scott-Moncrieff, London. Eng. Pat. 14,181, August 22, 1891.

The liquid is purified by upward percolation through a suitable filtering medium which is supported on a grating fixed in a tank, the latter being provided with a blow-off cock to remove the deposit when necessary.—F. H. L.

(C).—DISINFECTANTS.

Action of Boric Acid on Germination. J. Morel. Compt. Rend. **114**, 1892, 131—133.

See under XX., page 707.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Terpenes and their Derivatives. J. W. Brühl. Ber. **25**, 1892, 547—551.

THE paper deals with the composition of *Oil of laurel*. The sample examined was a thick oil of a greenish-yellow colour, having an acid reaction and boiling between 175° and 275° C. When treated with alkali and carbon dioxide successively, and then distilled, lauric acid together with a phenoloid substance, the nature of which was not determined, were obtained, but no eugenol could be detected. After treatment with potash and then sodium, a mobile, colourless, neutral oil results, boiling between 167° and 171° C. This consists of cineol, $C_{10}H_{18}O$, pinene, $C_{10}H_{16}$, in small quantity, and other hydrocarbons. The optical properties of the oil point also to its being a mixture, and are therefore in accordance with Wallach's observations that the oil does not contain a special terpene of boiling point 171° C., as stated by Gladstone (J. Chem. Soc. 1861, **17**, 5 and 18).

Laurel oil also contains other bodies in addition to the above, of a ketonic or alcoholic nature, which form solid compounds with sodium, decomposable by water. These were not investigated.—C. A. K.

Bromide of Potassium. H. Helbing and F. W. Passmore. Helbing's Pharm. Record, **7**, 1892.

THE authors have examined various brands of potassium bromide and conclude that there exists in commerce at the present time potassium bromide of foreign origin that does not comply with the requirements of the British Pharmacopœia, the samples tested containing from 4.52 to 5.96 per cent. of KCl, whilst specimens of English manufacture contained only 0.13 per cent. of KCl. The authors estimated the bromide with standard silver solution, which method they state as being the most practical and reliable for the determination of the amount of chloride present, due attention being paid to the possible presence of other substances that may affect the result.—J. C. C.

Nicotine. A. Pinner and R. Wolfenstein. Ber. **25**, 1892, 1428—1433.

WHEN oxynicotine (this Journal, 1891, 381 and 569) is heated with concentrated hydrochloric acid at 140° for 8—10 hours it yields, together with resinous products, an oily base of the composition $C_{10}H_{11}N_2O$, which the authors name *pseudonicotine oxide*. This compound is volatile with steam, seems to be very sensitive to light, and is readily soluble in water; its *hydrochloride*, $C_{10}H_{11}N_2O \cdot 2 HCl$ is crystalline, melts at 192°, and is very readily soluble in water; its *platinochloride* crystallises in needles and decomposes at about 120°.

Dehydronicotine, $C_{10}H_{12}N_2$, is formed when pseudonicotine oxide is distilled under the ordinary atmospheric pressure; it is an oil, does not turn red on exposure to the air, and is only sparingly soluble in water. Its physiological action is just as powerful as that of nicotine; pseudonicotine oxide, on the other hand, has only about $\frac{1}{10}$ th of the effect of nicotine.

When oxynicotine is heated with a saturated solution of barium hydroxide at 140° it is converted into nicotine, a resinous compound and traces of ammonia being also produced.—F. S. K.

Russian Peppermint Oil and Menthylamine. G. Andres and A. Andreef. Ber. **25**, 1892, 609—622.

THE authors have examined large quantities of Russian oil of peppermint with reference to the contained hydrocarbons which have been but little investigated.

The oil was fractionated repeatedly and heated with metallic sodium, six fractions boiling between 158° and 175° being finally obtained, of which the highest (173—175°) was the chief product. This is a terpene, $C_{10}H_{16}$, and resembles *levo-limonene*, except that its specific rotatory power is considerably too low. The fraction of boiling point 170°—173° also contains *levo-limonene* mixed with an isomeric hydrocarbon. The lower fractions contain terpenes mixed with hydrocarbons, having the formula $C_{10}H_{18}$, which have not been isolated. No evidence was obtained of the presence of naphthenes. The fractions 200°—205° and 205°—210° contain *menthone* ($C_{10}H_{18}O$) and varying quantities of *menthol*. The quantity of total hydrocarbons in the oil does not exceed 17 per cent., and the results obtained with oil prepared both from dried and fresh plants were similar. A quantitative determination of the menthol in the oil is not possible, since it cannot be completely separated from the oil by freezing, even after fractionation.

Menthylamine is obtained, contrary to the statement of Beckmann, by reducing the oxime of menthol with sodium in alcoholic solution. The product boils at 204° C., has a smell similar to that of conine, and a specific rotatory power $[\alpha]_D = -33.6^\circ$. *Dextro-menthoxime* may be similarly converted into a menthylamine which resembles the above in properties, but appears to be a mixture of the *levo*- and *dextro*-compounds.—C. A. K.

Pseudopelletierine. G. Ciamician and P. Silber. Ber. **25**, 1892, 1601—1604.

THE authors' investigations on pseudopelletierine lead them to confirm most of its discoverer's—Tanret's—observations (Compt. Rend. **86**, 1270; **87**, 358; and **88**, 716). They, however, find that it is best extracted from the crude extract of pomegranate-peel by means of petroleum, from which medium it crystallises in anhydrous prismatic tablets of the composition $C_9H_{15}NO$. It melts at 48° (Tanret gives 46°), boils at 246° according to Tanret, but is volatile at the ordinary temperatures. It is readily soluble in water, alcohol, ether, and chloroform, but less so in light petroleum; it is a strong base, and its solution in 25 per cent. potash becomes turbid when warmed. A series of salts is described, and also certain reactions.—D. A. L.

Oxygen Compounds obtained from Ethereal Oils. F. W. Semmler and F. Tiemann. Ber. **25**, 1892, 1180—1188.

THE authors are of the opinion that the specific odours of many ethereal oils are not entirely due to the presence of terpenes or allied compounds, but that certain of them contain also alcohols, ethereal salts, aldehydes, and ketones of the fatty series which influence their smell to a very considerable extent. Indian geranium oil, for example, has been shown to contain an unsaturated fatty alcohol—geraniol—of the composition $C_{10}H_{18}O$, which, on oxidation, is converted into the corresponding aldehyde, geranial or citral, $C_{10}H_{16}O$, a compound occurring in various essential oils (see Semmler, this Journal, 1891, 157, 269, and 382).

Two samples of oil of bergamot, obtained from Schimmel and Co. and from Merlino respectively, were carefully examined and found to be practically identical in properties; the specific gravity is 0.8782 at 12°, and refractive power $n_D = 1.4681$. On repeated fractional distillation under a pressure of about 15 mm. the oil is resolved into the following constituents:—

Limonene	About 10 per cent.
Dipentene	" 10 "
Linalool	" 25 "
Linalool acetate	" 20 "
Bergapten	" 5 "

Linalool, $C_{10}H_{18}O$, is an unsaturated fatty alcohol of sp. gr. 0.8712 at 20°; it is levo-rotatory, and its refractive power is $n_D = 1.4641$.

Linalool acetate, $C_{12}H_{20}O_2$, has a very characteristic smell, like that of oil of bergamot, and its specific gravity is 0.8951 at 20°; it is levo-rotatory, and on hydrolysis it is converted into linalool and acetic acid.

It must not be presumed that an oil having the same odour as oil of bergamot would be obtained by mixing the above-named constituents in the proper proportions, because it is very probable that the odour of the natural oil is influenced by the presence of traces of other compounds which have not yet been isolated.

"Petitgrain oil," of French and of South American origin, was also investigated: the crude oil is dark yellow in colour, and its specific gravity is 0.8891 at 20°. Its principal constituent is an oil of sp. gr. 0.8988 at 20°, which boils at 102°—106° under a pressure of 15 mm., and which the authors name *Aurantol acetate*; this compound forms about 70 per cent. of the crude oil, has a peculiar characteristic odour, and on hydrolysis is decomposed into acetic acid and an unsaturated fatty alcohol of the composition $C_{10}H_{16}O$, which is named *Aurantol*. This alcohol boils at 93°—95° under a pressure of 15 mm., has a specific gravity of 0.8691 at 20°, and its refractive power is $n_D = 1.4682$; it is levo-rotatory and combines with four atoms of bromine. In addition to aurantol acetate "petitgrain oil" contains limonene, a sesqui-terpene, and compounds containing oxygen which have a not inconsiderable influence on the smell of the natural oil.

Oil of lavender of English origin contains limonene and a sesqui-terpene in small quantities, but its principal constituent is an unsaturated fatty alcohol—*Lavendol*, $C_{10}H_{18}O$ —which can be isolated by fractional distillation under a pressure of 15 mm. *Lavendol* boils at 85°—91° under a pressure of 15 mm., is levo-rotatory, and has a characteristic odour; its specific gravity is 0.8672 at 20°, and its refractive power $n_D = 1.4651$. *Lavendol acetate*, $C_{12}H_{20}O_2$, CO_2CH_3 , also occurs in oil of lavender, of which it forms about 10 per cent.; it boils at 97°—105° under a pressure of 15 mm., is levo-rotatory, and has a specific gravity of 0.8972 at 20°. The natural oil doubtless contains other oxygen compounds which influence its odour.

Linalool, aurantol, and lavendol have all the same composition as geraniol, and also smell like the last-named compound; whether the four substances are identical or not remains to be ascertained.—F. S. K.

A Nitro-Derivative of Antipyrine. E. Jandrier. Compt. Rend. **114**, 1892, 303—304.

ON addition of nitric acid to a solution of antipyrine in sulphuric acid nitro- and nitroso-derivatives are formed. Nitro-antipyrine may be prepared in the following manner:—4 grms. of antipyrine are dissolved in 40 grms. of mono-hydrated sulphuric acid; to the cooled mixture about 3 grms. of nitric acid (sp. gr. 1.35) are added. Separation of the nitro-compound follows on pouring the whole slowly into water kept at a temperature below 10° C. Nitro-antipyrine is a straw-coloured crystalline substance melting at 260° C. It is insoluble in water, slightly soluble only in hot alcohol; it may be most conveniently recrystallised from glacial acetic acid. Reduction with zinc and acetic acid gives the corresponding amido-compound.—T. L. B.

Nitro-Atropine. A. Einhorn and L. Fischer. Ber. **25**, 1892, 1390—1391.

ATROPINE when treated with a mixture of nitric and sulphuric acids is converted into an oily mononitro-compound, which was isolated by means of its hydrochloride, which forms a crystalline compound with difficulty soluble in alcohol. It decomposes at 235° C. The nitro group is contained in the benzene ring of the acid radiol of atropine (tropic acid) and is in the para-position as shown by decomposition with hydrochloric acid, and subsequent oxidation, when 1:4 nitrobenzoic acid is formed.—C. A. K.

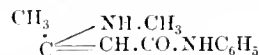
ψ-Tropin and some ψ-Tropeïns. C. Liebermann and L. Limpach. Ber. **25**, 1892, 927—939.

PSEUDO- or ψ-tropine as previously described (this Journal, 1891, 944 and 1023) crystallises from benzene in well-defined rhombic prisms. It forms a hygroscopic sulphate, and yields tropidine on reduction. The tropeïns described are those of mandelic and of tropic acid. The former is best prepared by the repeated evaporation of a solution containing molecular proportions of ψ-tropine and of mandelic acid. It forms a thick oil and yields a number of characteristic salts, which are described. A solution of the acetate was found not to exert any mydriatic action. Tropyl-ψ-tropeïne, similarly prepared, is a thick oil, having a strongly alkaline reaction and a specific rotatory power $[\alpha]_D = -4.9$. It is decomposed by baryta water into ψ-tropine and tropic acid, and hence is isomeric with atropine. Of its salts the hydrochloride and double gold and platinum chlorides are characteristic; the hydrochloride has no mydriatic action, but like atropine it acts as a heart-poison. The relation of this ψ-atropine to Ladenburg's hyoscine is discussed. The remainder of the paper deals with the nature of Ladenburg's *tropide* which is formed together with ψ-atropine in the above reaction. The authors show that its formula is $C_{15}H_{15}O_4$ and not $C_9H_9O_2$ from a molecular weight determination by Raoult's method.

—C. A. K.

β-methylamido-crotonanilide and its Relation to Antipyrine. L. Knorr and H. Taufkirch. Ber. **25**, 1892, 768.

THE "antipyrine alcohol" described by Brühl (Ber. 1892, **25**, 395) is, according to the authors' investigations, β-methylamidocrotonanilide—



and not an antipyrine derivative. A full account of the experimental evidence on which this conclusion rests is given, together with a suggestion that the sodium salt of the so-called alcohol prepared by Brühl is in reality a complex carbonate of the above anilide.—C. A. K.

The Action of Hypochlorous Acid on Tropine. A. Einhorn and L. Fischer. Ber. **25**, 1892, 1391—1394.

Hypochlorous acid acts upon tropine to form a crystalline compound, $C_7H_6NCl_3O$, which melts at $111^\circ C.$, and which readily gives up the chlorine atom to form a slightly basic body, $C_7H_7NCl_2O$. The latter melts at 108° . The reaction is undoubtedly a complex one, the carbon atom being liberated from the tropine molecule.—C. A. K.

The Boric Acids and Borax Industry. Scheuer. Zeits. f. ang. Chem. 1892, 241—248.

See under VII., page 683.

Action of Boric Acid on Germination. J. Morel. Compt. Rend. **114**, 1892, 131—133.

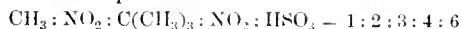
An injurious action of boric acid on beans was pointed out by Peligot (Compt. Rend. **83**, 686).

The present memoir deals with the action of various strengths of the solution on beans and on wheat, and the conclusions come to are that boric acid has the effect of delaying, or of completely preventing germination, according to duration of contact and strength of solution used; furthermore the action on grain and seeds of different kinds varies; for instance, wheat resists the action of the wash much better than does the bean. Borax acts in a similar manner to boric acid. It seems most probable that even very dilute solutions of boric acid will completely arrest the development of various fungoid growths and experiments are in progress with the object of deciding this question. Should the author's expectations be realised, then boric acid might rank with sulphate of copper as a preventative mildew and similar growths.—T. L. B.

The Nitration of Butyltoluene- and Butylxylene-sulphonic Acids. E. Noeling. Ber. **25**, 1892, 785—792.

As Kelbe and Baur have stated (Ber. **16**, 2560), butyltoluene is sulphonated with moderate ease by concentrated sulphuric acid at a temperature not exceeding 50° . It is, however, more rapidly attacked by fuming sulphuric acid containing 15 per cent. of anhydride. To isolate the sulphonic acid, conversion into its lead salt is not necessary, as the acid separates on the addition of a little water to its sulphuric acid solution. The crystalline mass obtained in this way was drained, washed with water, and dried on porcelain. A portion of it was nitrated with 6 to 8 parts of nitric acid (85 per cent.) at the ordinary temperature, the mixture being allowed to stand for some time. Another portion was heated on the water-bath with fuming nitric acid. In both cases a mixture of dinitrobutyltoluene sulphonic acid and trinitrobutyltoluene resulted, the proportion of the latter being greater in the case where heat was applied. Dinitrobutyltoluene sulphonic acid is easily soluble in water and odourless. Its sodium salt crystallises with 3 H_2O in large plates. Its barium salt, with 7 H_2O in white plates, which are sparingly soluble in cold water, but easily so in hot, and freely in alcohol. In the pure state it is free from smell, but even after several recrystallisations from water, it retains a slight smell of musk, which can be removed only by repeated washing with ether. (See Discussion, A. G. Green; this Journal, 1892, 308). When heated on the water-bath with concentrated nitric acid, barium sulphate is precipitated, and trinitrobutyltoluene formed, this change taking place very readily and being indicated by the powerful musk-like odour which is developed. As the constitution of butyltoluene sulphonic acid, according to an unpublished research of A. Baur, is $CH_3:C(CH_3)_3:HSO_3 = 1:3:6$ in the benzene nucleus, the constitution of dinitrobutyltoluenesulphonic acid is shown

to be such that the HSO_3 , CH_3 , NO_2 , and $C(CH_3)_3$ groups hold the relative positions—



(This Journal 1892, 306.)

The last-named compound, the author further finds, may be conveniently prepared by directly nitrating the sulphonic acid by the addition of a mixture of fuming nitric and sulphuric acids to its solution in sulphuric acid.

Dinitrobutyl-*m*-xylene sulphonic acid closely resembles its above-mentioned lower homologue. The assertion of F. Valentiner, Eng. Pat. 15,687 of 1890 (this Journal, 1891, 571), that this compound and its salts possess an odour of musk is, therefore, erroneous. The odour is due, as in the case of the incompletely-purified dinitrobutyltoluene sulphonic acid and its salts, to traces of the trinitro-derivative. The barium salt of the dinitroxylene compound is easily soluble in water, less so in absolute alcohol. The sodium salt is exceedingly soluble in alcohol, less so in water, and crystallises in beautiful silvery plates.

Valentiner (*loc. cit.*) has observed a simultaneous formation of tertiary-butylxylene and its sulphonic acid by the action of sulphuric acid on a mixture of isobutyl alcohol and *m*-xylene. The author finds that this reaction takes place even at a temperature below 45° , sulphuric acid thus producing the same intra-molecular change as aluminium chloride. Tertiary-butyl-*m*-xylene is also obtained, according to Goldschmidt's method, by heating a mixture of *m*-xylene, isobutyl alcohol, and zinc chloride. But of these three methods of preparation that with aluminium chloride is by far the most profitable. (See also this Journal, 1891, 1024, and 1892, 306.)—E. B.

Testing of Chloroform. C. Traub. Zeits. f. ang. Chem. 1892, 192.

See under XXIII., page 712.

PATENTS.

Improvements in the Manufacture of Peroxide of Barium and Peroxide of Hydrogen. T. Brochocki, Paris. Eng. Pat. 10,476, June 19, 1891.

Barium peroxide is prepared from the sulphate, which is first converted into the sulphide by reduction with carbon. The sulphate is mixed with carbon and tar, pressed into small balls or briquettes, and heated in a suitable furnace. Carbon monoxide or carbon dioxide is evolved, according to the quantity of carbon added, which are collected in separate gas-holders and employed for subsequent operations. The barium sulphide is lixiviated, the solution filtered and treated with carbon dioxide in a suitable vessel, when sulphuretted hydrogen is evolved, and barium carbonate precipitated. The former is either burned with air and the sulphur collected, or else employed to decompose barium sulphate according to the equation $BaSO_4 + 2 H_2S = BaS + SO_2 + 2 H_2O + S$. The barium carbonate is washed, dried, mixed with carbon and tar, and pressed into briquettes, which are heated in a current of carbon monoxide, whereby anhydrous baryta is formed and carbon dioxide evolved. This product is finally converted into the peroxide by passing a current of purified air over it at a temperature of about $600^\circ C$. By decomposing the peroxide with carbon dioxide, hydrogen peroxide is formed, together with barium carbonate, which latter is then ready for reconversion into the oxide.

A specially-constructed furnace, consisting of three sets of chambers, each set comprising a cooling, calcining, and heating chamber, placed one above the other, is employed for the working of the process, the whole of which takes place out of contact with the air.—C. A. K.

Improvements in the Manufacture and Production of Pharmaceutical Compounds. B. Wilcox, London. From Farbenfabriken vormals F. Bayer and Co., Elberfeld, Germany. Eng. Pat. 11,833, July 11, 1891.

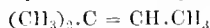
THE invention relates to new products which can advantageously be employed as substitutes for salol, and which avoid the detrimental effects produced in some cases by salol owing to its being decomposed in the system into phenol and salicylic acid. The new preparations are acetyl-amido-salol and the corresponding cresol derivatives. Acetyl-amido-salol is prepared by the action of para-nitro-phenol on salicylic acid in presence of a dehydrating agent, and the resulting nitro-phenyl-salicylate yields the corresponding amido-compound on reduction. This treated with acetic anhydride or acetyl chloride in glacial acetic acid solution forms para-acetyl-amido salicylate, a crystalline compound melting at 187° C.

In a similar manner the acetyl-amido-phenyl-cresol carboxylates are obtained from ortho-, meta-, and para-cresol carboxylic acids respectively as the starting points. They are all crystalline bodies; the ortho-compound melts at 181° C., the meta at 198° C., and the para at 167° C.

—C. A. K.

An Improved Anaesthetic and Hypnotic. J. F. von Mering, Halle a. Salle, Germany. Eng. Pat. 11,844, July 11, 1891.

THE amylene previously tried as an anaesthetic consists of a mixture of hydrocarbons prepared from fusel oil by the action of water-abstracting agents (ZnCl₂, &c.), which mixture was found to be unreliable in its action. The patentee finds that the product prepared from tertiary amyl alcohol in a similar manner is a reliable and good anaesthetic and hypnotic. This product—trimethylethylene—



boils at 38° C. It may be employed either in the pure state or mixed with alcohol or with ether.—C. A. K.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Quantitative Determination of Silver and Gold by Means of Hydroxylamine Hydrochloride. A. Lainer. Dingl. Polyt. J. 284, 1892, 17—19.

See under XXIII., page 710.

PATENT.

Improvements in the Manufacture of Colours, specially applicable for Colouring Photographs. A. J. Boulton, London. From C. H. W. Bruns, Halberstadt, Germany. Eng. Pat. 3791, February 26, 1892.

See under IV., page 679.

XXII.—EXPLOSIVES, MATCHES, Etc.

The Higher Nitric Ethers of Starch. O. Müllhäußer. Dingl. Polyt. J. 73, 137—143.

THE author gives a short history of the discovery and work done on nitro-starch, and says that it is only recently, by means of a process devised by the "Actiengesellschaft Dynamit Nobel," that it has been possible to manufacture it economically, and thus make it available as an explosive for military purposes. The product prepared by this process has the following composition:—C₆H₆O₃(NO₃)₂.

The author succeeded in preparing two bodies of the composition—C₆H₆O₃(NO₃)₂, and C₆H₇O₄(NO₃)₃. The starch molecule must consequently be taken twice as large, viz., C₁₂H₂₀O₁₀, and the higher members regarded as—

	Per Cent. N.
Tetra-nitro starch—C ₁₂ H ₁₆ O ₆ (ONO ₂) ₄	11.11
Penta-nitro-starch—C ₁₂ H ₁₆ O ₅ (ONO ₂) ₅	12.75
Hexa-nitro-starch—C ₁₂ H ₁₄ O ₄ (ONO ₂) ₆	14.14

That no nitro-compounds, but true ethers (esters) of nitric acid are formed, is proved:—

1st. In that the substances on treatment with sulphuric acid, separate NO₂H. The O.NO₂ residue appears thus to be replaced by the sulphuric acid residue.

2nd. On treatment with aqueous ferrous chloride nitric oxide and soluble starch are regenerated.

3rd. On shaking with sulphuric acid over mercury, all nitrogen is split off in the form of NO.

The body prepared by the process above referred to will be taken as tetra-nitro-starch.

This process is carried out as follows:—Potato starch is dried at 100°; then ground and dissolved in nitric acid of 1.501 sp. gr. in a suitable vessel made of lead, and provided with two jackets cooled by water. A screw agitator causes the acid to circulate. The starch is introduced through an opening in the cover of the combined agitator and digester in the proportion of 10 kilos. of starch to 100 kilos. of acid, the temperature being maintained between 20° and 25°.

This solution is then led to a precipitating apparatus, which is also surrounded with a cooling jacket, acid provided with a double-perforated bottom, between which is placed gun-cotton to act as a filter. This vessel is filled with spent nitro-sulphuric acid from the nitro-glycerin manufacture, and the solution of starch in nitric acid is sprayed into it through an ejector worked by compressed air, whereby the nitro-starch is precipitated in the form of a fine-grained powder. 500 kilos. of spent nitro-sulphuric acid are required to precipitate 100 kilos. of starch solution.

The nitro-starch collects on the gun-cotton filter, when the acid solution is run and drained off through the tap at the bottom of the vessel, and below the filter. It is then further freed from acid by pressure and washing till a neutral reaction is attained, and afterwards it is treated and let stand for 24 hours in contact with 5 per cent. soda solution. The product is then ground until a "milk" is formed, which is filter-pressed and washed with water, and lastly treated with a solution of aniline, so that the pressed cake, which contains about 33 per cent. of water, shall contain 1 per cent. of aniline.

Nitro-starch prepared by the author on the same lines in the laboratory contained 10.96 and 11.03 per cent. of N. It is a snow-white powder, which becomes electrified on rubbing, and is very stable and soluble even in the cold in nitroglycerin.

The author also prepared a tetra-nitro-starch containing 10.58 and 10.50 per cent. of nitrogen by pouring into water a solution of starch in nitric acid, which had stood for several days. The body thus produced had all the properties of that prepared by the other process.

Penta-nitro-starch is produced along with some tetra-nitro-starch by adding 20 grms. of rice starch dried at 100°, to a mixture of 100 grms. of nitric acid sp. gr. 1.501, and 300 grms. sulphuric acid sp. gr. 1.8. After standing for one hour, the mass is discharged into a large quantity of water, and then washed with water and soda solution. The yield was 147.5 per cent. This body was heated with

ether-alcohol, then the ether was distilled off, the penta-nitro-starch thus became precipitated, the tetra-compound remaining dissolved in the alcohol. The portion insoluble in alcohol contained 12.76 and 12.98 per cent. of nitrogen, and was thus penta-nitro-starch. The other portion contained 10.45 of nitrogen.

Hera-nitro-starch is the chief product when 40 grms. of dry starch, are treated with 400 grms. of nitric acid, sp. gr. 1.501, and allowed to stand for 24 hours, and then 220 grms. of this solution are poured into 600 cc. of sulphuric acid of 66 B. The white powder thus produced

contained 13.52, 13.23, and 13.22 per cent. of nitrogen, and therefore consisted principally of *penta-* and *hexa-nitro-starch*.

The experiments showed that the bodies prepared by precipitating the nitro-starch by strong sulphuric acid were less stable than those precipitated by water or weak sulphuric acid, the author being of opinion that possibly in the former case a sulpho-group may be formed, which in small quantity might occasion this instability. The following table shows the behaviour of bodies prepared in different ways under various conditions:—

Made from	Ignition Point.	Stability.	Per Cent. N.	96 Per Cent. Alcohol.	Ether.	Ether-Alcohol.	Acetic Ether.
1 part nitric, 2 parts sulphuric acid (containing 70 per cent. of water).	175	Stable	11.02	Soluble	Insoluble	Soluble	Soluble
1 part nitric acid, water.....	170	Stable	10.54	Soluble	Insoluble	Soluble	Soluble
1 part nitric acid, 3 parts concentrated sulphuric acid.	152	Unstable	12.87	Insoluble	Insoluble	Soluble	Soluble
1 part nitric acid, 3.5 parts concentrated sulphuric acid.	121	Unstable	12.50	Insoluble	Insoluble	Soluble	Soluble
1 part nitric acid, 3 parts concentrated sulphuric acid.	155	Unstable	13.52	Insoluble	Insoluble	Soluble	Soluble

The author recommends the production of a smokeless powder by moistening 6 grms. of nitro-jute (this Journal, 1892, 214), and 2 grms. of nitro-starch with acetic ether, and working into a uniform mixture, and then drying at 50°–60°. This product contained 11.51 per cent. of nitrogen, and was very stable.—W. M.

“*Safety*” Matches. B. Schultze. Dingl. Poly. J. 233, 1892, 274–284.

THE author has examined and compared 18 different kinds of so-called safety matches of Swedish and German manufacture, especially in regard to the readiness with which they could be ignited by friction on different surfaces, and he also investigated the glowing and falling off of the heads after the flame had been extinguished. The results are given in extensive tables, which along with the text in the original, should be consulted by those who are specially interested in this matter.

The author's experiments show that the claim, on all the different boxes examined, that the matches “ignite only on the box” is quite unfounded.—W. M.

An Improvement in the Manufacture of Explosives for Ammunition. F. A. Abel, London, and J. Dewar, Cambridge. Eng. Pat. 5614, April 2, 1889. (Second Edition.)

THIS invention relates to means of treating blasting gelatin whether it be simple or compounded with substances which are sometimes added to it, such as nitrates of hydrocarbons of a non-volatile character, in such a manner as to render it available for ammunition.

Blasting gelatin manufactured in the ordinary way but with a greater percentage of soluble nitro-cellulose and with a volatile solvent such as acetone or acetic ether sufficient to give it the consistence of a moderately thick jelly, or ordinary blasting gelatin with the addition of soluble nitro-cellulose and solvent to bring it to a like condition, is pressed through holes in a plate so as to form a number of wires, which at first are soft and pliable but become toughened by evaporation of the solvent.—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

On the Measurement of High Temperatures. H. Becquerel. Compt. Rend. 114, 1892, 390–392.

THIS is a reply to certain remarks made by M. Le Chatelier on the researches of M. E. Becquerel (*père*). These researches related to the measurement of high temperatures and the relative intensity of the light emitted by incandescent bodies (*e.g.*, platinum) at these temperatures. The author points out that Le Chatelier's optical measurements give results which in reality differ only very slightly from those obtained by his father and by Violle. As to the measurements of temperatures above 1,200° made by E. Becquerel, it is certainly true that they were based upon a hypothetical extrapolation. So also the numbers above 1,200 obtained by Violle were based upon extrapolation; but the probability of its correctness was increased by his experiments on iridium. It is at least possible that similar results by this method of calculation, deduced from the behaviour of a platinum-palladium couple may be more inaccurate than results obtained by extrapolation from the law of variation of the specific heat of platinum.—D. E. J.

INORGANIC CHEMISTRY.— QUALITATIVE.

Absorption of Carbon Monoxide by Blood. N. Gréchant. Compt. Rend. 114, 1892, 309–310.

See under XVIII., page 704.

Action of Ammonium Chloride at its Dissociation Temperature on Silicates. E. A. Schneider and F. W. Clarke. Ber. 25, 1892, 883–886.

THE authors have previously investigated the action of dry hydrogen chloride gas on a number of natural silicates (Amer. J. Sci. 1891, 40, 303; 42, 242). The results of heating a finely-divided mixture of the silicate (1 gm.) with ammonium chloride (10 grms.) at a temperature at which the latter salt rapidly volatilises, are now given. After heating, the residue is extracted with water and the solution analysed. In some cases it is necessary to heat several times with ammonium chloride before extracting with water.

Very slight action occurs with such minerals as olivine and wadswite (a variety of xanthophyllite); in the cases of serpentine, clinoclhor, and leuchtenbergite, the action is considerable, and the authors suppose that these silicates contain the group $Mg.OH$, the presence of which they consider may be detected by this process.

Natrolite, wollastonite, and pectolite are considerably acted on by ammonium chloride: little action occurs in the case of prehnite. Lazulite and turquoise are scarcely affected, whilst dufrénite is energetically attacked, a considerable quantity of ferric chloride being produced.

—W. J. P.

INORGANIC CHEMISTRY.— QUANTITATIVE.

Quantitative Separation of Metals of the Hydrogen Sulphide Group in a Current of Bromine Vapour. P. Jannasch and P. Etz. Ber. 25, 1892, 736—741.

Woon's metal (1 grm.) containing bismuth, lead, tin, and cadmium, is dissolved in dilute aqua regia, the solution evaporated to dryness, and the residue completely dissolved in water with addition of hydrochloric acid, and by the aid of heat. The metals are then precipitated in the hot solution by hydrogen sulphide, the precipitate filtered, washed, and dried on a tared filter at 100°. The mixture of sulphides is then transferred to a glass tube, and continuously heated in a current of bromine vapour as previously described by the authors. (Ber. 1891, 24, 3746, and 1892, 25, 124). The bromides of tin and bismuth distil, leaving lead and cadmium bromides in the boat; the latter, after cooling, is withdrawn from the tube, its contents treated with chlorine water, and separated as lead sulphate and cadmium carbonate in the usual manner. The volatilised bromides of tin and bismuth are collected in nitric acid, evaporated to dryness, and the residue heated to redness to expel the sulphuric acid. The bismuth is then extracted by nitric acid, separated if necessary from the small amount of silica derived from the vessels employed, and precipitated as carbonate; the residual stannic oxide may be at once weighed.

The above process gives good results, but the following is equally accurate and much quicker:—The alloy is cut into small pieces, mixed with excess of sulphur, placed in a large porcelain boat, and heated in a current of carbon dioxide; the conversion into sulphide is complete, and after distillation of the excess of sulphur, bromine vapour is passed over the mixed sulphides, and the separation effected as above described.—W. J. P.

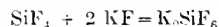
Quantitative Determination of Silver and Gold by Means of Hydroxylamine Hydrochloride. A. Lainer. Dingl. Polyt. J. 284, 1892, 17—19.

HYDROXYLAMINE is useful not only for the determination of silver and gold, but also for recovery of these metals from exhausted photographic liquors. In presence of excess of caustic potash, silver is precipitated completely by hydroxylamine. The most difficult solution to deal with is a cyanide solution, a considerable excess of caustic potash being necessary. In this case, furthermore, the first filtrate should be evaporated down with more hydroxylamine, in order to get the last traces of silver precipitated. Where the silver is to be separated from other heavy metals, it is best first of all to precipitate as chloride. With regard to the action of organic matter, it is shown that citric acid in no way interferes with the quantitative precipitation. Like silver, also gold is quantitatively precipitated by addition of hydroxylamine hydrochloride, followed by caustic potash. Thio-sulphate solutions precipitate quite well, but in cyanide solutions precipitation does not take place. In the case of gold salts it is to be noted that hydroxylamine hydrochloride is capable of throwing down all the gold even without the aid of caustic alkali, but the

solution must be heated: at ordinary temperatures neutral gold solutions give a precipitate of gold even in the dark, but the action is considerably hastened by exposure to sunlight.—T. L. B.

On the Estimation of Fluorine. Ad. Carnot. Compt. Rend. 114, 1892, 750—753.

THE estimation of fluorine is seldom attempted in analyses (especially when silicates are present) on account of the difficulties which it presents. Methods have been given by several eminent analysts (Berzelius, Rose, Fresenius, Wohler) but they are complicated and require the observance of minute precautions before accurate results can be secured. The method suggested by the author has been applied to substances containing fluorine which can be attacked by concentrated sulphuric acid; it is easily carried out and enables the analyst to estimate not only the fluorine but also the silicon present with satisfactory accuracy. The method (like others already known) is based on setting free the fluorine in the form of gaseous silicon fluoride: its novelty lies in the mode of estimating the gas evolved. Instead of calculating it from the difference of two weighings (Wohler and Fresenius) or from the weight of calcium fluoride obtained after a toilsome separation of the silica (Berzelius, Rose, Lasne) the author passes the silicon fluoride into a strong solution of pure potassium fluoride with which it forms a precipitate of fluosilicate of potassium, from the weight of which the fluorine and if necessary the silica can be determined. The reaction is expressed by the equation—



and the method is carried out as follows:—

The mixture of fluoride and silicate is treated with concentrated sulphuric acid in a small flask of 150 cc. capacity. A slow current of air or carbonic acid (carefully dried by passing through sulphuric acid) is led in by a tube reaching nearly to the bottom of the flask. The gas evolved is conducted by a bent tube to the bottom of a second flask containing a little mercury at the bottom, and above the mercury 20 cc. of a solution of pure potassium fluoride. Beyond this is an aspirator for regulating the current. The end of the tube should dip 2 or 3 mm. below the surface of the mercury so as not to be wetted by the aqueous solution. Every care should be taken to thoroughly dry the apparatus beforehand, so as to avoid any decomposition of the silicon fluoride by moisture.

It is advisable to use for analysis such a quantity of the substance as will not contain more than about 0.1 grm. of fluorine; thus about 0.2 grm. of rich fluorides (fluorspar, eryolite, &c.) should be taken and up to 2 grms. or even more of substances containing a smaller proportion of fluorine (natural phosphates, bones, &c.). The substance is intimately mixed in an agate mortar with fine calcined quartz in such proportion that the mixture contains at least 10 parts of silica to one of fluorine.

The apparatus being set up and well dried, the current of gas is stopped, the mixture introduced and 40 cc. of pure sulphuric acid added; the current of gas is then re-established and the flask warmed over an iron plate; the temperature inside should be near 160°, but should never exceed this. The flask should be slightly shaken from time to time. The evolution of gas usually ceases in an hour and a half or two hours. The solution of potassium fluoride now contains a gelatinous precipitate which is scarcely visible. The tubes are removed without delay and the aqueous solution decanted. The flask and mercury are washed several times with small quantities of water which are added to the solution; the volume of the whole should not exceed 100 cc. An equal volume of 90 per cent. alcohol is added and the precipitate is allowed to settle. After decanting the supernatant liquid and replacing it by dilute alcohol the precipitate is collected on a weighed filter and further washed with dilute alcohol. It is dried at 100° until the weight is constant and from this the amount of fluorine and silica can be calculated. (One part of K_2SiF_6 contains 0.3451 of fluorine.)

It is of importance that the re-agents employed should be free from fluorine. This can generally be secured in the case of sulphuric acid and calcined quartz; but both can be tested by a blank experiment. The fluoride of potassium should be free from fluosilicate; this can be tested by dissolving 2 grms. of the salt in 100 cc. of water and adding an equal volume of alcohol. If no precipitate is apparent after standing for 24 hours the sample is satisfactory.

In the analysis of a fluoride containing silica the same method may be adopted provided that the walls of the flask are not sensibly attacked. The silicated fluoride should be mixed with a large excess of finely-divided quartz and pure calcined silica; the mixture is calcined and accurately weighed. The silica has now to be estimated in two parts. A small portion is found with the fluorine in the precipitate of fluosilicate of potassium. (One part of K_2SiF_6 contains 0.1271 of Si, or 0.2815 of SiO_2 .) The rest remains in the state of silica in the residue which has been treated with sulphuric acid and can be estimated in the usual way. From this latter the amount of silica added must of course be deducted.—D. E. J.

Estimation of Sulphur in Coal. A. Grittner. Zeits. f. ang. Chem. 1892, 170.

The combustible sulphur in coal can be estimated by Sauer's method, which has been modified by Dammer and Fresenius, but the method is rather tedious. The author adopts the form of combustion tube, also suggested by Sauer, which is drawn out narrow in the middle. By introducing a current of oxygen from the hinder part of the combustion tube towards the narrowed part in the middle, and another current just quick enough to carry away the products of the combustion from the front of the tube, the combustion proceeds much quicker. The narrow, drawn-out part of the combustion tube ought to be red hot, the exit end must be just warm enough to prevent sulphuric acid from condensing. This author recommends the use of permanganate of potash instead of bromine in the absorption apparatus.

Another good method for the determination of the combustible sulphur is to estimate the total sulphur according to Eschka (this Journal 1889, 361, 364), and the sulphur in the ash by oxidising with bromine in the presence of hydrochloric acid, then concentrating on the water-bath, filtering and washing. In the filtrate iron and alumina are precipitated according to Lunge's method, and in the filtrate from this precipitate the sulphuric acid is estimated in the usual way. The difference between these two estimations represents the sulphuric acid corresponding to the combustible sulphur.—C. O. W.

Estimation of Sulphuric Acid in Sulphates. E. Stolle. Zeits. f. ang. Chem. 1892, 234—235.

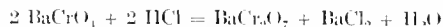
A known weight of the substance is dissolved in a 500 cc. flask, and a solution of barium chromate in hydrochloric acid, prepared as described below, is run in from a burette in sufficient quantity to precipitate all the sulphuric acid, care being taken to avoid a large excess. The liquid is now made ammoniacal, whereby all the barium which remains in solution is precipitated as neutral barium chromate, and only so much ammonium chromate is formed as corresponds to the quantity of barium which has been precipitated as sulphate. The liquid is made up to the mark with water, filtered, and an aliquot portion of the filtrate acidified with sulphuric acid and titrated with a standard solution of a ferrous salt, potassium ferrieyanide being used as an indicator. The process is best conducted at the ordinary temperature, and is applicable to all sulphates which are soluble in water or hydrochloric acid, and are without action on chromic acid. The solution of barium chromate is prepared by adding a slight excess of potassium chromate solution to barium chloride solution, precipitating the excess of chromic acid with a couple of drops of barium chloride, washing the barium chromate by decantation with hot water and dissolving it in dilute

hydrochloric acid; the solution is finally diluted to sp. gr. 1.06. The adoption of this method entails the use of only one standard solution, namely, that of the ferrous salt, whereas Preeht's original method (Zeits. Anal. Chem. 19, 521) requires three. (Compare this Journal, 1892, 548.)

—A. G. B.

Estimation of Sulphuric Acid in Sulphates. A. v. Asbóth. Chem. Zeit. 16, 1892, 922.

The author points out that Stolle's method (preceding abstract) is useless as he describes it, inasmuch as a hydrochloric acid solution of barium chromate gradually evolves chlorine, the chromic acid doubtless becoming chromium chloride, and more barium chloride being formed than should be present according to the equation—



When such a solution was used 24 hours after it had been made it indicated only 87 per cent. of K_2SO_4 in a pure sample of potassium sulphate, showing that less ammonium chromate went into solution than should have been the case (compare preceding abstract). When ammonia was added to the barium chromate solution and the precipitate filtered, barium chloride was found in the filtrate. The author suggests the possibility of preparing the barium chromate solution immediately before each determination.

—A. G. B.

Estimation of Potassium as Perchlorate. W. Wense. Zeits. f. ang. Chem. 1892, 233—234.

The author has previously pointed out (Zeits. f. ang. Chem. 1891, 691) that the perchlorate method becomes an excellent one if a small quantity of perchloric acid is added to the alcohol which is used for separating the potassium perchlorates from the other perchlorates. In order to facilitate the washing the perchlorate should be obtained in a granular form; this is best effected by warming the concentrated solution on the water-bath before adding the perchloric acid, which should then be dropped in to the extent of about $1\frac{1}{2}$ — $1\frac{3}{4}$ times as much as is equivalent to the potassium supposed to be present. Much free acid should be first eliminated by evaporation to dryness. When these precautions are observed the precipitates of 10—12 analyses can be filtered and washed in an hour, and four hours will suffice for 13—14 determinations. The precipitation of sulphuric acid, when the determination is being made on such substances as carnallite residues, can be avoided by evaporating with sufficient perchloric acid to decompose all the chlorides, washing with alcohol, dissolving in hot water, evaporating to dryness, igniting and estimating the potassium chloride with silver solution. The method is cheaper than the platinum process; for 5,000 potash determinations some 20 kilos. of potassium chlorate and the same amount of sulphuric acid would be sufficient, even if all the perchloric acid were thrown away after it had been used.—A. G. B.

Note on the Analysis of Slag of Metallic Appearance from the Manufacture of Phosphorus in Electrical Furnaces. J. C. Chorley. Chem. News, 65, 301.

The process of manufacture in which this slag is formed may be briefly described as follows:—The materials, consisting of redonda phosphate (native phosphate of alumina), some form of calcium phosphate, carbon, and sand are first heated in an auxiliary furnace, and are then fed into the electrical furnace, built of firebrick in the form of a rectangular trough. An alternating current of about 5,000 amperes with an E.M.F. of 50—60 volts is employed (this Journal, 1891, 544). Owing to the intense local heat, most of the oxygen combines with the carbon present and phosphorus distils over. Two distinct kinds of slag are formed, that largest in quantity being chiefly silicate of lime and alumina, whilst the other, containing iron, silicon, and phosphorus is distributed throughout the mass in more or less globular buttons. Three separate

samples of this latter slag were obtained at different tappings; all were steel-grey in colour, very hard and brittle, and breaking with a metallic fracture; it appeared quite homogeneous, but did not exhibit any crystalline form under the microscope. When examined in the state of very fine powder with a one-fifth objective, a few particles of transparent matter were observed, evidently silica. The slag is extremely stable; it is easily fusible with the oxyhydrogen blow-pipe, a little oxidation takes place. Hydrochloric and nitric acids, dilute or concentrated at 100°, have little or no action upon it. After being heated to 100° with aqua regia for 30 hours, very little action could be detected. With hydrofluoric acid it is practically unaltered.

With dilute sulphuric acid a similar result was obtained; but long boiling with concentrated sulphuric acid decomposes it partially. Direct fusion in a platinum crucible is impossible, as the phosphorus at once attacks the platinum. When heated in a current of sulphuretted hydrogen a superficial layer of sulphide of iron is formed. There is very little action when it is heated with bromine or iodine.

Only two methods of decomposition were found available for analysis.

1. By heating the finely-powdered slag in a porcelain boat in a current of dry chlorine, and passing the gases first through water and then through a dry plug of cotton wool to retain solid particles, the iron was then volatilised as Fe_2Cl_6 , the silicon as SiCl_4 , which was decomposed by the wash-water, and the phosphorus as PCl_3 or PCl_5 ; in about an hour complete decomposition was effected, only a little silica being left in the boat. The contents of the whole apparatus were then washed into a basin, and after the addition of hydrochloric acid evaporated to dryness and heated to render silica insoluble. After adding weak hydrochloric acid the silica was filtered off and weighed; the filtrate was then evaporated several times to dryness with nitric acid in order to oxidise the phosphorus completely, and was finally dissolved in weak hydrochloric acid and diluted to 250 ccm. The iron in 25 ccm. was estimated by titration in sulphuric acid solution with permanganate of potash, and the phosphorus in 25 ccm. as $\text{Mg}_2\text{P}_2\text{O}_7$, with intermediate precipitation with ammonium nitro-molybdate, and in certain cases directly as ammonium phospho-molybdate.

2. This method was as follows:—(a.) The finely-powdered slag was heated with excess of a neutral solution of copper sulphate in a sealed tube to about 170° for 4 to 5 hours. A considerable quantity of metallic copper was precipitated with some phosphide of copper, while some iron, phosphorus, and silicon went into solution: when the tube was opened there was no pressure. The contents were washed out and treated with sufficient nitric acid to dissolve the copper, and the residue was filtered off; the filtrate was then evaporated to dryness with hydrochloric acid and silica estimated. The copper in the filtrate was precipitated with hydrogen sulphide, and the filtrate from this added to the similar filtrate in the second part of this method. (b.) The residue from (a) was fused with about five times its weight of fusion mixture at a bright red heat for one hour in a platinum crucible, and when cold the contents were dissolved in dilute hydrochloric acid and evaporated to dryness, and silica estimated as usual. The filtrate was then mixed with the filtrate from (a) made up to 250 ccm., and the analysis was continued as in the first method.

The mean results obtained were as under:—

	Sample No. 1.	Sample No. 2.	Calculated for Fe_2PSi_2 .	Sample No. 3.	Calculated for Fe_2PSi_2 .
Fe	70.55	68.75	72.02	73.79	71.01
P	9.81	10.81	9.97	11.03	13.63
Si	17.90	19.10	18.00	19.31	12.33
O and loss	1.71	1.31	..	1.87	..

This slag may be a definite compound containing a small amount of impurity. The analyses of Nos. 1 and 2 agrees fairly well with the formula, Fe_2PSi_2 , and that of No. 3 with Fe_2PSi . Or it may be a mixture of silicide and phosphide of iron in varying proportions. As it is not crystalline, the last view is perhaps the correct one; yet silicide of iron is easily attacked by acids, and this compound is not, and its power of resistance may be due to the existence of some definite compound. The specific heat was determined and found to be 0.146, being very close to that calculated for a mixture of its constituents, viz., 0.142, the specific heat of iron being taken as 0.114, that of phosphorus as 0.174, and silicon as 0.173 (Regnault). The specific gravity was found to be 5.965. The substance is a conductor of electricity.

—J. C. C.

The Preparation and Estimation of Pure Platinum.
F. Mylius and F. Foerster. Ber. 25, 1892, 665—686.

See under X., page 690.

Bromide of Potassium. H. Helbing and F. W. Passmore.
Helbing's Pharm. Record, 7, 1892.

See under XX., page 705.

Some Separations by Electrolysis. E. F. Smith and D. L. Wallace. Ber. 25, 1892, 775—782.

See under XI., page 696.

ORGANIC CHEMISTRY.— QUALITATIVE.

Testing of Chloroform. C. Traub. Zeits. f. ang. Chem. 1892, 192.

CHLOROFORM prepared from chloride of lime contains ethylidene chloride and other impurities, which give coloured products with sulphuric acid. By treating chloroform with sulphuric acid and other reagents, a chloroform can be obtained which in all respects is equal to Pietet's, refined by freezing. The sulphuric acid test for chloroform may be made more delicate by mixing equal volumes of the two and keeping the mixture, which must be repeatedly shaken in the dark for from six to eight days. No discolouration ought to be noticeable. Chloroform and acid are then separated and the chloroform dissolved in the acid is left to evaporate at ordinary temperatures. The acid is diluted with five parts of water, and 1 cc. of a decinormal solution of nitrate of silver added. No alteration ought to take place. Only a very pure product will bear this test.

—C. O. W.

Testing of Boiled Linseed Oil. W. Fahrion. Zeits. f. ang. Chem. 1892, 171.

See under XII., page 696.

PATENT.

A Method of Analysing Alcohols and other Liquids or Liquefiable Bodies and Apparatus therefor. E. de Pass, London. From E. Gossart, Paris, France. Eng. Pat. 14,697, August 31, 1891.

THIS method, intended more especially for the detection of impurities in commercial spirits, is based on the following principle:—A drop of a pure liquid when allowed to fall on the edge of the meniscus surface of another liquid will

assume for a short time the spheroidal state, if the supporting fluid contain as impurity a portion of the same liquid as that constituting the rolling drop. In practice, in order to make the duration of the spheroidal state as long as possible, some substance conferring viscosity, such as citric acid, may be added to the reagent and the liquid under examination, and the meniscus surface of the latter is exaggerated by placing it in a vessel of suitable shape, such as a narrow cell tapering acutely at each end. Or a tank divided into several compartments by means of partitions gradually decreasing in height may be used, one side of each partition being painted with some substance which repels liquids, so that the menisci bordering the liquid steps may be alternately concave and convex. The reagents employed are—amyllic, butylic, and propylic alcohols, wood spirit, aldehyde, acetone, acetic ether, &c. Small pipettes, the points of which are held about 2—3 mm. above the edge of the meniscus, are used to deliver drops of the above reagents. The drops which roll over the meniscus of the liquid being tested, indicate the presence, whilst those which do not roll, indicate the absence of the respective impurities. It is stated that the presence of one-twentieth of a given impurity may be directly detected; whilst smaller proportions may be found by careful fractional distillation of the spirit, the "first runnings" and "tailings" being tested separately.—H. T. P.

ORGANIC CHEMISTRY.— QUANTITATIVE.

Contributions to the Chemistry of Brown-Cool Tar.
F. Hensler. Ber. 25, 1892, 1665.

See under III., page 671.

ANALYTICAL AND SCIENTIFIC NOTES.

Use of Nitroso-β-Naphthol in Quantitative Analysis.
M. Schleier. Chem. Zeit. 16, 1892, 420—421.

Separation of Iron and Beryllium.—Solution of beryllium sulphate gives, even on standing, no precipitate with nitroso-β-naphthol, whereas iron is quantitatively precipitated by the reagent in question. The method of separation advised is as follows:—The solution of sulphate or chlorides of beryllium and iron are evaporated to small bulk and then ammonia is added until permanganate turbidity is formed; this turbidity is just dissolved by a slight addition of hydrochloric acid, after which about an equal volume of 50 per cent. acetic acid is added to the cold solution; precipitation with a solution of nitroso-β-naphthol in 50 per cent. acetic acid follows. Filtration may be performed after about 4—5 hours. The beryllium is precipitated in the filtrate by means of ammonia after evaporation for the purpose of getting rid of the acetic acid.—T. L. B.

Solvent Action of Liquid Organic Compounds. A. Etard.
Compt. Rend. 114, 1892, 112—115.

For his purpose the author selects mercuric and cupric chlorides. The solubility of mercuric chloride in water up to 120° C. is represented by a curved line, the temperatures corresponding to abscissæ and the percentages of salt dissolved to ordinates; whilst from 120° up to 150°, at which temperature dissociation begins, the curve becomes a straight line. The curve of solubility of mercuric chloride in methyl alcohol is exactly similar to the water curve, only the first portion is given between the temperatures -35° and +38°, at which latter point the break takes place.

In the case of ethyl alcohol a diagram shows two curved lines between -50° and +60° (the break occurring at about -5°) and then a straight line follows. As we pass higher in the series of alcohols, however, the distinctions of the various curves disappear, and so almost straight lines are obtained in the case of propyl-, butyl-, and amyl alcohols, and such is the case for ether, acetone, acetic

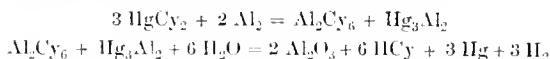
acid, with acetic and formic ethers. The author suggests this as a means of studying the influence of homology and isomerism.

Solubility of cupric chloride in the liquids named is represented by straight lines, and in many cases the amount of salt entering into solution decreases as the temperature increases; this happens with allyl alcohol, acetone, ethyl formate, and ethyl acetate.—T. L. B.

The Action of Metals on Salts dissolved in Organic Liquids. R. Varet. Compt. Rend. 114, 1892, 224—225.

In studying the red liquids which are produced when aluminium chloride acts on benzene in presence of hydrochloric acid gas, Friedel found that they were no longer formed when care was taken to exclude all traces of water. Following up this observation the author has investigated with the following results the action of certain metals on salts dissolved in water and in various organic liquids:—

I. *Action of Aluminium on Cyanide of Mercury dissolved in Water.*—The mercury is displaced by aluminium with formation of cyanide of aluminium, which is decomposed by the water into alumina and hydrocyanic acid; at the same time an amalgam of aluminium is produced which rests upon the water with formation of alumina and hydrogen. The reactions may be expressed by the equations—



II. *Action of Aluminium on Cyanide of Mercury dissolved in Ammoniacal (Absolute) Alcohol.*—An excess of aluminium (in small pieces) was added to the solution, which was then put aside in a cool place protected from all traces of moisture. When the reaction had finished the solution was filtered (moisture being all the while carefully excluded), and then concentrated over potash and quicklime. After some days the surface of the liquid becomes covered with a thick, soft, transparent crystalline layer; this is a double cyanide of mercury and aluminium combined with alcohol and ammonia. In this case the substitution of aluminium for mercury is never complete.

III. *Aluminium and Cyanide of Mercury dissolved in Pyridine.*—If the pyridine is perfectly anhydrous there is no displacement of mercury by aluminium, but if a small quantity of water be added the same reaction occurs as in an aqueous solution. The reaction ceases as soon as the water has disappeared.

IV. *Nickel and Bichloride of Mercury dissolved in Water.*—Here the most noticeable fact is the formation of calomel, but there is also a slight replacement of mercury by nickel. When the reaction is carried out in an open vessel oxide of nickel is formed, but this does not occur if the reaction be carried out in a sealed tube with water previously boiled.

V. *Nickel and Bichloride of Mercury dissolved in Pyridine.*—In the cold, no reaction; when heated, there is displacement of mercury by nickel.

VI. *Iron and Bichloride of Mercury dissolved in Pyridine.*—No reaction either in the cold or when heated. If water is added there is immediate substitution of iron for mercury; calomel is also formed, and the iron is oxidised.

It is thus evident that certain metals which can replace others in their salts when dissolved in water, lose their property when certain organic liquids are substituted for the water as solvents.—D. E. J.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

NEW CUSTOMS TARIFF OF CUBA.

See *Board of Trade Journal* for August, p. 171 *et seq.*

SPAIN.

Regulations affecting Sale of Cotton Seed and other Oils.

A despatch, dated the 16th July, has been received from Sir H. Drummond Wolff, Her Majesty's Ambassador at Madrid, enclosing a copy and a translation of a law published in the "*Eco de las Aduanas*," regulating the sale of cotton and other oils. The following is a translation of the law referred to:—

Art. 1. From the date of the publication of this law in all the Custom houses throughout the Peninsula and colonies $1\frac{1}{2}$ per 100 of wood tar or petroleum will be mixed with all cotton or rape-seed oil which may be imported.

Art. 2. Olive oil passing through the Spanish Custom houses will be examined, and, if found to contain an admixture of cotton-seed oil or animal fat $1\frac{1}{2}$ per 100 of wood tar or petroleum will be mixed with it so as to render it unfit for food.

Art. 3. Mayors and municipal judges who have cognisance of the sale of olive oil mixed with any other oil will seize it, and the judge on conviction will consider the vendors guilty of contravention of the second paragraph of Art. 595 of the Penal Code.

Art. 4. The cost of the materials employed in rendering useless cotton oil or adulterated olive oil shall be chargeable to the person introducing the merchandise.

URUGUAY.

Proposed Remission of Import Duties on Agricultural Products.

The French *Moniteur Officiel du Commerce* says that in its sitting of the 8th May last, the Uruguayan Chamber of Representatives adopted a proposed law, according to which the following products destined for the use and improvement of agriculture are to be free of import duty:—

Sulphate of iron, mineral superphosphates and phosphates, nitrates of soda and potash, sulphates of ammonia and lime, sulphates, chlorides, carbonates of potash, and guano from the Pacific.

This project was at once transmitted to the Senate, together with the favourable report of the Finance Commission.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

NEW INDUSTRIES IN BRAZIL.

Two manufactories (says our Consul at Rio Grande do Sul) are in course of construction in this city, one for the conversion of the fat produced in the country into soap, candles, oils, &c., and the other for using up the horns and bones of cattle in making combs, brush-backs, knife handles, &c.

DRUGS AND CHEMICALS IN JAPAN.

Yokohama imported 137,524*l.* worth of "Western" medicines and drugs in 1891, and 143,235*l.* worth in 1890. Among the chemicals and drugs imported the principal are bicarbonate of soda, caustic soda, soda ash, paraffin wax, bichromate of potash, chlorate of potash, carbolic acid, antifebrin, cocaine, bismuth, iodoform, iodide of potassium, quinine, &c.

Chemicals are likely to continue in demand. It is true that trials have been made to manufacture various chemicals such as bicarbonates of soda, caustic soda, paraffin wax, &c., in Japan, but in most of these cases the cost of production has been too great to render the trials successful.

Soda crystals and bleaching powder only can be manufactured at a cost which is prohibitive of competition by the imported articles; but there are not many other articles at present imported in which competition from Japanese manufacture is likely to be felt—at least, in the near future.

The importation of chemicals is, for the most part, a venture of the foreign import merchant, Japanese dealers preferring to purchase from stock rather than run the risk of making purchases on contract.

Carbolic acid is now imported mostly in tins or large zinc bottles, and it is found preferable to import quinine also in bulk, instead of bottles, owing to the saving effected in freight.

The greater part of the drugs imported now come from Germany. The loss of much of this trade to the British manufacturer can undoubtedly be traced to a want of care in packing, from which loss by breakage results, and to the fact that his get-up of the goods, in the matter of bottles and labels used, is neither so good nor so attractive as the Continental.

Some difficulty has been experienced, occasionally, in getting medicines passed by the Government analyst, on the ground that these are not chemically pure, although perfectly suitable for medicinal use, and such as would be passed in Europe. It may be hoped that longer experience may lead to more common-sense views in these matters.—*Ibid.*

CHEMICALS IN MEXICO.

The industry of chemical products is not yet a large one in Mexico, considering that products like muriatic acid are so necessary. In the whole of Mexico there are not more than two factories of chemicals. One kilogramme of native sulphuric acid sells at 14 cents, and it costs the Mexican manufacturer not more than 5 to 6 cents. The raw material is found in great abundance in the vicinity of the volcanoes.—*Ibid.*

PRODUCTION OF MERCURY IN RUSSIA.

The production of mercury in Russia has sensibly increased during the last decade, particularly in the mines of Jekaterinoslaw. According to the *Revue d'Orient* some new mines were discovered last year in the Caucasus, in the district of Daghestan. The production of the establishment at Jekaterinoslaw amounts to upwards of 300,000 kilos. of pure mercury. The working of the mines costs comparatively but little, so that the low price of the metal renders foreign competition impossible, and upwards of 200,000 kilos. are annually exported from Jekaterinoslaw. The same paper states that a tax of half a rouble per pound is to be levied on the mercury produced.—*Chamber of Commerce Journal.*

ORCHILLA IN LOWER CALIFORNIA.

Orchilla, orchil, or archil (*Rocella tinctoria* properly) was formerly prepared from the lichen *Rocellus*, which grows on rocks adjoining the sea in the Canary and Cape Verde islands, Sardinia, the Minorea Islands, the Levant, and on the rocks of Sweden. From it is obtained the archil of commerce, which yields a rich purple tincture, extremely beautiful. Orchil in Europe is generally sold in the form of a cake. It was extensively used by dyers until 1853, when the discovery of orchilla in America and on the Galapagos Islands created quite a commercial sensation among the European manufacturers and dealers by its superiority over any lichen yet in use, giving it quite a prominent place in the European markets for its delicate colour, lustre, and tone, especially for silks.

The Galapagos Islands compose a group lying on the equator 10° or 12° west of Quito and Guayaquil, and belong to the Republic of Ecuador. The group consists of six large and seven smaller islands. Albemarle, the largest, is 60 miles long and 15 miles broad. The smaller islands possess the weed.

In 1872 an American captain, John Howard, of a whaling ship, well informed of the nature of the orchilla

weed from the Galapagos Islands, made a discovery of a superior quality of the same lichen on the lands bordering Magdalena Bay, Lower California. Samples were obtained by the said captain, and in a short time quite a fleet of vessels from Guayaquil and San Francisco, having enterprising parties on board, landed on the Magdalena Bay grounds with the necessary supplies and means for starting the picking and packing of orchilla for export to the European markets.

It is evidently known what importance the orchilla trade assumed at Magdalena Bay and surroundings for several years after its discovery, and how, by shrewd management, Mr. I. P. Hale succeeded in dislodging all other claimants to the orchilla lands (starting from latitude 20° 40' S. to latitude 28° N.), with very few exceptions, by obtaining a Mexican grant or Government contract, which gave him the entire belt of the orchilla lands, six miles broad, on the Pacific coast side of Lower California, and comprising the said degrees of latitude.

Over 1,500 men have been employed in gathering the moss, and about an equal number also employed in carting, packing, &c.

The following figures show the cost per ton of 2,000 lb. ready for shipment, in Mexican coin:

Picking and delivery, 150 dol. per cwt.	Dols.
Hydraulic-press packing	30.00
Other expenses and shipping	7.00
Export duty	1.50
Total	5.00
	137.50

The reproduction of the orchilla growth matures every two years, when it is ready for repicking, packing, and export.

Since the Kongo State has become the natural producer of orchilla that branch of industry in America has become totally depressed, particularly in Lower California. Europe finds many advantages in the proximity of the African orchilla to her markets, and the cost of transportation, &c., is a great deal lower.

The revival of the orchilla trade in Lower California can only be brought about by the revival of the manufacture of the dye in the United States.—*U.S. Consular Reports.*

ORCHILLA IN CAPE VERDE.

Orchilla, a species of lichen, differs in form from most of the mosses found growing upon trees and rocks; it resembles a miniature shrub more than the usual lichen.

It grows upon large rocks, and is found in the mountainous parts of these islands; also on the Canaries. It is plentiful, but very difficult to obtain, growing as it does on the rocks down the steep sides of the precipices, where it is shaded from the sun the greater part of the day. From the best information which I can obtain from those who have been long in the business of exporting it there is gathered annually about 120 tons from all these islands, which goes to Lisbon.

It is gathered by the natives in sacks and baskets and sold to the merchants in its dry state at about 4 cents per pound. When exported there would have to be added half a cent per pound as export duty and the costs of sacks to ship it in.

Owing to the indolent habits of the natives, there are some years when not above 80 or 90 tons are gathered. This is when the general harvests are plentiful. It is only when unfavorable climatic conditions, resulting in poor crops, occur that the natives are compelled to work to earn their corn, beans, and rice—their principal articles of food.

I have by the mail which takes this report sent to the Department an average sample of the orchilla grown on the island of St. Iago (Santiago).—*Ibid.*

ORCHILLA IN ECUADOR.

Orchilla is a dye moss found on the coast of Ecuador, near Guayaquil, and in the Galapagos Islands. It is not cultivated, but grows wild, and can only be had in limited quantities.

The moss is gathered by hand from the rocks upon which it grows. It is spread in the sun to dry and cure,

and is then pressed into bales of about 150 lb. to 200 lb. ready for shipment.

The total export as at present known could not exceed 2,000 quintals per annum, and the present price is from 5 dols. to 6 dols. per quintal in American gold, with an export duty of 2.75 dols. per quintal in American gold additional. That costing 5 dols. is from the coast, and that costing 6 dols. from the Galapagos Islands, and is thought to be of a superior quality.

Pedro A. Moreira, of Manta, Martin Reinberg and Co. and Noverta, Osa and Co., of Guayaquil, are reliable commission houses through which arrangements could be made; but I would recommend that a contract be made with José Monroe, of Guayaquil, who is in charge of the Galapagos Islands at present.

The demand for orchilla at present is very light, but on the first appearance of an increased demand the prices would most probably be much higher than now, unless purchasers and manufacturers were protected by contracts.—*Ibid.*

KOREAN PAPER.

Korean paper is highly esteemed, and always forms part of royal presents and of the tribute paid to China. Besides the same uses as with us—for writing and for books—it fills a great diversity of needs. It serves as string and in the manufacture of lanterns, fans, umbrellas, shoe soles, hats, boxes, and makes very good rain coats; it covers floors and walls and ceilings, and, stretched on frames, supplies windows and doors. It is highly prized in China and Japan, and is especially sought after for the manufacture of umbrellas.

It is made from a bush of the mulberry order (*Broussonetia papyrifera*), which is indigenous, growing in many parts of the Kingdom, but thriving best in the moist, warm climate of the south. It is chiefly raised from cuttings for this especial purpose, and the wild and cultivated plants are said to be of equal value.

The bark, which alone is used, is generally gathered in the spring, and is boiled for a long time in water, in which a quantity of wood ashes has been mixed, till it becomes a pulp, the mass having been beaten during the whole time of the boiling. Fine bamboo screens are then placed in shallow wooden vats and a ladle full of the pulp is spread evenly over the screen by a dexterous circular motion of the hand. The operation is repeated once or twice, or as often as may be necessary—the more frequent the operation the finer the paper—and the screen allowed to drain into the vats till a proper consistency is reached, the drippings being thus saved. They are then placed on a hot *hang* floor to dry. After the drying has proceeded far enough, the paper is laid on a hot floor and ironed by hand. The long lines in the paper show strands of the bamboo screens, and their nearness, distinctness, or absence indicates the fineness or otherwise of the paper. They are almost imperceptible in some grades of paper, while in others they are distinct and far apart.

Paper is made by the paper guild, a numerous and prosperous association. The province of Chulla is the chief seat of manufacture.—*Ibid.*

CELLULOSE FOR BOTTLE SHELLS.

An invention which may prove to be of much practical use to the wine trade has recently been made by a gentleman living in this vicinity, and the sole right of the manufacture of it sold to a large and enterprising factory near Mayence, which expects to meet with great success in introducing it. This is simply the conversion of the raw cellulose as it comes from the machine for the paper manufacturer into shells for wine bottles in substitution of straw.

As is well known to the trade, the straw shell is the universal covering and protector of the wine bottle, and is clumsy, dirty, ill smelling when moist, and prone to fall to pieces; and, also, it does not adhere to the bottle with a firm grasp, but easily slips off. To avoid all this, under the new invention sheets of common cellulose are stamped with fairly deep indentations, oval in shape, about an inch long and less than half an inch wide, and about the same distance from each other. The sheets are then cut

into strips of the length of a wine bottle and sufficiently long to go twice around it. They are then rolled twice around with the hand, so as to form a double shell, and fastened together near the top and bottom with a metal spring. There is thus double protection to the bottle. The raised surface is outside and the indentation within, and the protuberances resemble cocoons in shape and size. The indentations are so made that when the cellulose is rolled together they do not all set into each other, but generally upon the flat surface between the indentations. The result is that great elasticity and power of resistance are given to the shell when on the bottle, so that it can be thrown upon the floor on its side without the bottle breaking, and this resistance will be offered in the case when packed with wine bottles. It also fits tightly and does not lose the bottle in handling or falling.

To begin with there is, therefore, less breakage. Then the bottles can be packed more closely together than when straw is used, 60 bottles going with cellulose where only 50 could be put with straw. This makes a slight saving in boxes, and consequently, also, another saving in freight by water. Again, the straw is dusty and dirty in character, and the capsules and labels on the bottles, when that is used, have to be protected with tissue paper, which is not required when cellulose is employed, as that presents a white, clean surface to the bottle. The cellulose is also more durable than straw, is compact, and, what is also a desirable advantage, is a non-conductor of cold and heat; so that wine protected by it can be shipped in extreme cold or hot weather without injury, which can not now be done with straw.

The cellulose shells cost here about 1.25 dols. per 1,000 more than the straw ones do, but in the end are claimed to be cheaper, because they are more durable, admit of more bottles going into a case, are lighter in weight, and, besides, when worn out with use, will be bought back again by the factory making them at about 1.25 dols. per 1,000 (which is the difference in price between cellulose and straw shells), and worked up again into new shells.—*Ibid.*

OVER-PRODUCTION OF SUGAR.

In view of the experimental success which the cultivation of the sugar beet has already attained in various parts of the United States, and the preparations that are being made to greatly extend the area of such cultivation by farmers and others who are more or less inexperienced in the sugar industry, it would seem timely and prudent to consider some facts of recent development which relate more directly to the commercial aspect of the subject. That the soil and climate of large areas in our country are well adapted to the growing of beet sugar has been practically demonstrated—if, indeed, any such demonstration was necessary in a country possessing soil so fertile and climate so varied as those of the United States.

It remains to be proven whether, under the conditions that now exist, the production of beet sugar on a large scale can be made permanently profitable in face of the competition which is so rapidly developing in other countries. Upon this and several co-ordinate questions opinion in this country is sharply divided, and it may be of interest to inquire what suggestion may be fairly derived from the present condition of beet culture in the principal sugar-producing countries of Europe.

At present there are two important operations involved in the cultivation of sugar-beets which require to be performed by hand labour. These are the thinning out of the young plants in the spring or early summer and the topping of the mature vegetable in the autumn. The labour requisite for this purpose is far more costly in the United States than in France, Germany, or Austria. But, on the other hand, land is far cheaper and more fertile in our country than it is abroad, and American laws secure to the farmer a bounty of from 1½ to 2 cents per lb. for all sugar which he may produce, whether it be exported or sold for domestic consumption. Will the advantages thus secured to our sugar culturists enable them to permanently maintain the competition against sugars imported free of duty and which have been grown on lands worn by centuries of cultivation and requiring constant fertilisation by labour which costs

only from 25 to 50 cents per day? This question has been already discussed by some of the more thoughtful economists of France and Germany, and opinion is divided as to whether, in the issue which must soon be practically tested, it will be the American or the European sugar-grower who must go to the wall. The rapidity with which the issue is approaching will be apparent from the following comparison, which shows the increase during the past three years of the area devoted to beet culture in France, Germany, and Austria, and which is here quoted on the authority of the Deutsche Zuckerindustrie, the leading organ of the trade in this country:—

Years.	France.	Germany.	Austria.
	Acres.	Acres.	Acres.
1888-89.....	424,849	691,609	289,978
1890-91.....	607,867	880,061	796,328
Increase.....	183,027	188,461	506,350

If these statistics may be trusted, they reveal an increase in the area of lands devoted to sugar culture of 43½ per cent. in France, 27 per cent. in Germany, and 174 per cent. in Austria within a period of three years. This enormous expansion would doubtless have already precipitated a crisis in the sugar market but for the influence of two important facts, viz., the unfavourable season of 1891, which greatly reduced the yield of beet sugar in proportion to the area of land under cultivation; and the abolition of sugar import duties in the United States, which opened a free market that has for the moment absorbed the surplus from Europe and prevented the break in prices that would otherwise have been inevitable.

The question is, therefore, will the cheapness of sugar in the United States so stimulate its consumption there as to consume the surplus that would be grown in Europe during a fairly productive year in addition to the steadily growing supply from domestic production? This is where will come the rub, for which it is wise to be prepared. It is estimated that, if the season of 1891 had been fairly productive, Germany, France, and Austria would have been able to export 780,000 tons of sugar in addition to their already enormous export, which far exceeded that of any previous year, the shipments from the single port of Hamburg having reached 8,196,000 sacks of refined sugar, against 7,127,000 sacks in 1889, and 4,363,000 sacks in 1888. Careful examination has shown that only two-fifths of the present sugar product of Germany is consumed at home, leaving three-fifths of the whole for export; and it is not apparent that the ratio of sugar consumption per capita is higher in Austria or France than here or that it will be likely to increase.

Taken alone these facts would seem to be ominous for the future of sugar culture in the United States. But, on the other hand, there are certain considerations which weigh in the opposite direction. Beet culture rapidly drains the soil of several elements that can only be restored by fallowing, rotation with other crops, and by fertilising with costly artificial manures. Ground rents and wages are steadily though slowly advancing in all these countries, notably in Germany; so that the farmers of Saxony, for example, already complain that, except in the case of a full crop there is no longer any important profit in sugar-growing. It is not probable that the cost of sugar production can ever be lower in Germany than it is at present, but there is a strong probability that the bounties now paid by the Government on domestic sugars exported from this country will be reduced or wholly abolished. There is a large proportion of the German people who insist that the sugar industry has been over-stimulated at the expense of other interests, so that any change that may be made in future will undoubtedly be in the direction of reduced bounties.

From the standpoint of the American farmer who is about to engage in the culture of beets to be sold to a neighbouring sugar factory, there is also the consolation that beet-raising, unlike wine or fruit growing, does not involve the planting

of vines or trees which must be tended for years before they become productive. If, upon trial, beet culture does not prove remunerative, it can be promptly abandoned and the land devoted to other crops. The principal risk would seem to be on the part of the firms and individuals who are erecting extensive plants for the manufacture of sugar from beets in the United States, for which they guarantee to pay a fixed price during a prescribed period, and it is to these that the logic of the present situation is especially important.—*Ibid.*

CHEMICAL INDUSTRY IN GERMANY.

In his annual report on the trade and commerce of the district of Frankfurt-on-the-Main, Mr. C. Oppenheimer, Her Majesty's Consul-General at that town, supplies the following particulars respecting the position of the chemical industry in Germany, which is an important branch of the export trade of that country:—

The following statement gives a general idea of the export of the most prominent chemicals and drugs in 1891:—

Essential oils, 2,546 met. centners; gelatin, 4,535; glue, 37,737; explosives, 19,404; soda, calcined, 353,303; potassium, 110,934; alkaloids, 584; quinine, 1,869; chloride of potassium, 769,962; iodide of potassium, 977; sulphate of potash, 301,888; mineral waters, 335,632; salicylic acid, 2,170; saltpetre, 96,629; hydrochloric acid, 103,123; gunpowder, 37,834; tartaric acid, 7,769.

An increase in exports is to be noted in the preceding statement for calcined soda, gelatin, glue, quinine, chloride of potassium, sulphate of potash, muriatic acid, a small improvement in potassium. However, a retrogressive movement is to be observed in essential oils, explosives, iodide of potassium, mineral waters, salicylic acid, saltpetre, gunpowder, and tartaric acid.

The following statement gives the more important figures in the export of another branch of the chemical industry, dyes, colours, &c., viz.:—

Lead and coloured pencils, 9,464 met. centners; varnish and lac varnish, 5,597; oil and water-colour paints, 13,538; ultramarine, 44,040; alizarine, 81,685; aniline, 41,031; aniline and other coal-tar products, 86,818; white lead, 117,538; zinc white and grey coloured zinc, 104,000.

The export in coal-tar products, aniline, alizarine, colours and dyes, and zinc white, have increased; others, e.g., ultramarine, have decreased. The opinion formed of the trade in general of the chemical industry for this year will not be an unfavourable one. Germany's chemical industry takes a high place, and its products are forwarded to almost all countries of the world. The reason for this extension is to be found in the high theoretical talents of the German people and the excellent schools, which, year by year, furnish a body of educated chemists to advance the trade of the country.

One branch of the chemical industry is worthy of special attention, namely, the potassic salts. This industry has formed a syndicate which publishes accounts every year, and thus facilitates inspection of the course of business.

Of chloride of potassium (80 per cent.) was sold in 1891, 1,341,635 met. centners; 1890, 1,265,526; 1889, 1,237,482.

The total amount of sales in muriate of potassium (90 per cent.) were, 1891, 179,804 met. centners; 1890, 129,471; 1889, 62,213.

The total sales of calcined muriate of magnesia (48 per cent.) were, 1891, 113,998 met. centners; 1890, 108,302; 1889, 92,148.

The total sales of potassic manure salts were, 1891, 30,779 met. centners; 1890, 18,331; 1889, 22,381.

Of kieserite the total sales were, 1891, 285,591 met. centners; 1890, 320,048; 1889, 318,239.

Of which Great Britain alone received, 1891, 251,454 met. centners; 1890, 281,938; 1889, 253,172.

The syndicate of the potash works (a sort of combination whose occupation is restricted to the sales in common of the products of all the works concerned) with reference to this makes the following remarks, which will be interesting to those engaged in agriculture:—

"It may be seen from the above figures that the total sales have considerably increased from year to year. A continuous increase in the consumption of the products is, however, only to be noticed in those countries in which among the great masses of the population the fact has gained a firm hold (proved by scientific researches), that without a suitable manuring of the soil with potassic salts no lucrative harvests can be obtained. In this respect the sales of kainite in Germany and of concentrated potassic salts to France and the United States of America are noticeable. Italy and Scandinavia have also for years shown themselves to be good markets for potassic manure salts. In those countries, where the salts are mainly used for technical purposes, the consumption is always influenced by a combination of different circumstances, to which the articles manufactured from potassic salts are subjected, and for this reason the sale to those markets fluctuates at times considerably."

The percentage in which foreign countries participate according to the preceding statistics is noticeable. Several products, e.g., kieserite, are almost exclusively manufactured in Germany for foreign countries. This fact also explains why Germany's chemical industry, so highly developed, is favourable to free trade. The chemical industry of Germany in many articles is sufficiently strong to disregard the Customs barriers raised by other countries.

The export in chemicals to Great Britain, especially in 1891, is given in the following statement:—

Lead and coloured pencils, 2,487 met. centners; oil and water-colour paints, 2,040; ultramarine, 19,305; caustic soda, 3,258; alum, 33,137; glue, 8,881; explosives, 6,045; soda, calcined, 21,464; soda, crude, 10,947; alizarine, 27,991; aniline and coal-tar products, 18,194; white lead, 76,883; chloride of potassium, 129,420; chloride of magnesium, 78,908; sulphate of potash, 46,245; mineral waters, 40,147; saltpetre, 48,087; tartaric acid, 2,633; zinc white and zinc grey, 21,910.

The chief articles of Germany's chemical imports from Great Britain are as follows, the figures referring to 1891:—

Varnishes, 3,602 met. centners; chloride of lime, 26,451; carbonate of ammonia, 12,522; sulphate, 198,810; anthracene, 51,956; catechu, 12,264; cinchona bark, 19,526; chromate of potassium, 15,294; glycerin, crude, 20,644; india-rubber, 6,942; indigo, 3,560; carbolic acid, 14,100.—(No. 1082, *Foreign Office Annual Series*.)

THE SICILIAN SULPHUR INDUSTRY.

The United States Consul at Palermo, in a recent report to the authorities at Washington, supplies the following particulars respecting the position of sulphur mining in Sicily. Additional information on this subject is given at pp. 530—1 of the *Board of Trade Journal* for May 1892.

The Sicilian sulphur industry has lately passed through a crisis that, on the one hand, was most serious in its effects, and, on the other, might be considered really beneficial in its results, notwithstanding the fact that many operators have lost heavily on account of over-production, expensive systems of mining, and a general decline in prices. This was partially due to the fact that so many had embarked in sulphur mining to the neglect of all other industries, partially to the expensive system of mining without mechanical appliances by which the miners ascended circuitous steps from the bottoms of pits 300 to 500 feet deep, carrying the ore to the surface in bags on their shoulders, and partially to the excess of supply over the demand. As a result of all which there was such a decline in prices that mines were either operated at a loss or closed. Many abandoned their mines, and the production would have shown greater decrease had not many owners and lessees set fire to their mines, extracting melted sulphur, in order to reduce expenses, regardless of waste and damage to their property.

A result of the crisis which might be considered really a benefit consisted in forcing Sicilian sulphur-miners to supplant the old system with more modern means. In the second half of 1890 prices began to experience an unexpected and brisk rise, the industry to show more

activity, and naturally the first consideration in view of former experiences was the means of operating at less expense, resulting in numerous instances in the adoption of steam power and mining machinery, strange as it may seem, hitherto unused.

Sicilian ignorance of modern inventions was shown in the case of a large mine at Lerara, in the centre of the island, wherein the lessees agreed, by the usual form of indenture, among other things, to put in, at their own expense, a means of bringing the ore to the surface; but the lessees—an enterprising American and an Englishman—instead of a "seala" (the steps above mentioned), opened a shaft and installed mining machinery at an expense of several thousand dollars, enabling them to produce several times the quantity per day that would be possible by means of a seala, and, although the lessor received a royalty per ton on the production, his prejudices against an innovation of machinery were so strong that, contrary to his own interests, he claimed the terms of the contract violated by the failure to establish a seala, found a court concurring in this antiquated view, ousted the lessees, removed their machinery, and, after nearly two years' litigation, they have just obtained possession of their property by virtue of a judgment of a higher court.

Since the latter part of 1890 prices have maintained a steady and apparently healthy rise, sulphur now commanding an average of 25 dollars per ton at the mines, stimulating an increasing activity throughout the sulphur districts. And yet this chief branch of Sicilian industries is not exempt from fears and dangers. It is not over-production alone that causes alarm; there is also the danger of losing their American market through the strong competition of sulphur pyrites. This has been found so advantageous that most of the sulphur used in England is produced from pyrites, and it is viewed here as the gravest aspect of the industry.

The export of sulphur is confined to the ports of Palermo, Girgenti, Licata, and Catania. The amounts exported from the ports named during the five years ended December 31st, 1891, were as follows:—1887, 4,946,927 cantars (cantar = about 98 lb.); 1888, 4,521,975 cantars; 1889, 4,568,866 cantars; 1890, 4,474,781 cantars; and 1891, 3,809,536 cantars.

The exports to the United States were largely in excess of those to any other country, constituting a large proportion of the commerce between Sicily and the United States.

GENERAL TRADE NOTES.

PRODUCTION OF SALTS AT STASSFURT.

According to the report of the Stassfurt Potassium Syndicate the total production in metrical tons of the various products during the past half-year is given below. The corresponding figures for 1891 are also given:—

	Jan. to June 1892.	Jan. to June 1891.
Kamite and sylvine.....	37,900	52,300
Carmallite.....	5,500	5,200
Kieserite.....	2,500	2,600
Potassium chloride.....	10,200	11,300
Miscellaneous.....	2,100	300

During July the imports of alkali from Great Britain amounted to 10,795 cwt. as against 7,871 cwt. in July 1891.—*Industries.*

A RIVAL TO STASSFURT.

According to the German press, potash deposits equalling the famous Stassfurt mines in richness and extent have been discovered in the Wipper Valley, near Sondershausen, in the German Principality of Schwarzburg-Sondershausen,

by a mining engineer from Dortmund. The Government of the Principality have submitted to the local Legislative Assembly a draft contract with the discoverer of the deposits in which the latter, under penalty of a fine of 3,000,000 marks, undertakes to form a company (the necessary capital of which is estimated at 8,000,000 marks) to work the deposits. The Principality will take shares to the amount of 2,000,000 marks in the company, and will receive a royalty of 15 per cent. on the net profits for the sole rights of working to be granted to the discoverer.—*Chemist and Druggist.*

TRANSVAAL QUICKSILVER.

A rich quicksilver mine (says *South Africa*) is said to have been discovered in the district of Waterberg (Transvaal), near Zebedela's station. Samples of cinnabar ore and pure quicksilver metal from this mine are reported to be at Johannesburg.—*Ibid.*

PATENTS IN CANADA.

Manufacturers and inventors can now take their patents in the Dominion for eighteen years instead of for fifteen years as hitherto, whilst the patents for the intermediate periods of five and ten years will now be for six and twelve years respectively; another advantageous alteration is that no samples or models will be required for the issue of a patent, though power is reserved to the officials to require them if needed.—*J. H.*

CEYLON AS A SOURCE OF INDIA-RUBBER SUPPLY.

At the London Chamber of Commerce on Monday last, Mr. J. Ferguson, the corresponding secretary to the Colonial and Imperial Institutes in Ceylon, gave an address on "Tropical Agriculture in that Colony." Dealing with the india-rubber plant, he thought there was much encouragement for the Ceylon planter to take up this product, for which he understood there was a large and growing demand at remunerative prices, especially as the prospects of the supply from South America, Africa, and the East (nearly all forest trees) was gradually falling off, or at any rate was below the requirements of manufacturers. If it was true, as he had learned, that one province of Para in Brazil had developed an export equal to 17,000 tons per annum in a favourable year, and worth 300*l.* a ton, or 5,000,000*l.*, all the rubber being got from systematic tapping of the trees, there ought certainly to be room in Ceylon for extensive planting experiments with a view to the supply of the future. In Ceylon no little attention had been given to the cultivation of caoutchouc, or india-rubber, trees over a dozen years ago, when they had been hard pressed for products to take the place of coffee; and for some years great hopes were expressed that the industry would become a profitable and permanent one. Sample parcels of Ceylon Ceara rubber harvested from trees 8 to 10 years old sold as high as 4*s.* per pound; but the great rush into tea, and the greater ease with which returns could be got from that product, together with the long time required by rubber trees to mature, and the greater expense in tapping and harvesting, discouraged further planting, and he could not speak of more than 450 acres in all Ceylon as now being cultivated with rubber plants, although of late years Dr. Trimer had been able to report very favourably on experiments under his direction in the Botanical Gardens, and attempts were now being made by the Ceylon Forests Department to grow the tree in jungle clearings. The gardens had also sent plants and seeds to North Borneo and East Africa. In Colombo they had endeavoured to bring all the information about rubber into a Planters' Manual, and there could be little doubt that if the Ceylon garden and forest experiments went on well during the next few years, planters would once more take up the industry.—*Electrician.*

GOLD PRODUCTION IN SOUTH AFRICA.

The gold production of the Rand, South Africa, has at last passed the century mark so long hoped for, the production of this wonderful district for June being 103,252 oz., and it is estimated that it will by no means stop here. The month of greatest output for every year since

1889 has been December, the figures being 40,401 oz. for December 1889, 50,352 for December 1890, and 80,321 for December 1891. The monthly output for 1892 has been: January, 84,650; February, 86,649; March, 93,244; April, 95,562; May, 99,436, and June, 103,252, a total of 562,703 oz. The output for the corresponding six months of each year since 1888 has been: 1888, 89,320 oz.; 1889, 173,567 oz.; 1890, 224,589 oz.; 1891, 323,124 oz.—*Engineering and Mining Journal*.

TIN MINES IN THE UNITED STATES.

The tin mining industry of this country, states the *Engineering and Mining Journal*, is not in a flourishing condition; in fact, it is very unsatisfactory.

The Harney Peak Mining, Milling, and Manufacturing Company's mines in South Dakota have been opened to a considerable depth at a great number of places, and a very large amount of money has been expended in this development work, and more recently in building a fine mill, yet, according to our information, the supply of ore does not justify the starting of the mill. Moreover, the local papers are outspoken in denouncing the expenditures for property, claiming, with much corroborative evidence, that there has been gross dishonesty in this department of the company's business.

It seems pretty well established that at the present time no paying tin mines have been opened in South Dakota, though magnificent specimens and "promising" veins have been found in many places. Unfortunately the mines, like the companies, are better at "promising" than "performing."

In California the Temescal mines of the San Jacinto estate, also an English corporation, have greatly disappointed the investors and the experts who made such glowing reports on the property a few years ago. There the company injudiciously expended a very large amount of money in a worthless dam and in a mill, without ascertaining that the mine could supply it with paying ore. At present there are practically no reserves of paying ore in the mine. The output of tin which, up to a few months ago, had amounted to 120,000 lb., will probably not exceed 300,000 lb. this year. The ore in the reserves, it is said, runs only 3 to 3½ per cent. of black oxide, instead of the 12 to 20 per cent. so confidently set forth in the prospectus of the company two years ago.

It is yet perhaps too early to say that this property does not contain paying veins, but it is certain that there is nothing yet in sight which would pay, the quantity being wholly insufficient to supply an economical plant, and too poor to work on a small scale.

The company owns a large estate and has many chances yet for redeeming the past, but if our advice are to be relied on, a pretty thorough change in the administration will take place before dividends come in sight.

In Virginia, the Boston Tin Mining Company, operating the Cash Mine, in Rockbridge County, have built a large (75,000 dols.) plant and have developed the property to the depth of 60 ft., and a length of some 200 ft., exposing a vein about 7 ft. wide of ore that is said to average 3 per cent. of tin. Unfortunately, the title to this property is so defective that it is at present impossible to say when or how it can be perfected. The vein is here said by experts to be extremely "promising," and the reserves already large for the amount of work done. Until the title is made clear, it is, however, unlikely that this mine will become a producer of any importance.

From all this it is evident that our tin mines have thus far been disappointing. We do not, however, abandon hope that this industry will some day become important. Except in South Dakota the amount of development work done has been too little to condemn the properties, and even there it is possible that permanent deposits of ore of paying quality may be proved, as we sincerely hope they will be. Had the work of development preceded the sale to the English company, and had the whole enterprise not been floated with so many and gross mis-statements, its failure up to the present time to have become self-sustaining would not have attracted so much attention or criticism.

The manufacture of tin plates in this country has also been disappointing, though there is no reason whatever why this industry should not grow to very important proportions, even though the tin mines should defer for years the fulfilment of their promise.

THE CHOLERA AND CARBOLIC ACID.

Once again the cholera epidemic is overlapping the bounds of its Central Asian home, and, spreading ruin throughout Russia, threatens to invade Western Europe. Among the famine-stricken Russian peasantry, the disease finds a congenial breeding-ground, and the panic-stricken efforts of Russian officialdom to cope with its progress are totally ineffective. By any well-organised Government the extreme probability of an invasion of the epidemic, always latent in the countries beyond the Caspian, into the Russian provinces, already decimated by the recent famine, would have been foreseen, and precautionary measures organised. Not so, however, in Russia. Now that the scourge is already within its gates, disinfectants, it is true, are hurried forward from Germany and England by trainfuls and shiploads; but it is quite possible that they will be too late to stamp out the disease, or even to arrest its progress.

It is almost incredible that, with the cholera raging in its midst, the Russian Government should permit the annual fair at Nijni-Novgorod to be held as if nothing abnormal had happened, yet such, it appears, is the case. To this fair, which will shortly open, traders from all parts of Central and Northern Asia and of Eastern Europe repair, and it is thence that large quantities of many Asiatic products, including a goodly quantity of drugs, find their way to the markets of the West. The annual turnover at this fair represents a value of about 20,000,000*l.*, and this fact, no doubt, accounts for the decision of the Government to let it take its course, although exceptional sanitary measures are to be taken in respect to the disinfection of the city and its visitors.

Carbolic acid appears to be the chief, if not the only, disinfectant resorted to by the Russian officials. The Medical Department of State has ordered immense quantities of the acid from abroad, to be distributed at cost price to the local authorities, and it is said that one firm in Berlin received a telegraphic inquiry whether 200 tons of carbolic acid could be despatched at once to the suffering districts.

The first Russian orders for carbolic acid appear to have been placed in Germany, but as that country does not manufacture enough for its own requirements, almost the whole of the increased demand will have to be supplied by makers in Great Britain.

It is, therefore, the English market which has been chiefly affected by the sudden demand, and which is likely to profit most by it. To our manufacturers and dealers the reanimation of the carbolic acid market has been a most welcome interruption of the unusual stagnancy of trade. The principal run has been upon the various qualities of liquid acid, and in this class of carbolic the rise has been very rapid, parcels which, six weeks ago, were being hawked about in vain for 8½*d.* per gallon readily realising 1*s.* 4*d.* per gallon last week. Crystals have not advanced in quite the same proportion as liquid acid, but they also show a decidedly higher value, 4½*d.* per lb. having been paid already for 34°–35°, while for 39°–40°, 5½*d.* per lb. has been conceded, and manufacturers are unwilling to sell anything more of this kind below 5½*d.* per lb.

The weak point in the position of the article is that the demand is limited to the summer months, and that no one believes that the figures now quoted can be maintained beyond the end of September. Before the present scare set in, carbolic acid of all descriptions had fallen to prices lower than had ever before been recorded, and several makers had ceased manufacturing. But they all have their plant ready to start again as soon as there is a prospect of better times, and the higher the present rise in prices, the sooner, therefore, will over-production set in again. The synthetic carbolic acid which was placed upon the market by a German firm of aniline-dye manufacturers a few years ago, and looked upon for awhile as likely to become a serious

competitor to the coal-tar acid, has receded into obscurity, and not much is heard of it now in commercial circles. It was good, but much too dear. It is still possible, however, that it might make its reappearance under more favourable market conditions, and prevent the coal-tar product from rising beyond a certain point.

Although the superiority of carbolic acid as a disinfectant has frequently been challenged, there is no doubt that it continues to hold the first place in popular favour, and no other disinfectant is so liable to sudden demand and rise in value. Within the last 15 years there have been, at intervals, regular runs up it during the summer months. Its price has been seriously affected in turns by yellow-fever epidemics in America, and by cholera epidemics in Japan, the East, Spain, and Russia. When any sudden demand sets in during the summer (which is also the season when the output is the smallest), it is no unusual thing to witness an advance in price of 50 or 100 per cent. within a couple of weeks; but it happens very rarely that this increase is prolonged beyond the autumn. In 1879 there was a sudden and somewhat sustained rise, as a result of an unusual demand from America and the far East. In 1884 the occurrence of cholera in the south of France, and in 1885 the fear of a renewed outbreak, caused prices to double within a few weeks. In 1886 there was a fresh recovery in price, which continued slowly until the spring of 1887, when carbolic had reached three times the value of its lowest point. Then came a good time for the manufacturers. The French Government set about to manufacture melinite. One of the principal ingredients of that explosive was picric acid, about two-thirds of which is carbolic acid, and the quantity of carbolic thus consumed was enormous. We cannot give reliable statistics to show even the approximate quantity of carbolic acid consumed in the manufacture of melinite, but some idea of it may be formed by the figures showing the increased imports of carbolic acid into Germany when the German Government followed the French in using the drug as an ingredient in the manufacture of its war-material. Previous to 1888 Germany imported from 800 to 1,000 tons of carbolic per year, in 1888 she took 1,200 tons, in 1889, 2,400 tons, and in 1890, 1,900 tons—the excess being all used, it is believed, in the manufacture of explosives. Since 1890 the continental demand has been decreasing rapidly, and the English makers, no longer able to dispose of their output abroad, have gradually been compelled to throw their surplus stock upon the home market. It is estimated that the total quantity of coal-tar converted into various commercial products is about 820,000 tons per annum, of which over 600,000 tons fall to the share of this country, while France produces nearly one-half of the residue. Assuming that the production of carbolic acid is about one-twentieth part of the weight of the coal-tar converted, its total output in Europe would be about 11,000 tons a year, of which more than 30,000 tons are produced in this country.—*Chemist and Druggist*.

AMERICAN POTASH.

This was formerly an article of much importance, and was exported from the country in large amounts. The New England States were at first the principal producers of potash, Boston, where it is now of no consequence, once being the great export market. With the destruction of the forests the source of supply receded from the East, progressing into the West, where until a comparatively recent period more or less was manufactured, but at present only a few stray casks drift into the hands of wholesale druggists or commission merchants. However, contrary to general opinion, the manufacture of potash is still carried on in some parts of the North west on a considerable scale. In the neighbourhood of the forest of Northern Michigan, and in portions of the provinces of Canada, this substance is still systematically manufactured the year through. By "potash" is meant a substance containing 80 to 95 per cent. of carbonate and hydrate of potash, the balance being made up of sulphate of potash, chlorides of sodium and potassium, and insoluble matter. About 70 per cent. KOH is the standard which it is possible to obtain, but Mr. Lloyd found the average of many casks of first sorts came out at

58·4 per cent., and dealers would not guarantee more than 60 per cent., as they had not control of the "salting" which is practised by makers. However, a strong protest improved matters during the last 12 months. A total of 504,138 lb. averaged 73·5 per cent. KOH, three car-loads averaging over 75 per cent. KOH, while one car-load averaged over 80 per cent. This is evidence that a standard of 70 per cent. KOH is attainable. For generations it has been customary to add more or less salt to the contents of the potash-kettle just before it is "melted down," and sometimes lime is also added. This not only increases the yield and helps to make it cake, but it improves its appearance. Good potash is generally opaque, of a dull grey, slate, or bluish colour, often streaked with red or greenish stains. It deliquesces on exposure to the air, and becomes slowly pasty. It is mostly (unless much lime is present) soluble in water. Sometimes it presents a whitish appearance in the centre of the cake, and occasionally is honeycombed. This description will generally average 70 per cent. and upwards KOH. That which is largely mixed with salt is usually crystalline, often nearly white, pearly, and translucent, or a beautiful delicate pink, and seems to be the most highly valued by those who judge only from appearances.—*Ibid*.

SUGAR-GROWING IN QUEENSLAND.

The *Sydney Mail* for June 4th has the following notice:—

The extension of the Polynesian labour in Queensland has so far invigorated the sugar-growing industry of that colony that large areas of virgin soil are likely to be cleared and placed under cane. There is being seriously considered a proposal to erect, at a cost of 100,000*l.*, four central mills in the Bundaberg district. It is shown that there is at present in the banks of the district more than this sum, the savings of farmers who have small blocks of rich land. The interest at present obtained for this money is 4½ per cent. The supporters of the four mills in question say that the venture will pay at least 10 per cent. on capital invested, and, more than this, that the mills will make land much more valuable than it is at present.

GUM ACACIA IN JAVA.

Dr. de Vrij, the Dutch pharmacist, calls attention to the fact that the *Acacia dealbata*, a native of Australia, from the stem of which exudes an excellently soluble gum, grows in profusion in the Java mountains, and states that some 35 years ago he was in the habit of using this gum regularly for pharmaceutical purposes. It might be worth while to collect and export it.

PAVERS OF INTEREST TO TECHNOLOGISTS AND OTHERS.

The following articles in the *Board of Trade Journal* for August will repay perusal:—

"Cinchona and Indigo Cultivation in India".....	p. 154
"Mining Development in Peru".....	p. 156
"Production and Export of Copper in Japan".....	p. 207
"Mining in British Columbia".....	p. 215

The United States Consular Reports for June contain the following:—

"Bohemian Mirror and Plate Glass".....	p. 249
"Plate Glass Manufacture in Belgium".....	p. 255
"Plate Glass Manufacture in England".....	p. 261
"Austrian Sheets and Mirror Glass".....	p. 263
"Silk from Wood Pulp".....	p. 386

INDUSTRIAL PROSPECTS IN EGYPT.

The following particulars regarding the present industrial condition of Egypt are extracted from the report of the Austro-Hungarian Consul at Alexandria, published in the Austrian *Handels Museum* of July 7th.

The most important representatives of the agricultural industry are the sugar factories, 22 in number, and

situated chiefly in the province of Minieh. They produce, together, about 150,000 tons of sugar per annum. There is, in addition, the large refinery of *El-Hawamidieh* in Cairo.

The oil industry is largely represented in Cairo, after which, in this respect, come Daehahieh, Girget, and Esneh. Cotton-seed oil, much in use for adulterating olive oil, is the chief manufacture in this category. The manufacture of oil cakes may be mentioned as a side product, and as secondary manufactures, the production of olive and sesame oil. A paste used for toilet purposes is also made from sesamum.

Other establishments worthy of mention as closely connected with the agricultural industry are those for cleaning rice, manufacturing manure, fruit essences, perfumes and dyes, as also the 600 or more hatching ovens, in which about 6,000,000 eggs are annually hatched.

Chemical industries embrace the manufacture of soap, candles, and matches in Alexandria, and of glass and starch in that town and in Port Said.

Other important industries are those of cigarette-making, paper-making, printing, quarrying, tile, brick and cement making. There is also a considerable annual production of soda (about 8,000,000 kilos.), saltpetre (about 700,000 kilos.), and salt.

Glass-making, which flourished here of old, and which has everything in its favour so far as the supply of raw materials is concerned, viz., unlimited quantities of soda and sand, has ceased to exist as an industry. Those who raise the objection that it would be impossible to compete with cheap Belgian manufactures would do well to remember how successfully this competition was met by the glass factory established a few years ago at Pascha Bagtsehe, near Constantinople.

The establishment of a cannery for the preservation of fish, vegetables, and quails would be a profitable speculation—40 per cent. of the quails, hitherto shipped alive, have perished on the journey—as there is a good supply of cheap and excellent oil, and tin boxes are now being made in Alexandria.

The rags which Egypt now exports so largely to America would make an excellent raw material for the manufacture of paper, especially packing paper.

Palm fibre, for making coarse ropes and packings, dyestuffs, such as Kartham, henna, and indigo, all of which are produced in excellent quality in Egypt, and mother-of-pearl would be found of the greatest use towards fostering native industry.

THE MINERAL STATISTICS OF THE UNITED KINGDOM FOR 1891.

COPPER, LEAD, TIN, &c.

Although the miscellaneous mineral productions of the United Kingdom are somewhat exposed to the risk of being put in the shade by the preponderating importance of the iron and coal trades, when removed from contrast with these two industries they make a by no means despicable appearance. Their total value at first hand, that is, at the mines or open-works, reached last year almost 14 millions sterling. It is true that a very large proportion of this, viz., 8,693,000*l.*, represents the estimated value of the stone—lime-stone, building-stone, paving-stone, &c.—produced, and although stone is strictly a mineral substance, it is not one which is often classed in that category by the popular imagination. Clay is another substance which answers to the same description, and the value of the production last year amounted to 943,896*l.* This does not include ordinary clay, but only fireclay, china clay, potter's clay, &c. Slabs and slates might almost be classed with stone, and of them the production in 1891 was valued at 987,000*l.* Next to these in order of value comes salt, of which 976,824*l.* worth was produced last year; whilst oil-shale to the value of 707,177*l.* was raised. These are the more important of the minerals which are rather outside our province.

Coming now to metalliferous minerals, such as tin-ore, lead-ore, zinc-ore, and copper-ore, we find that the first-

mentioned is now by far the most important of this class. Indeed the value of the production last year considerably exceeds that of the other three combined. The quantity of ore raised in 1891 amounted to 11,188 tons, valued at 735,240*l.* against 14,911 tons produced in the preceding year, and valued at 782,492*l.* From the former quantity, 9,353 tons of metal were obtainable by smelting, and from the latter, 9,602 tons. The sources of supply last year were as follows:—From mines in Cornwall, 13,030 tons of tin-ore; from open-works in the same county, 113 tons; from rivers, foreshores, and the refuse of dressing-floors, 1,300 tons; and from mines in Devonshire, 44 tons. The price of tin presented remarkable steadiness last year, the standard having ranged between 88*s.* and 93*s.* per cwt., the opening price being 91*s.* and the closing price 90*s.* The average price for the year was, however, distinctly lower than in 1890. Last year the mean of the monthly prices was 94*l.* 1*s.* 1*d.* per ton for English block tin, compared with 97*l.* 13*s.* 3*d.* per ton in 1890; while the price of Straits tin showed an average of 91*l.* 4*s.* per ton, against 91*l.* 4*s.* for the previous year. But while, as we have just seen, the yield of home mines showed a falling off of 423 tons, the quantity of foreign tin imported increased considerably, and this in spite of the lower values we have just referred to. Of ore the imports amounted to 2,332 tons, and here we have a decrease of 331 tons; but 28,200 tons of block, ingot, and bar tin were imported last year, compared with 27,038 tons in 1890. The Straits Settlements continue to be the principal outside source of supply, and sent us last year 21,000 tons, or three-fourths of the whole imports, in blocks, ingots, and bars. New South Wales, from which we received 4,390 tons, is the only other country which sends us any quantity of importance. The exports of tin remained practically stationary, the quantity of British tin shipped abroad having been 5,165 tons in 1891, and 5,132 tons in 1890; whilst 14,621 tons of foreign metal were re-exported last year, against 14,618 tons in the previous 12 months. The total supply of tin last year, domestic and foreign—leaving imported ore out of the question—was 37,553 tons, of which 19,786 tons were exported, leaving as the amount of the home consumption 17,767 tons, if we may assume that stocks remained the same.

Lead ranks next to tin so far as the value of the production is concerned, although this is less than one-half of the figure reached in the case of the latter metal. The quantity of lead ore raised in the United Kingdom last year was 43,859 tons compared with 45,651 tons in 1890, the former being valued at 356,783*l.* and the latter at 406,164*l.* Last year's production was equivalent to 32,205 tons of metal, while that of the previous year was equal to 33,590 tons, and the amount of silver obtainable from the lead was respectively 279,792 oz. and 291,724 oz. In calculating the quantity of silver procurable, the amount contained in ores with less than 3 oz. of silver per ton of ore is omitted, as in the majority of cases it is not extracted, and it is assumed that an average of $\frac{1}{2}$ oz. of silver is left in every ton of desilverised pig-lead. It is not surprising that the production of lead should have declined, seeing that the mean of the monthly prices was almost 20*s.* per ton lower in 1891 than in 1890, and the falling-off in value is amply justified by the reduction in the quantity exported, which amounted last year to 29,266 tons of pig-lead and 18,967 tons of rolled and sheet lead and lead pipes and tubing, against 34,701 tons and 20,856 tons respectively in 1890. The exports of foreign lead did not vary to the same extent, 148 tons less of ore, but 335 tons more of pig and sheet lead having been shipped abroad. But while the exports thus experienced considerable diminution, the imports on the other hand increased not a little. Of lead ore 20,560 tons were received, against 19,236 tons in 1890, whilst 169,724 tons of foreign pig and sheet lead came into this country from abroad last year, compared with 158,649 tons in the previous 12 months. The net result of the production of home mines and of imports and exports was that, in 1891, 152,893 tons of lead were available for home consumption, against 135,047 tons in 1890. The yield of copper ore from British mines continued its downward course last year, and it may be said, speaking roundly, that the output of 1891 was 33 per cent. less than that of 1890,

the figures being respectively 8,836 tons and 12,136 tons. The native production of copper is now, however, a matter of trifling importance compared with the entire trade, and the actual position will perhaps be most clearly shown in tabular form.

	1891.		1890.	
	Quantities.	Amount of Copper obtainable by Smelting.	Quantities.	Amount of Copper obtainable by Smelting.
	Tons.	Tons.	Tons.	Tons.
Copper-ores and precipitate from mines in the United Kingdom, Colonial and foreign ones, excluding cupreous pyrites.....	9,158	720	12,481	956
Copper precipitate and residua imported.....	88,990	8,000	111,028	9,502
Burnt ore from cupreous pyrites imported.....	123,337	51,801	101,907	14,062
Burnt ore from cupreous pyrites imported.....	531,288	14,106	395,684	14,245
Totals.....	612,773	74,633	624,100	69,235

The increase in the supply indicated by these figures is sufficient explanation, coupled with the falling-off in trade, of the decline which values exhibited last year, the price of "best selected" copper having fallen 57 per ton compared with 1890.

TABLE VI.
PRODUCTION OF MINOR MINERALS.

	1891.		1890.	
	Quantity.	Value at the Mines.	Quantity.	Value at the Mines.
	Tons.	£	Tons.	£
Alum clay.....	10,763	3,228	11,527	5,763
Alum shale.....	5,474	681	6,420	802
Antimony ore.....	15	250	11	200
Arsenic.....	6,048	58,593	7,276	60,727
Arsenical pyrites.....	5,005	4,370	5,114	4,414
Barytes.....	26,876	32,120	25,353	29,684
Bog ore.....	16,075	8,037	11,512	7,256
Clays.....	3,222,035	943,806	3,308,214	899,166
Cobalt and nickel ore...	..	..	84	260
Fluorspar.....	141	187	268	392
Gold ore.....	11,117	12,200	575	434
Gypsum.....	151,708	60,038	110,293	57,991
Jet.....	766	153	1,228	215
Lignite.....	1,664	1,330	2,630	767
Manganese ore.....	9,476	6,213	12,444	6,733
Ochre,umber, &c.....	13,602	20,103	19,068	17,475
Oil shale.....	2,361,110	707,177	2,212,250	608,360
Petroleum.....	100	150	35	52
Phosphate of lime.....	10,000	20,000	18,000	29,500
Salt.....	2,013,571	976,824	2,116,849	1,100,014
Slates and slabs.....	115,929	987,000	131,352	1,027,235
Stone, &c.....	..	8,093,743	..	8,708,391
Sulphate of strontian....	8,064	1,030	10,276	5,138
Uranium ore.....	31	620	22	2,200
Wolfram.....	138	3,341	101	1,848

The production of zinc is chiefly remarkable for the fact that, unlike tin, lead, or copper, it increased last year. The improvement was, however, small, the quantity of ore raised in Great Britain being 22,216 tons against 22,041 tons in 1890, and the amount of metal obtainable by smelting 8,891 tons compared with 8,582 tons. It may be of interest to some of our readers to note that the quantity of gold produced in Wales increased considerably last year. From 14,117 tons of ore 4,008 oz. of metal were obtained, against a yield in 1890 of 206 oz. from 575 tons of ore. Four mines—one in Carmarthenshire and three in Merionethshire—were worked, but the chief producer was the Morgan mine, in the latter county, which raised 13,802 tons of ore, yielding 3,452 oz. of gold.

There are a number of minerals obtained in the United Kingdom which scarcely call for special mention at our hands; particulars of these will be found in Table VI. in preceding column.—*Iron.*

BOARD OF TRADE RETURNS

SUMMARY OF IMPORTS.

	Month ending 31st July	
	1891.	1892.
	£	£
Metals.....	1,819,628	1,861,865
Chemicals and dyestuffs.....	435,782	440,745
Oils.....	726,156	534,160
Raw materials for non-textile industries.	3,967,914	4,283,371
Total value of all imports....	32,824,111	33,497,585

SUMMARY OF EXPORTS.

	Month ending 31st July	
	1891.	1892.
	£	£
Metals (other than machinery)....	3,246,514	2,648,308
Chemicals and medicines.....	668,479	596,410
Miscellaneous articles.....	2,657,360	2,282,134
Total value of all exports.....	21,945,112	19,463,597

IMPORTS OF METALS FOR MONTH ENDING 31ST JULY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Copper:—			£	£
Ore..... Tons	5,064	10,312	29,137	72,358
Regulus..... "	8,989	14,018	259,707	322,729
Unwrought.... "	3,361	2,950	185,730	136,202
Iron:—				
Ore..... "	202,190	319,796	212,481	229,484
Bolt, bar, &c.... "	8,751	9,125	88,100	80,569
Steel, unwrought.. "	744	1,022	7,512	4,476
Lead, pig and sheet "	13,585	18,001	173,144	199,025
Pyrites..... "	18,341	56,783	81,611	96,017
Quicksilver..... Lb.	83,683	11,474	8,739	1,072
Tin..... Cwt.	57,629	41,715	260,113	207,831
Zinc..... Tons	5,986	3,557	135,809	76,829
Other articles... Value £	..	..	398,446	435,273
Total value of metals	..	..	1,810,628	1,861,865

IMPORTS OF OILS FOR MONTH ENDING 31ST JULY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Cocoa-nut..... Cwt.	18,075	15,882	£ 26,898	£ 18,128
Olive Tuns	3,157	1,443	127,207	52,840
Palm Cwt.	91,720	71,296	101,908	81,109
Petroleum Gall.	9,447,850	9,492,993	197,496	163,147
Seed Tons	983	1,012	27,503	25,190
Train, &c..... Tuns	3,907	1,847	62,912	35,389
Turpentine Cwt.	76,727	68,149	105,914	81,131
Other articles .. Value £	..	..	76,518	77,235
Total value of oils ...	..	..	726,153	534,169

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST JULY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Bark, Peruvian.. Cwt.	3,752	6,878	£ 7,509	£ 14,903
Bristles..... Lb.	488,641	373,917	71,160	54,298
Caoutchouc..... Cwt.	15,082	17,673	159,592	164,859
Gum :—				
Arabic..... "	4,783	5,583	11,495	12,766
Lac, &c..... "	5,652	12,009	17,529	49,341
Gutta-percha "	5,009	1,549	68,644	9,304
Hides, raw:—				
Dry..... "	37,033	27,681	108,550	80,071
Wet..... "	48,553	51,394	111,623	110,536
Ivory "	1,084	1,145	52,089	53,293
Manure:—				
Guano..... Tons	147	362	709	1,810
Bones..... "	6,454	2,080	30,450	8,878
Paraffin..... Cwt.	38,074	32,905	56,435	45,400
Linon rags..... Tons	2,889	2,209	26,517	19,787
Eaparte..... "	26,477	11,341	96,298	67,068
Palp of wood "	10,913	14,580	62,531	73,603
Rosin..... Cwt.	220,503	150,318	54,758	35,367
Tallow and stearin "	123,718	179,053	158,752	222,422
Tar Barrels	10,183	20,590	5,527	11,076
Wood:—				
Hewn Loads	220,726	286,707	479,042	622,210
Sawn "	683,487	785,462	1,474,811	1,742,339
Staves "	13,842	18,762	49,079	54,674
Mahogany Tons	1,973	3,828	17,515	32,152
Other articles.... Value £	..	..	856,302	796,581
Total value .....	..	..	3,967,914	4,283,371

Besides the above, drugs to the value of 45,438*l.* were imported as against 74,691*l.* in July 1891.

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 31ST JULY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Alkali..... Cwt.	5,012	1,125	£ 3,992	£ 2,077
Bark (tanners, &c.) ..	14,333	37,508	22,445	18,247
Brimstone "	56,455	42,794	16,167	11,416
Chemicals..... Value £	..	..	120,719	118,902
Cochineal Cwt.	270	210	1,628	1,259
Cutch and gambier Tons	1,394	2,302	31,558	48,404
Dyes:—				
Aniline Value £	..	..	20,360	18,111
Alizarine ..... "	..	..	26,500	20,511
Other ..... "	..	..	1,552	1,959
Indigo Cwt.	485	1,323	8,418	21,932
Nitrate of soda.... "	18,897	65,610	8,153	28,628
Nitrate of potash . "	24,768	26,495	21,989	23,347
Valonia Tons	1,167	1,922	23,204	18,159
Other articles... Value £	..	..	129,097	108,361
Total value of chemicals	..	..	635,782	449,745

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 31ST JULY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Gunpowder..... Lb.	350,500	513,400	£ 23,841	£ 14,944
Military stores.. Value £	..	..	112,405	54,199
Candles..... Lb.	1,383,300	1,300,100	28,386	24,259
Caoutchouc Value £	..	..	102,450	165,245
Cement..... Tons	50,108	51,629	98,493	93,721
Products of coal Value £	..	..	161,823	88,187
Earthenware ... "	..	..	168,303	165,883
Stoneware ..... "	..	..	13,725	10,773
Glass:—				
Plate..... Sq. Ft.	249,185	199,498	18,156	12,050
Flint..... Cwt.	10,150	7,113	20,282	18,984
Bottles..... "	66,035	70,085	31,019	33,007
Other kinds.... "	17,284	19,965	13,749	15,824
Leather:—				
Unwrought "	12,006	10,868	111,625	110,133
Wrought Value £	..	..	33,284	24,805
Seed oil..... Tons	5,392	4,198	120,782	83,440
Floorecloth Sq. Yds.	1,747,100	1,172,900	77,096	53,649
Painters' materials Val. £	..	..	142,777	124,777
Paper Cwt.	91,939	74,173	154,096	125,040
Rags..... Tons	4,227	4,194	29,395	28,210
Soap Cwt.	44,430	13,980	18,916	46,683
Total value .....	..	..	2,657,360	2,282,134

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR
MONTH ENDING 31ST JULY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Brass..... Cwt.	10,825	9,154	16,844	37,602
Copper:—				
Unwrought..... "	55,121	82,568	155,254	202,826
Wrought..... "	23,304	25,146	77,184	75,098
Mixed metal.... "	21,969	19,741	62,319	49,475
Hardware..... Value £	..	..	221,148	170,557
Implements..... "	..	..	115,808	100,188
Iron and steel..... Tons	290,803	221,894	2,178,450	1,762,184
Lead..... "	4,035	5,473	64,252	63,537
Plated wares... Value £	..	..	36,208	25,736
Telegraph wires, &c. "	..	..	150,754	25,906
Tin..... Cwt.	8,920	7,196	42,129	36,067
Zinc..... "	14,122	15,114	14,650	14,558
Other articles .. Value £	..	..	81,514	84,574
Total value .....	..	..	3,246,514	2,618,308

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING
31ST JULY.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Alkali..... Cwt.	156,156	363,819	175,379	136,900
Bleaching materials ..	129,845	107,000	44,799	41,438
Chemical manures. Tons	32,416	29,316	162,772	148,862
Medicines..... Value £	..	..	81,826	72,339
Other articles ... "	..	..	203,703	196,871
Total value .....	..	..	668,479	596,410

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

14,144. J. Dawson. A new and improved apparatus for regulating the heat of dye-vats, wool-washing bowls, and other vessels containing liquid heated by steam. August 5.

14,145. J. Proctor. Improvements in mechanical stokers. August 5.

14,631. J. H. Annandale. Improvements in apparatus for separating or cleaning matters suspended in liquids. August 13.

COMPLETE SPECIFICATIONS ACCEPTED.*

1891.

11,690. J. A. Burley.—From P. A. Mallet and A. T. Lagniez. Improvements in analysing columns. August 17.

13,447. A. Colson. Column stills for distillation of gas liquor and other liquids. August 17.

13,522. J. Reed. Condensers. August 17.

13,523. J. Reed. Improvements in evaporators, partly applicable to feed-heaters and condensers or distillers. August 17.

16,281. B. L. Fletcher and J. Hoyle. See Class XV.

16,806. J. Ehlig. Ozonising apparatus. July 27.

16,904. A. Suiter, and A. R. Margary. Regulators for compressed gas. August 17.

17,185. T. Scott. See Class VII.

17,274. R. W. Deacon.—From W. Maxwell. See Class XVI.

1892.

11,704. H. E. Newton.—From A. E. Ashcroft and J. Howell. Method and apparatus for generating steam by the aid of molten slag. July 27.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

13,339. J. M. Bailey. Improvements in apparatus for the production of fuel gas. Complete Specification. July 21.

13,379. W. Hawkins, T. Hawkins, H. Fuller, and W. H. Fuller. Improvements in generators to be used in the production of hydrogen gas. July 21.

13,467. B. Gibbons and W. P. Gibbons. Improved means or apparatus for discharging gas retorts. July 23.

13,470. T. B. Jones. The prevention of choked ascension pipes in the manufacture of coal-gas. July 23.

13,472. S. Walker and S. S. Walker. Improvements in the manufacture of oxygen and carbonic acid and in apparatus employed in the said manufactures and in other like manufactures. July 23.

13,601. R. F. Strong and A. Gordon. Improvements in the manufacture of artificial fuel. Complete Specification. July 26.

13,762. J. D. Brunton. Improvements in means or apparatus for drying, more especially intended for drying peat. July 28.

13,912. J. E. Newby. Improvements in and connected with coke ovens. July 30.

13,956. J. W. Buckley and J. H. Buckley. Improvements in the method of and apparatus for the manufacture of coal-gas. August 2.

14,070. J. Fraser. An improved description of fire-lighter and the method of manufacturing same. August 4.

14,105. J. Beveridge and J. B. Alliot. Improvements in or connected with the method and means for treating wood and other materials at high temperatures, whereby heat may be more effectively utilised. August 4.

14,174. J. Bowing. Improvements in coking processes, and in the manufacture of coke and in the recovery of tar products. August 5.

14,191. F. J. Lankford. Improvements in the treatment of coal shale. August 5.

14,266. J. Royle. Improvements in fire-lighters. August 8.

14,374. J. A. Wanklyn and W. J. Cooper. Improvements in the refining of petroleum. August 9.

14,383. C. H. Ridsdale. Improvements in the treatment or solidification of mineral oils and other liquid hydrocarbons. August 9.

14,490. B. Parkin. Improvements in the manufacture of illuminating gas. August 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

12,396. H. H. Leigh.—From T. Bauer and G. Mendheim. Coke ovens. July 27.

15,390. H. Williams. Apparatus for use in manufacture of illuminating gas. August 3.

15,975. H. Brier. Means for obtaining oxygen and nitrogen from the air. July 27.

17,298. Brin's Oxygen Company, Limited, and K. S. Murray. See Class VII.

18,082. The Gas Economising and Improved Light Syndicate, Limited, and J. Love. Apparatus for carburetting gas or air. August 17.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATION.

14,174. J. Bowing. See Class II.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

13,147. J. V. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture of mordant-dyeing colouring matters. July 18.

13,305. C. S. F. Mellor. Improvements in or relating to dyes, pigments, or the like. July 20.

13,475. O. Imray.—From the Society of Chemical Industry, in Basle, Switzerland. Production of a red azo-colouring matter. July 23.

13,766. C. S. F. Mellor. Improvements in or relating to dyes, pigments, or the like. July 28.

14,253. O. Imray.—From the Society of Chemical Industry, in Basle, Switzerland. Production of azo-colouring matters. August 6.

14,301. C. D. Abel.—From The Farbwerke vormals Meister, Lucius, and Bruning, Germany. Improvements in the manufacture of alpha-naphthol and of alpha-naphthol sulphonic acids from the corresponding amido compounds. August 8.

14,398. Brooke, Simpson, and Spiller, Limited, and A. G. Green. New blue and bluish-green colouring matters, and the process for their manufacture. August 9.

14,478. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new colouring matters. August 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

13,677. B. Willeox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of colouring matters derived from anthraquinone and alizarin blue. July 27.

1892.

9360. C. D. Abel.—From L. Durand, Huguenin and Co. Manufacture of new bases applicable for production of substantive dyes. August 17.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATION.

14,029. J. Miller, sen., and J. Miller, jun. Improvements in the method of and apparatus for rendering textile fabrics waterproof by one treatment or process. August 3.

COMPLETE SPECIFICATION ACCEPTED.

1891.

20,610. E. Viarenzo and E. Casper. The treatment of rhea, and apparatus therefor. August 10.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

14,101. S. Smithson. Improvements in or relating to means or apparatus for dyeing yarns, piece-goods, and the like. Complete Specification. August 1.

14,230. W. Waengler. Improved method of removing impurities from bleaching keirs formed in the operation of bleaching cotton and other textile fabrics. August 6.

14,375. W. E. Aykroyd, W. H. Aykroyd, and J. Smith. Improvements in or connected with dyeing, tinting, sizing, and bleaching, or similarly operating upon textile fabrics or fibres, or other materials. August 9.

14,396. W. T. Lye. Improvements in the bleaching or dyeing of "chip" or "chip-plaits," and straw or straw-plaits. August 9.

14,397. W. T. Lye. Improvements in the bleaching or dyeing of "chip" or "chip-plaits" and straw or straw-plaits. August 9.

14,421. S. Schmidlin. Improvements in certain machines for washing, soaping, bleaching, dyeing, and similarly treating textile fabrics. August 10.

14,507. J. M. Collins. Improvements in and connected with machinery for dyeing and scouring yarn. August 11.

14,593. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the process of dyeing or printing with aniline black. August 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

15,174. A. and J. Graemiger. Apparatus for dyeing, scouring, bleaching, &c. yarn in cop or similar compact form. August 17.

16,463. D. Stewart. Apparatus for bleaching, dyeing, and treating textile materials. August 3.

16,700. O. Inray.—From H. W. Wilson. Bleaching vegetable textile materials. August 3.

1892.

11,318. A. S. Lyon and J. H. Lorimer. Apparatus for skein-dyeing. July 27.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

13,121. E. H. Cook and A. E. Petter. Improvements in treating residues (seconds) from zinc smelting, galvanised iron scrap, flux skimmings, and acid residues for the purpose of obtaining products therefrom. July 18.

13,208. W. Maltster. Improvements relating to the manufacture of sulphate of ammonia. Complete Specification. July 19.

13,411. H. V. Castner. Improved bleaching compound. July 22.

13,538. S. Meyer. A process for solidifying sulphuric acid and facilitating the transport of the same. July 25.

13,686. E. de Cuyper. Improvements relating to the collection of ammonia and ammoniacal salts from gaseous and liquid mixtures. July 27.

13,822. H. W. Wallis. Improvements in the manufacture of chlorine. July 29.

14,039. W. Walker. See Class XVIII.—B.

14,051. E. Ulrichs. Process or processes for obtaining alkali, carbonates, and "blanc fixe" from witherite or heavy spar (barium sulphate) and the corresponding alkali sulphates. August 3.

14,607. H. H. Lake.—From J. H. C. Behnke and The Chemische Fabrik Billwälder, Germany. Improvements in the production of carbonic acid gas. August 12.

14,642. M. N. d'Andria. Improvements in the manufacture of muriate of ammonia and other by-products. August 13.

14,645. A. Hof. Improvements in the production of dry hydrochloric [acid] gas. August 13.

14,657. A. Hand and H. Kunheim. An improved process for the extraction of alumina from bauxite and other substances. August 13.

14,665. C. Dreyfus. Improvements in the manufacture of protosulphate and persulphate of iron. August 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

13,684. C. R. C. Tichborne, A. E. Darley, S. Geoghegan, and M. F. Purcell. Process and apparatus for manufacture of solid carbonic acid (CO_2). August 17.

14,159. T. Parker and A. E. Robinson. Treating solutions containing nickel and iron for obtaining useful products therefrom. July 27.

15,822. F. H. Gossage. Obtaining monocarbonates from bicarbonates of the alkalis. July 27.

15,833. J. M. and A. Milnes. Apparatus for manufacture of bleaching-powder, &c. July 27.

16,647. A. Boake and F. G. A. Roberts. Manufacture of acid sulphites. August 3.

17,185. T. Scott. Evaporating pans for manufacture of salt from sea-water or brine. July 17.

17,298. Brin's Oxygen Company, Limited, and K. S. Murray. Preparation of anhydrous oxide of barium, or substances of like properties, for separation of the oxygen and nitrogen of atmospheric air. August 10.

19,637. E. Edwards.—From H. Bauer and J. Syiketta. Production of boron sulphate compounds, and application of such products to the unliming of hides and skins and for the prevention of putrefaction. August 3.

1892.

12,884. E. Küchenmeister. Manufacture of vinegar and apparatus therefor. August 17.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

13,220. H. H. Leigh.—From I. K. Rue, United States. Improvements in enamelled bricks, and in the manufacture thereof. Complete Specification. July 19.

13,227. W. P. Thompson.—From The Clay Glass Tile Company, United States. New or improved process of plating clay with glass and in articles made in accordance therewith. Complete Specification. July 19.

13,355. F. Ohm. Improvements in the means or materials for decorating, colouring, and enamelling glass, earthenware, and metals, and for the direct production of glass. July 21.

13,416. H. L. Doulton and R. Meldrum. Improvements in glazing pottery. July 22.

13,569. J. W. Bonta. Improvements in lears or annealing furnaces for sheet or plate glass. Complete Specification. July 26.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

15,108. E. G. Cole and H. Keston. Means for forming clay into pots or vessels. August 3.

16,846. D. Rylands and A. Husselbee. Lining metallic or other vessels or tubes with glass. August 3.

17,126. J. Slater and J. J. Royle. Treating china, earthenware, and similar surfaces. August 17.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

13,206. J. T. Drawbridge. Improved road paving. July 19.

13,602. J. C. Bloomfield. Improvements in the manufacture of plaster. July 26.

13,819. W. White. Improvements in paving blocks for roads, footpaths, and other surfaces. July 29.

13,825. W. N. Hartley and W. E. B. Blenkinsop. Improvements in and relating to the manufacture of material applicable as a waterproof covering for roofs and other such like purposes, or as a substitute for glass. July 29.

14,336. J. E. Keseling and C. Fuchs, jun. An artificial stone composition. Complete Specification. August 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

- 12,633. T. D. Harries. An artificial stone. July 27.
 16,375. W. R. Taylor. Method and apparatus for burning cement-making materials. August 3.
 18,284. W. A. Briggs. Improved marine cement. August 3.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

- 13,137. L. J. D. Holtzer. Improvements in the production of steel and in the manufacture of springs therefrom. July 18.
 13,148. G. G. M. Hardingham.—From H. Wilisch, Germany. Improvements in hardening particles of steel or other metal and in apparatus therefor. Complete Specification. July 18.
 13,194. E. G. Brewer.—From A. A. Cowles, United States. Improvements in annealing furnaces. July 19.
 13,215. T. M. Ash and H. W. Gill. Improvements in coating with metals non-metallic articles. July 19.
 13,555. J. B. Torres. Improvements in the manufacture of alloys and in the purification thereof. Complete Specification. July 25.
 13,752. R. W. James.—From W. R. Hinsdale, United States. Process of preventing segregation in large ingots. July 28.
 13,933. T. Hampton. Improvements in the manufacture of steel. August 2.
 13,960. D. Jones and B. Jones. Improved means for skimming molten metal and apparatus for timing iron or steel plates. August 3.
 14,147. F. W. Durban. Extracting gold from its ores. August 5.
 14,223. T. Twynam. Improvements in the manufacture of copper. August 6.
 14,241. J. Colley. Improvements in iron and steel manufacture. August 6.
 14,264. P. Hart. Improvements in the method of desulphurising zinc ores. Complete Specification. August 8.
 14,288. J. F. Johnston. An improvement in the manufacture of steel ingots. August 8.
 14,579. A. K. Huntington and R. T. Preston. Improvements in bronze alloys. August 12.
 14,586. J. L. Sebenius. Improvements in apparatus for removing when casting, gases and impurities contained in the metal or alloy. Complete Specification. August 12.
 14,590. R. Taylor and D. Davies. Improvements in the manufacture of tin orterne plates and in the means or apparatus employed therein. August 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

- 11,342. H. Parkes and J. C. Montgomerie. Extraction of gold and silver from ores or compounds. August 10.
 12,917. F. W. Harbord and W. Hutchinson, jun. Utilisation of tin-plate scrap. July 27.
 13,740. C. James. Smelting complex silver ores. August 17.
 14,449. H. Pieper. Production of damascened metal bars for use in making fire-arm barrels. August 3.
 14,823. W. H. Martin and W. Pethybridge. Gold extraction apparatus. August 10.
 15,782. G. L. Addenbrooke. Alloying aluminium with other metals. July 27.

17,450. L. A. Pelatan. Treating copper ores and mattes. August 3.

17,955. C. W. Pinkney. A metallic alloy for articles subjected to great heat. August 3.

19,191. F. W. Martino. Manufacture of alloys of nickel with various other metals. August 17.

1892.

2193. N. Lébédoff. Extraction and treatment of metals. August 10.

9370. G. D. Burton. Forging metals for making steel and iron tools. July 13.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

- 13,453. G. Bamberg. Improvements in electrodes for use in electrolytic apparatus, and in their manufacture. July 23.
 13,541. F. E. Elmore. Improvements in the manufacture of continuous lengths of tube by electrolysis. July 25.
 13,542. F. E. Elmore and A. S. Elmore. An improvement in tanks or cells for electrolysis and like purposes. July 25.
 13,685. H. H. Lake.—From G. A. Oncken, United States. Improvements relating to the saturation or impregnation of organic fibrous and cellular matter with liquids by the aid of electricity, and to apparatus therefor. July 27.
 13,764. J. B. Lee. Improvements in the construction of secondary batteries. July 28.
 14,044. J. C. Fell.—From W. Morrison, United States. Electrodes for secondary batteries. Complete Specification. August 3.
 14,089. C. C. Lesenberg and J. von der Poppenburg. Improvements in dry batteries. Complete Specification. August 4.
 14,180. J. L. Dobell. Improvements in or connected with electric batteries. August 5.
 14,181. C. P. Shrewsbury and J. L. Dobell. Improvements in or connected with electric batteries. August 5.
 14,206. J. L. Dobell. Improvements in or connected with electric batteries. August 6.
 14,250. S. A. Rosenthal and V. C. Doubleday. Improvements in secondary batteries. August 6.
 14,395. J. W. Cann and R. E. Commans. Improvements relating to electric furnaces for the treatment of auriferous sulphide ores and for other purposes. August 9.
 14,658. A. J. Smith. Improvements relating to electric accumulators or secondary batteries and to the manufacture of plates or electrodes therefor. August 13.
 14,659. H. H. Lake.—From F. C. Jenkins, Germany. Improvements in and relating to electric accumulators. August 13.
 14,660. J. Rousseau. Improvements in and relating to the manufacture of plates for electric accumulators. August 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

- 11,712. H. C. Bull. Electric batteries. August 17.
 17,160. H. H. Lake.—From La Société dite Electriciteits-Maatschappij (System de Khotinsky). Electric accumulators. July 27.

1892.

- 10,200. C. Kellner. Process and apparatus for the electrochemical production of bleaching agents. July 27.
 12,306. J. B. Lee. Construction of secondary batteries. August 10.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

13,845. H. Rinck. A method of destroying the green colouring of castor oil. July 29.

14,114. R. Haddan.—From B. Jaffé and L. Darmstädter, Germany. Improvements in the separation of wool-wax from wool-fat, and in the preparation of lanoline from the more fluid residue. Complete Specification. August 4.

14,287. A. Paget. Improvements in apparatus employed in the treatment of oleaginous and other seeds. August 8.

14,328. G. B. Main. Improvements in treating wool-greases to obtain lanoline and soap. August 9.

14,352. E. S. H. Wraith and E. Stephenson. An improved means of extracting oil from crushed seeds of various kinds by a chemical process, also an improvement in the mechanical apparatus used for the extracting process. August 9.

14,354. J. Kennedy. An improved soap. August 9.

14,405. H. H. Lake.—From O. P. Amend and J. H. Macy, United States. Improvements relating to the desulphuration of oils. August 9.

14,535. W. T. Congdon. An improved saponaceous compound applicable for various purposes. August 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

16,552. H. H. Lake.—From La Société Anonyme des Parfums Naturels de Cannes. Purification of the residues obtained from fatty substances. July 27.

1892.

2320. F. Hughes.—From A. Motte and Co. Process and apparatus for removing fatty matters from wool-washing and other waters. August 17.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

13,143. C. Rawle and H. McKenna. Improvements in the manufacture of india-rubber for insulating and other purposes. July 18.

13,240. H. Pfanne. An improved method of manufacturing varnish and apparatus therefor. Complete Specification. July 19.

13,272. F. A. Tagliaferro and A. A. Moore. Improvements in composition for ships' bottoms. July 20.

13,305. C. S. F. Mellor. See Class IV.

13,402. E. Biernath. A new or improved heat insulating and waterproof material. Complete Specification. July 22.

13,424. R. Ripley. Improvements in or appertaining to bag or washing blue. July 22.

13,440. C. R. F. Schloesser, C. R. M. Schloesser, and R. P. Schloesser. A new and improved method for the production of imitation bronze powders for colouring, printing, and other purposes. July 23.

13,460. J. Bradley. Improvements in the manufacture of india-rubber. July 23.

13,766. C. S. F. Mellor. See Class IV.

13,860. T. C. Jefferies. A self-polishing black substitute for black lead. July 30.

14,052. E. Uriehs. Processes for the manufacture of white pigment and of lithopone. August 3.

14,053. E. Uriehs. Processes for the manufacture of white colouring matter or paint. August 3.

14,479. A. Tapsell. An improved anti-fouling paint or composition. August 10.

14,656. A. J. Smith. Improvements in and relating to the manufacture of white lead. Complete Specification. August 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

12,480. J. C. Martin. Manufacture of pigments or paints. July 27.

16,582. J. Frankenburg. Manufacture of aniline lakes suitable for manufacture of india-rubber cloth, &c. August 17.

1892.

7688. W. Cutter. Manufacture of gold, silver, and bronze paints. July 27.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATION.

13,264. W. Francis, J. A. Carrick, A. F. Grant, and H. A. Leverett. An improved process of rapidly making leather. July 20.

COMPLETE SPECIFICATION ACCEPTED.

1891.

19,637. E. Edwards.—From H. Bauer and J. Syiketta. See Class VII.

XV.—AGRICULTURE AND MANURES.

COMPLETE SPECIFICATION ACCEPTED.

1891.

16,281. B. L. Fletcher and J. Hoyle. Method and apparatus for treating or drying artificial manure, grain, minerals, &c. August 3.

XVI.—SUGARS, STARCHES, GUMS, ETC.

APPLICATION.

14,419. L. E. A. Prangey. Improvements in the process and machinery for the continuous refining of sugar. August 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

16,464. D. Stewart. Apparatus for extracting juice from sugar canes. August 3.

17,274. R. W. Deacon.—From W. Maxwell. Multiple-effect apparatus for concentrating sugar juice and other liquids. August 17.

1892.

8336. W. P. Thompson.—From J. A. Morrell and W. R. Stringfellow. Process and apparatus for concreting sugar, or crystallising saline or other solutions. July 27.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

13,846. H. Rinck. An improved ferruginous beer. July 29.

13,980. A. J. Boulé.—From F. L. Hume, United States. Improvements in or relating to the purifying of spirituous liquor and other liquids. Complete Specification. August 2.

14,118. E. Korn. A novel treatment of beers to adapt them for transport and for preservation purposes. Complete Specification. August 4.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

13,684. C. R. C. Tichborne and others. See Class VII.

1892.

9777. B. J. B. Mills.—From The Brewing Improvement Co. Treating hops for brewing purposes. August 10.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

13,615. S. T. Achör. Improvements in soluble chocolate and the process of preparing the same. Complete Specification. July 26.

13,642. H. H. Lake.—From S. Crump, United States. An improved food compound and a method of manufacturing the same. Complete Specification. July 26.

14,349. G. Barker.—From R. B. Beaumont, United States. Improvements in gelatinous food products. August 9.

14,651. A. J. M. Bolanachi. Improvements in or relating to the treatment of milk, cream, and various food materials, and in apparatus therefor. August 13.

B.—Sanitary Chemistry.

13,713. A. Kozloff. A furnace or apparatus for deodorising and consuming excrement. July 27.

14,039. W. Walker. An improved process and apparatus for the purification of sewage, and the production of alkalis, chlorine, ferric chloride, and electric energy. August 3.

14,175. C. E. Bell. Improvements in the manufacture of materials used in the purification and filtration of sewage and other liquids. August 5.

14,313. A. Goldthorp. A new or improved process and apparatus for purifying water. August 8.

14,324. W. H. Hughes. Improvements in or relating to the filtration and purification of water for domestic, sanitary, and manufacturing purposes. August 9.

14,370. J. Lowe. An improved method of drying the sludge or residuum in the purification of town sewage. August 9.

14,664. C. Dreyfus. Improvements in the treatment of sewage and other foul waters of analogous nature for effecting the purification thereof. August 13.

C.—Disinfectants.

13,291. J. Y. Johnson.—From F. von Heyden, Germany. Improvements in the manufacture of antiseptics. July 20.

13,316. C. A. Burghardt. Improvements in the production of a ferric chloride preparation for the treatment of sewage or other foul water. July 21.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1891.

14,755. E. Wilhelm, A. Brugier, and H. Trillich. Method and apparatus for manufacturing malt coffee. July 27.

1892.

9667. J. Bibby. Manufacture of composite cakes for cattle feeding and the like. August 3.

11,988. J. Y. Johnson.—From H. Salzer. Means for preserving meat and the like. August 3.

B.—Sanitary Chemistry.

1891.

12,567. S. Phillips and S. F. Smart. Disinfecting and ozonising air filter. August 3.

17,275. T. B. Wilson. Utilisation of sewage sludge, and production of filtering and purifying material therefrom. August 3.

1892.

9733. M. A. Lutzner. Method and apparatus for removing particles of soot and ash from waste gases emitted by chimneys. August 3.

11,989. C. G. Collins. Process of purifying water. August 3.

C.—Disinfectants.

1891.

13,262. H. B. Thornton. Disinfectants for water-closets and other places where water is used. August 10.

1892.

11,049. M. Syer. Improved disinfecting compound. August 17.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

14,270. J. Fletcher and W. Fletcher. Improvements in and relating to the manufacture of paper. August 8.

14,335. E. Jerome. Improvements in toilet paper. Complete Specification. (Filed August 9. Date applied for 3rd March 1892, being date of application in United States.)

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

14,897. A. Schlumberger. Producing safety paper by means of water-mark. August 3.

1892.

8473. J. Robertson. Manufacture of vegetable parchment. July 27.

XX.—FINE CHEMICALS, ALKALOIDS ESSENCES,
AND EXTRACTS.

APPLICATIONS.

13,400. T. S. Lemon. A new process for making and applying artificial camphor. July 22.

14,161. O. Imray.—From The Society of Chemical Industry in Basle, Switzerland. Production of dioxynaphtho-mono-sulpho acid and of its salts. August 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

16,371. O. Imray.—From the Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of tropine. August 3.

16,552. H. H. Lake.—From La Société Anonyme des Parfums Naturels de Cannes. See Class XII.

20,851. R. A. Cheesebrough. Manufacture of perfumes. August 17.

XXI.—PHOTOGRAPHIC PROCESSES AND
MATERIALS.

APPLICATION.

13,977. N. B. Kenealy. Improvements in or relating to photographic processes. August 2.

COMPLETE SPECIFICATION ACCEPTED.

1891.

17,967. G. B. Bradshaw. Improvements in photography. August 17.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

13,429. A. E. Pike. An improved explosive compound. July 22.

13,529. A. V. Newton.—From A. Nobel, France. Improvements in the construction of and means for discharging rockets. July 25.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

7087. H. Schlund. Distance fuses. July 27.

1892.

12,744. H. J. Allison.—From A. C. Rand. Explosive compounds. August 17.

PATENT UNCLASSIFIABLE.

APPLICATION.

13,847. L. S. Langville. An improved carbon product. Complete Specification. July 29.

THE JOURNAL

OF THE

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FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

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Monday, November 7th.—Mr. Watson Smith. "1. The Preparation of Nitrous Oxide. 2. A Reaction between Cupric Acetate and Galena."

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I.—GENERAL PLANT, APPARATUS. AND MACHINERY.

The Use of Oil in Ammonia Gas Compressors and its Influence on the Efficiency of the Compressors. Hans von Strombeck. J. Frank. Inst. 133, 297-307.

THE object of the experiments described by the author was to determine the effect the oil injected into the compressing cylinder of the De La Vergne refrigerating machine has upon the efficiency of the machine. In the old form De la Vergne machine with a single-acting compressor the cold oil is drawn from a tank kept at low pressure into the compressor during the down stroke of the piston of the latter, *i.e.*, when the compressor is fully charged with gas. During the compression the oil absorbs a certain amount of the ammonia. This passes out with the oil into the low pressure tank and therefore represents a loss in the efficiency of the compressor.

In order to determine the amount of the loss a series of tests was made to ascertain the quantity of ammonia which the oil can hold in solution at different pressures and temperatures. The quantity of ammonia held in solution by the oil before and after compression can then be calculated and the difference will represent the loss.

As an illustration, the author assumes a compressor of 12-in. diam., and 24-in. stroke, the capacity of which will be 2,714 cub. in. Let 35 cub. in. of oil be injected at each down stroke. He assumes further a terminal pressure of 146.7 lb. absolute, at a temperature of 150° F., and a back pressure of 44 lb. at a temperature of 70° F. The author's experiments show that at a temperature of 150° F., and under a pressure of 146.7 lb., 1 volume of oil absorbs 12.430 volumes of gas, and at a temperature of 70°, and under a pressure of 44 lb., 1 volume of oil absorbs 6.599 volumes of gas, both volumes being reduced to normal pressure and temperature. One volume of oil, therefore, if reduced from 146.7 lb. and 150° to 44 lb. and 70°, loses 5.831 volumes of ammonia. This quantity of gas at the actual pressure and temperature (44 lb. and 70°) occupies only 2.09 volumes. Hence the quantity of

ammonia which is allowed to escape out of the 35 cub. in. of oil injected occupies, on the suction side of the compressor, 73.15 cub. in., and as the capacity of the latter is 2,714 cub. in., the loss in efficiency is 2.69 per cent.

The oil used in the De La Vergne machines is necessarily a mineral oil, as all animal and vegetable oils would saponify in contact with ammonia.

The tests were carried out as follows. The oil to be experimented upon is placed in a strong glass flask with a graduated neck, and is immersed in an oil bath. From the top of this flask issue two tubes fitted with stop-cocks, the one a capillary tube, being that by which the ammonia enters the flask, the other, of larger bore, with two branches, one branch connected to a mercury manometer capable of measuring to four atmospheres, the other to a bottle containing mineral oil, through which the gas escapes into the atmosphere. The object of this bottle is to indicate the velocity of the current of ammonia. In order to lessen the risk of sudden evolution of gas, the generating apparatus is immersed in a cold water tank. When the oil is thoroughly saturated, which takes from 1½ to 2 hours, according to the temperature and pressure used, both of which can be varied, the cocks are closed, the generating apparatus removed, and instead of the manometer a series of flasks containing dilute hydrochloric acid is substituted. On opening the cocks and sending a current of pure air through the apparatus, the acid will absorb every trace of the ammonia, forming pure ammonium chloride which can be weighed, whence the volume of gas absorbed by the oil under the given conditions can be calculated.

The table below gives some of the principal results, the numbers representing the volumes of gas absorbed by one volume of the oil at the temperatures indicated.

Pressure in lb.	32° F.	70° F.	150° F.
14.67	3.139	2.197	1.213
29.34	6.233	4.442	2.387
44.01	10.045	6.599	3.556
58.68	15.655	8.523	4.692

—D. E. J.

PATENTS.

Improvements in or connected with Means or Apparatus for Heating Metals by Liquid or Gaseous Fuel. G. Rodger, Sheffield. Eng. Pat. 12,998, July 31, 1891.

By means of this invention the flame and heat from the combustion of an oil spray are directed on to or about any metal or material to be heated. By means of plates, suitably arranged, the air is heated and the apparatus made regenerative. A suitable form of furnace with regenerator is shown in the drawing attached to the specification.—D. A. S.

Improvements in the Combustion of Fuel and Furnace Apparatus therefor. R. Marshall, Honor Oak Park, Surrey. Eng. Pat. 8159, April 30, 1892.

This invention relates to the more complete combustion of fuel with reduced air supply, and without the production of smoke. A special form of furnace is used, into which the fuel is charged by means of a hopper, and from the bottom of which the products of combustion are drawn by the ordinary chimney draught through the boiler or other flues. The air for combustion is admitted by a valve on the top of the fuel, and passes downwards carrying with it the gases and distilled products from the green fuel, which are decomposed by the incandescent fuel at the bottom, and practically a complete combustion effected without the production of smoke.—D. A. S.

* Any of these specifications may be obtained by post by remitting 8d.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

II.—FUEL, GAS, AND LIGHT.

The Production of Heating Gas and Ammonia.

A. Henin. *Chem. Trade J.* **11**, 147—148.

In the dry distillation of coal the production of ammonia does not exceed 10 per cent. of the total nitrogen, being limited by the water of combination of the coal. This conclusion is corroborated by the fact that in blast furnaces where raw coal is used, although all the coal is consumed, and consequently all the nitrogen is liberated, the product of ammonia does not exceed 15 per cent. of the total nitrogen. In addition to the water of combination in the coal, there is doubtless also a proportionate effect due to the water of combination of the iron ore and flux, perhaps slightly influenced by traces of water carried into the furnace with the air blast.

If all the nitrogen in coal could be converted into ammonia, a coal containing $1\frac{1}{2}$ per cent. of nitrogen would produce per ton the equivalent of 164 lb. of sulphate of ammonia. This result is not obtainable in blast furnaces; it is impossible in the manufacture of illuminating coal-gas or of coke; but it is realisable to a large extent in the manufacture of heating gas for metallurgical and other uses.

The nascent hydrogen from the water of combustion of the coal is the main element which accomplishes the transformation of the nitrogen into ammonia. Hence, the more water the more ammonia. If a sufficient outside supply of water is given, all the other conditions being favourable, the total amount of the nitrogen may be secured as ammonia. Practice has demonstrated the correctness of this view. In 1877, Dr. H. Gronven, of Leipzig, discovered that in a large excess of superheated steam, when the necessary conditions of temperature, time, and contact are supplied, combined nitrogen is transformed into ammonia. He applied his discovery to an analytical method of nitrogen determination, which gives concordant results with other accurate methods. Later on, Bellby, Foster, Guegen, and others (this Journal, 1881, 216) demonstrated that the coke, which retains a large percentage of nitrogen even at a light red heat, parts with it in the form of ammonia in the presence of a large excess of steam at an intense heat. Since, in accomplishing this result, the steam is decomposed by carbon, liberating hydrogen, and the carbon is transformed into carbon dioxide and carbon monoxide, it is evident that we have here the elements of a process for producing simultaneously large quantities of ammonia and also heating gas of high calorific value. Between this theoretical reaction, however, and the establishment of an economical manufacturing process, there were many difficulties to overcome. As has been pointed out, the main conditions for the formation of ammonia are eminently favourable to the production of a good heating gas. But high temperature is not compatible with a large excess of steam unless the latter be intensely superheated; and such a temperature cannot be maintained for any considerable time without an outside supply of oxygen or an expensive external heating. Moreover, steam in large excess is liable to produce a gas very high in carbon dioxide, and hence of comparatively little calorific value. Nor should it be forgotten that ammonia, under favourable conditions, is decomposed at a temperature far below that which is required to decompose water and reduce the carbon dioxide into carbon monoxide. The practical operation, therefore, must be so conducted as to maintain the proper heat, make the conditions for the decomposition of ammonia as unfavourable as possible, and, at the same time, produce such a gas as is required in the metallurgy of iron and steel where rapidity of heating and melting, with the lowest percentage of waste, is a prime consideration.

The author has found that when high pressure steam is moderately superheated and evenly distributed and diffused in the glowing mass, a limited supply of air, drawn into the generator, is sufficient to maintain the temperature needed to admit continuously from 1 lb. to $1\frac{1}{2}$ lb. of high pressure steam to the pound of coal, and that this proportion of steam is ample to provoke the necessary reactions which

transform into ammonia 50 to 60 per cent. of the total nitrogen of the coal, and still to produce a gas of the following composition:—

	Per Cent.
Carbon dioxide	10.50
Oxygen	1.00
Carbon monoxide	29.00
Methane and homologous compounds	4.50
Hydrogen	38.00
Nitrogen	26.00
	100.00

This gas is rather high in carbon dioxide, but the total of combustible matter is considerable, and the efficiency of the gas in a regenerative furnace for heating iron is very great. It burns with a sharp, white-bluish flame, not without luminosity, and heats more rapidly and more economically than the ordinary Siemens gas.

It would seem, at first glance, that the admission of 1 lb. to 1.75 lb. of steam to the pound of coal would have a high cooling effect, hindering the steady production of a gas of the above composition, if the carbon is taken as the only source of heat. Practice shows, however, that such is not the case. There are different ways of accounting for this result. In the first place, independently of the heat furnished by the high-pressure superheated steam, many reactions producing heat occur, such as the formation of the ammonia, &c. On the other hand, the gas being exhausted at high speed, the operation takes place under a constant partial vacuum, with an apparent increased facility of the reactions, and subsequent distillation of the products. Whatever the explanation of this precisely is, the actual result is, that not only is there no cooling effect in the continuous production of the above gas, but that the temperature has a tendency to increase in the zone of combustion. If the steam has been sufficiently superheated and diffused thoroughly in that zone, it is practically all decomposed during the operation; and the reactions proceed without intermission, the liberated nitrogen being transformed in the presence of nascent hydrogen into ammonia, whilst the resulting fuel gas, as the above analysis shows, is still high in hydrogen.

The danger of the dissociation of the ammonia is not as great in practice as has been anticipated. If we remember in what infinitesimal proportion the ammonia is present, diluted, and hence practically protected by the other gases, it is evident that the chance of decomposition, with ordinary care, is very small. And if the product is instantaneously exhausted from the hot atmosphere, carried into the cooler zone immediately above, and led out through green fuel on the top, the ammonia is secured.

With well-devised producers and the proper plant, when the art of managing and controlling the heat of the different zones of the fuel bed has been mastered, there is no difficulty in producing regularly, with the proper amount of steam, from each ton of coal, 70 to 80 lb. of sulphate of ammonia; 130,000 to 150,000 cub. ft. of heating gas of high quality; and, in addition, some 15 to 20 gallons of tar, according to the nature of the coal.

The generator must be perfectly accessible, so that it may be easily cleaned, and the coal may be perfectly broken through. The aim should be to keep the fuel like a sponge, but without holes or large cavities. The advantages of a good stirring are obvious; it insures the complete diffusion of the steam through the glowing mass, maintains the high temperature in the lower part of the generator, and keeps the top cool, thus tending to secure economy in coal, the minimum of necessary cooling-surface in the condensers, and the maximum yield of ammonia. The carbon dioxide should be kept at a minimum. Its formation is a function of temperature; the lower the temperature at which the carbon and air or the carbon and steam come in contact, the more carbon dioxide is formed. It must not be forgotten that the depth of the fuel has a very important bearing on the condition and results.

In order to obtain good heating gas and the largest yield of ammonia and tar, the gas must be well cooled and well scrubbed. If the gas be not cooled, the quantity of water which it will suck from the washing apparatus is so great as to destroy the value of the gas for heating purposes, while

the ammonia, even if it be in the form of fixed salt or sulphate, is carried away, and the more volatile constituents of the tar are carried forward and settle in the conduits.

The system is entirely smokeless, and has the further advantage of taking the sulphurous acid very thoroughly out of the gas.—W. S.

Ignition Temperature of Electrolytic Gas. F. Freyer and V. Meyer. Ber. 25, 1892, 622.

See under XXIII., page 780.

PATENTS.

Improvements in or connected with the Manufacture of Illuminating and Heating Gas. W. H. Wilson, Waterloo, Lancaster. Eng. Pat. 5468, March 28, 1891.

ACCORDING to this invention tar is distilled and the resulting gases combined with coal-gas, the combination being effected in a chamber at comparatively low temperature. By this means the inventor claims that the illuminating quality of the coal-gas will not be injuriously affected.—D. A. S.

Improvements in the Method of Using Hydrocarbon Oils for Heating Purposes, and in the Arrangement and Construction of Apparatus and Appliances for such Purposes. E. N. Henwood, London. Eng. Pat. 10,320, June 17, 1891.

FOR the generation of steam, smelting of ores, &c., an apparatus consisting of a fire-brick furnace provided with an air-tight wrought iron or steel front is employed. Through an aperture in the iron front passes an arrangement consisting of four concentric tubes, each of which is provided with a stop-cock or valve, and a dial indicator, for regulating and indicating the quantity of oil, steam, or air passing into the furnace. The centre tube, through which steam is introduced, is provided with a taper plug at the end, so that its orifice is annular; the second tube is used for the introduction of oil, the third for steam, and the outermost for air; the steam and the air are preferably superheated. With this apparatus the most perfect combustion can be attained without smoke or noise from the blast.—F. S. K.

Improvements in the Manufacture of Gas for Illuminating and Heating Purposes, and in or connected with Apparatus therefor. J. H. R. Dinsmore, Liverpool. Eng. Pat. 11,740, July 10, 1891.

WHEN tar or other liquid hydrocarbon is converted into gas and mixed with crude coal-gas in a heated duct, the tarry deposits are so hard that they are with difficulty removed from the duct. If, however, the tar is gasified in one chamber of a heated duct, and then mixed with crude coal-gas in a second and separate chamber, the deposits do not become hardened, and the duct can be easily cleaned.

The apparatus used for carrying out this improved process consists of a retort or duct which is provided with two central, horizontal, partial diaphragms. The coal is distilled in the lowermost portion and tar is introduced at the back on to the top of the lower diaphragm which forms the top of the coal retort, and projects towards the mouth-piece. The tar-gas and the coal-gas pass towards the mouth-piece, and the mixed gas is then led above the upper partial diaphragm, where it is further heated and rendered permanent.—F. S. K.

Improvements in Appliances for Use with Incandescence Lamps. A. Heald, London. Eng. Pat. 14,752, September 1, 1891.

THIS is an improved method of suspending mantles for producing light by incandescence. The mantle is suspended from a bridge supported by a rod disposed centrally within the burner. An improved method of packing the mantle to prevent fracture in transit is also described.—D. A. S.

Improvements in Apparatus for Use in the Manufacture of Illuminating Gas. H. Williams, Manchester. Eng. Pat. 15,390, September 11, 1891.

AN improvement and simplification of the apparatus described in a former patent (No. 5434, 1890; this Journal, 1891, 626).—F. S. K.

A New Process of and Apparatus for the Manufacture of Illuminating Gas. C. B. de Lamarre, Biloxi, Mississippi, U.S.A. Eng. Pat. 6362, April 1, 1892.

THE method and apparatus claimed are briefly as follows:—From a steam generator, steam is passed into a decomposing-retort charged with coke or charcoal, the connection being by means of valved piping. There is then a main cooler; with an auxiliary cooler, a purifier and a carburettor interposed between the decomposing-retort and that main cooler. The main cooler is connected with the gasometer. The auxiliary cooler, purifier, and main cooler are in communication with the retort, carburettor, and each other, by piping with suitable valves, so that whilst the carburetted gas first only passes through the main cooler, later on it may receive a preliminary cooling in the auxiliary before carburetting and passing through the main cooler to the gasometer.

The carburettor is charged with the "necessary oil" or "spirits of petroleum," and the purifying material consists of "an alkaline solution of potash or chromate of potash" in one chamber of the purifier, and a solution of oxalic acid in the other. The first chamber with the chromate is said to arrest the sulphuretted hydrogen, which is retained by the chromium as "sulphide thereof."—D. A. S.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Homoprocatechin (Homocatechol) and Two of its Nitro-Derivatives. M. H. Coubin. Compt. rend. 115, 1892, 234–236.

THIS substance is obtained by treating the creosol of wood-tar with hydriodic acid gas at a temperature of 180° C., and subsequent fractional distillation. Below 230° C. any creosol which has not been acted upon by the gas passes over and may be used for a subsequent operation, the portion which passes over between 230° and 265° C. containing the homocatechol. The residue consists of resinous matters.

The product obtained between 230° and 265° C. is treated repeatedly with boiling water; the aqueous solution is filtered after cooling, and evaporated to a dark-brown syrup, which is dried over sulphuric acid for a considerable time and then purified by fractional distillation under reduced pressure. Most of it passes over between 210° and 215° at 190 mm. pressure in the form of a viscous, colourless liquid which solidifies to a white mass the more readily if some crystals from a preceding operation are introduced. This is homocatechol containing a little pyrocatechol; its fusion point is 49°–50° C. The author has prepared two nitro-derivatives from it as follows:—

Eleven grms. of homocatechol are dissolved in 500 cc. of ether, and little by little 4 cc. of fuming nitric acid are added. After about 24 hours the mixture is agitated with a little water, the ethereal layer separated, and distilled. To the residue of this distillation water is added, and the mixture re-distilled. The water which passes over is of a yellow colour and contains some oily drops. It is heated to bring this nitro-derivative into solution. It crystallises out on cooling in golden-yellow scales, which are only slightly soluble in cold water, but readily soluble in warm water, alcohol, and ether. About 79°–80° they melt, and begin to decompose about 180°. Alkaline colour then dark red.

The formula is $C_7H_7NO_2$, which is that of a mono-nitro-derivative.

According to another method, 5 grms. of homocacchol are dissolved in 150 cc. of water, and to the solution 18.5 grms. of nitrite of soda are added, and then, little by little, hydrochloric acid so long as nitrous fumes are disengaged. The dark-red mixture is agitated with twice its volume of ether, the ethereal layer separated, and distilled. The brown residue of the distillation is dried over sulphuric acid and then treated with boiling benzene, which on cooling deposits very strongly-coloured crystalline crusts. These are purified by re-crystallisation from benzene and then by a series of crystallisations from dilute alcohol, when it forms little sulphur-yellow needles slightly soluble in cold water, but readily soluble in warm water, alcohol, ether, and benzene. It fuses and begins to decompose at about 180°. The formula is $C_{12}H_{10}NO_2$, like that of the preceding, and it is isomeric with it.

This body gives with an excess of alkali a beautiful purple colouration resulting from basic combinations, which have not been obtained in crystals. If to a solution of this body either potash or ammonia are added little by little until the liquid begins to turn purple, on cooling beautiful orange-yellow needles are obtained, which are monobasic alkaline salts easily purified by successive crystallisations from water. The potassium salt was found to have a composition agreeing with the formula $C_{12}H_6KNO_4 + H_2O$.—J. H. C.

The Composition of Liquid Ammonia of Commerce, and the Manufacture of Liquid Ammonia of 99.995 per cent. Strength. H. von Strombeck. J. Frank. Inst. 1892, 134, 58—64

If the so called chemically-pure liquid ammonia be allowed to evaporate in a vessel connected with an inverted condenser kept cool by a freezing mixture, an alkaline yellow fluid of penetrating odour is obtained, mixed with crystals of ammonium sesquicarbonate. The yellow fluid is a constant product from whatever source the ammonia is derived, but the sesquicarbonate occasionally dissolves instead of assuming the crystalline state. By saturation with hydrochloric acid gas and removal of the excess with lime a neutral liquid is yielded, which is still yellow from the presence of traces of lubricating oil. On distillation at a pressure of 200 mm. at 40—50° C. a colourless liquid passes over, the mineral oil remaining behind. Mineral matter, such as sand, oxide and sulphide of iron, is also sometimes to be found, the average composition of six samples of liquid ammonia derived from different sources being as follows:—

	Per Cent.
Ammonia (by difference)	98.745
Moisture	0.014
"Colourless fluid"	1.116
Sesquicarbonate	0.052
Oil	0.011*
Mineral matter	0.002
	100.000

This "colourless fluid" has a specific gravity of 0.7948 at 15.5° C., is miscible with water and burns with a slightly luminous flame. On fractional distillation, 14.9 per cent. was found to pass over at 74°—78° and 78.6 per cent. at 78—82° C., and it consisted chiefly of isopropyl alcohol, methyl and ethyl alcohol, acetone and methyl-ethyl-ketone being also present.

Metallic sodium having the property of decomposing these substances, as well as the water and the ammonium sesquicarbonate with the formation of ammonia and hydrogen as the only volatile products, the author has devised and patented (U.S. Pat. 477,089) a process for the production of liquid ammonia absolutely free from every foreign substance except the lubricating oil, *i.e.*, of, on the average, 99.995 per cent. purity, the increase in the cost being only about 2.5 per cent. The ammonia gas, manufactured in the usual manner, is freed from water as completely as possible and led through two vessels containing sodium kept liquid by means of steam-jackets,

whence it is drawn into the compressor and liquefied in the usual way. To avoid, however, the extra work on the engine caused by the presence of the hydrogen evolved during the reaction, the gases may advantageously be passed over palladium black or gauze, for although this is a very expensive material, 1 lb. costing about 80*s.*, by a suitable arrangement of cocks, air may be periodically led over the palladium, removing the absorbed hydrogen and making it fit for use over again. In this way probably $\frac{1}{2}$ lb. of palladium would be the extreme amount required even for the largest plant.

The author gives as an additional advantage of this process the opinion that the terrific explosions occurring every now and then in the refrigerating plant would thereby be done away with, as he holds that they are in all probability due to the presence of the alcohols and ketones, which during compression are converted into hydrocarbons, &c., by the thermo-electricity developed between the tin solder of the joints and the iron of the rest of the apparatus. On this subject he is still experimenting.—F. H. L.

The Coal-Tar Industry during the Year 1891. Chem. Ind. 15, 1892, 145—149.

DURING the first nine months of the year 1891, the coal-tar trade was fairly brisk, but at the end business fell off, and owing to speculation as well, prices fell very considerably, in some cases as much as 50 per cent. Fifty and 90 per cent. benzene which in January were quoted at 3*s.* 6*d.* and 4*s.* 9*d.* per gallon respectively in London, in December were only worth 1*s.* 9*d.* and 2*s.* 2*d.*; and phenol, which, as a disinfectant, has suffered much from Koch's publications in past years, was being sold in December at 5*d.* per lb. (34°—35° crystals). The use of naphthalene for carburetting gas has greatly fallen off, owing to the competition of the various regenerative burners, and although it is being used in the manufacture of explosives such as Favier's (this Journal, 1888, 549 and 589), as is also the case with phenol, the consumption in times of peace is too small appreciably to affect the price. Anthracene, too, has fallen off from 1*s.* 3*d.* to 1*s.* per unit, and the demand has been very small. On the other hand, the "denaturing" bases have increased 25 per cent. in value, and, according to Delbruck, the consumption has gone up from 43.1 to 53.1 million litres per annum in Germany.

Recent reports of The Gas Light and Coke Company show that petroleum products have been largely used in gas manufacture, and this, *inter alia*, it is thought, may be taken as a sign that the public are far from satisfied with the illuminating power of the gas usually supplied: the great interest displayed in the Dinsmore process (this Journal, 1889, 960, and 1890, 442) which is said to have proved unsuccessful (this Journal, 1891, 685) also points in the same direction. The result of this dissatisfaction may well be that in the future, gas manufacturers will have to keep the whole of their benzene in the gas, and so the depreciation of price, which must otherwise undoubtedly occur owing to the increasing amount of benzene produced by the coke ovens, may be avoided. Should, however, the benzene of the gasworks remain on the market, the question arises as to the lowest price which will pay the owners of the coke ovens for the pure article, and this may be taken in England at about 3*s.* 6*d.*, and in Germany at 2*s.* 6*d.* per gallon.

Pearson's Creolin (this Journal, 1886, 274) and Lysol (this Journal, 1890, 1136) are said not to have proved as successful as could be wished, the cloudy or opaque nature of the preparations, as well as the free or loosely combined alkali they contain militating largely against their employment by the medical world. Should however, the new efforts to use cresol in a perfectly soluble form (this Journal, 1891, 722) be more successful, this hitherto neglected product may rise considerably in value. Hand Smith's process (this Journal, 1889, 553) for assisting the solution of resins, such as copal, by previous treatment with benzene or phenol, may also turn out valuable, as is also the progress made in the employment of highly nitrated tar hydrocarbons as explosives (this Journal, 1888, 588; and

* Eliminating one sample the average amount of oil was 0.005 per cent.

1891, 1028). Paramidophenol has been found to be a good developer for photographic work, and anthranilic acid is being used for the manufacture of artificial indigo (this Journal, 1891, 831).

On the more scientific side of the coal-tar industry more advances have been made during the past year, among which the following may probably become of technical importance. Liebermann has found in phenylhydrazine (this Journal, 1891, 578) a new reagent, much more delicate than the old alcoholic potash, for the detection of carbon bisulphide in benzene, from which impurity few commercial samples are now shown to be free. Étard and Lambert have isolated (this Journal, 1891, 688) pyropentylene, the last of the three members of the indene group (this Journal, 1891, 38); this being of special interest owing to Wallach's researches on the similarities between it and the terpenes (this Journal, 1891, 850). Baur has finally settled the composition of artificial musk (this Journal, 1890, 964, and 1891, 1024), and found it to be an isopropyl compound (this Journal, 1892, 305). Noëling has discovered that ethylbenzene is present in small quantities in commercial xylene (this Journal, 1891, 912); and Bizzari, by reducing eumaron (this Journal, 1890, 275) to amidophenanthrene, has shown its close relationship to chrysene and phenanthrene. Wiechelsaus, by a new study of that portion of coal-tar which boils at 240° , has discovered a better method for the production of α - and β -methyl-naphthalene. Elbs has assigned to paranthracene the molecular weight 303 (this Journal, 1892, 340), whence its formula appears to be $C_{28}H_{20}$.

Among the oxygen compounds of coal-tar, phenol only has been investigated, and this merely with regard to its reddening in air and light. Fabini has assigned to this colour the name phenerythrene (this Journal, 1891, 453 and 800), but he has not actually isolated such a body, nor proved that his artificially produced colour is really the same as the natural one, for the reddening takes place even in phenol absolutely free from metallic salts. Schwarz has improved the synthetical process for the production of β -picoline from glycerol and ammonia, and has also obtained small quantities of the α -compound; and Ladenburg's experiments on the addition products of pyridine (this Journal, 1891, 848) promise to yield highly interesting results regarding the constitution of many alkaloids. The formation of carbazol from orthodiamidophenol has been recently successful (Täuber, this Journal, 1890, 1123, and 1891, 630), while Blank had previously obtained it in another way from ortho-amidophenol (this Journal, 1891, 336). Kramer and Spilker's work on the condensation products of methylated benzene and allyl alcohol and the production of artificial lubricating oils (this Journal, 1892, 22), promises to be of great importance.

Taken as a whole—having regard to the competition of the coke ovens on the one hand and of the electric light on the other, the outlook for the tar trade is not so bright as it has been in past years, and there is no doubt that it is passing through a period productive of great anxiety to those connected with it.—F. H. L.

The Production of Heating Gas and Ammonia. A. Hemin. Chem. Trade J. **11**, 147—148.

See under H., page 731.

PATENTS.

Improvements in Coke Ovens. H. H. Leigh, London. From T. Bauer, Berlin, and G. Mendheim, Munich. Eng. Pat. 12,396, July 21, 1891.

This patent relates to improvements in the construction of coke ovens, worked either with or without extraction of by-products. The essential feature of the invention is a new arrangement of the air-heating chambers, through which the products of combustion are led in order that their heat may be utilised for raising the temperature of the fresh-air supply.—F. S. K.

Improvements in and Relating to Retorts for Distilling Shale and like Minerals, and for Dealing with the resulting Products. R. Orr and R. M. Sutherland, Linlithgow. Eng. Pat. 15,552, September 14, 1891.

THE principal improvement here described is a new method of discharging the spent shale from the bottom of the retorts into a lower hopper chamber, whence it is delivered vertically through the door of a hopper to the removing hutches.

For a description of the apparatus the original must be consulted.—F. S. K.

Improvements in the Purification of Pyrolignites. F. H. Pickles, Fairfield, and R. H. Pickles, Marple. Eng. Pat. 20,753, November 28, 1891.

It is proposed to separate the pyrolignites (such as crude sodium acetate, wood acid, and black-iron liquor) from the tarry matters accompanying their production by treatment with carbonaceous matter, or with residues containing the same. The residues obtained in the manufacture of potassium prussiate, or those by calcining animal matter alone with the carbonates or hydrates of the alkalis, are specially adapted for this purpose. The *modus operandi* consists in heating up to boiling point a pyrolignite containing about 25–30 per cent. of impurities with about 50 per cent. by weight of the residue; the liquor is then settled, filtered, and concentrated.—H. A.

IV.—COLOURING MATTERS AND DYES.

On Diamidosulphobenzide and some of its Derivatives. Ch. Lauth. Compt. rend. **114**, 1892, 1023–1024.

DIAMIDOSULPHOBENZIDE, $SO_2(C_6H_4NH_2)_2$, is easily prepared as follows:—Sulphobenzide is dissolved in three times its weight of nitric acid (48° B.) mixed with five times its weight of sulphuric acid; the mixture becomes very warm, and is kept warm for half an hour. On cooling it crystallises, the crystals are washed with water and, after the removal of the acids, are treated with alcohol until the melting-point of the product reaches 197° C. The dinitrosulphobenzide thus obtained is reduced by warming it with one and a half times its weight of tin and three times its weight of hydrochloric acid; after the reduction is complete the tin is removed by H_2S ; the liquid is concentrated on a water-bath and the base precipitated by ammonia. After one or two crystallisations from benzene or alcohol the product is absolutely pure. It forms rhomboidal prisms, melting at 165 – 170° C. soluble in water, alcohol, and benzene when warm, and separating out on cooling. It is not attacked by zinc and sulphuric acid; attempts to obtain paramidodithiophenol in this way were unsuccessful. It readily yields diazo-derivatives when treated with nitrite of soda in presence of hydrochloric acid, and these when acted on by the usual reagents yield beautiful colouring matters. A list of these dyes is given (orange, scarlet, brown, and violet colours), but the author adds that they do not appear to be superior to others which are already known. Contrary to his expectation they have no affinity for cotton.—D. E. J.

On Azo-Compounds and Colouring Matters derived from Chrysianiline. A. Trillat and de Raczowski. Compt. rend. **114**, 1892, 1024.

DIAMIDOPHENYL acridine, $C_{19}H_{11}N_3$, is easily prepared by dissolving commercial phosphine, which is generally impure, in a large quantity of acidulated water and pouring it slowly into a dilute solution of carbonate of soda with continual agitation. The base is thus obtained in the form of a yellow powder. It is diazotised by dissolving it in dilute acid, and adding sodium nitrite in the cold. The tetrazoic

compound obtained has the same properties as those of the diazobenzene class, and easily yields, by the usual methods, compounds with the amines, phenols, &c.

It was of interest to discover if this colouring matter derived from tetrazochrysaniline could enjoy at the same time the stability of chrysaniline and the brilliancy of the tetrazo-colours. The best results were obtained by combining tetrazochrysaniline with disulphonaphtholate of sodium. Disulphonaphtholazochrysaniline is, when freshly prepared, a green powder with metallic reflex. It is insoluble in alcohol, but very soluble in water, to which it imparts a magnificent red colour. The compounds with the sulphophenols give shades varying from rose to bright red. They dye silk well, but wool very badly. Non-mordanted cotton does not take the colour; and even when mordanted with tannin it only receives the colours faintly. In solidity, brilliancy, and resisting power the colours are inferior to those of chrysaniline.—D. E. J.

An attempt to place the Manufacture of Ink on a Scientific Basis. W. Inglis Clark. Chem. and Druggist, July 30, 1891—152.

Towards the beginning of this century a Dr. Lewis made some attempts to place the manufacture of ink on a satisfactory basis, and he succeeded so far as to determine that an excess of iron salt in the ink is detrimental to its permanence, such ink becoming brown on exposure. Three parts of galls to one part of ferrous sulphate were the proportions which he fixed upon as the best. He did not use boiling water in extracting the galls, and this has to be taken into account in considering exact experiments, for cold water would not, as he used it, extract more than half of the gallo-tannic acid from the galls. This observer was the first to introduce logwood as a tinctorial agent, and he made the interesting and important observation that acetic acid in the men-struum provides an ink of greater body and blackness than sulphuric acid does—a circumstance due to the smaller resistance of acetic acid to the formation of iron gallo-tannate. This observation has since been utilised by dyers. In 1798 Ribancourt determined that an excess of galls is quite as injurious to the permanence of ink as an excess of iron, but Dr. Clark's research does not sustain his explanation that this is due to the reducing action of the gallo-tannic acid. Dr. Bostock communicated a paper to the Society of Arts in 1830, in the course of which he stated that the tannin, mucilage, and extractive matter are "without doubt the principal causes of the difficulty which is encountered in the formation of a perfect and durable ink. For a good ink the essential ingredients are gallic acid and a sesqui-salt of iron." In this point Dr. Bostock peculiarly hit the mark. Owing to his working with galls he was unable to make decisive experiments, but he concludes, and that rightly, that in proportion as ink consists merely of gallate of iron it is less liable to decomposition and any kind of metamorphosis.

The introduction of blue-black ink is the next phase of the development towards modern methods which is noticed. The object of adding a dye is to give temporary colour to the ink, and, as indigo-paste is used, it has been assumed that this keeps the iron gallo-tannate in solution. Any virtue of this kind which indigo-paste possesses is more likely due to the sulphuric acid which it contains than to the indigo itself. The essential part of the paste required is the sulpho-indigotate of sodium, now commonly called indigo-carmin. The commercial paste contains varying proportions of free sulphuric acid, and it is essential in ink manufacture that only the minimum of this constituent should be admitted. It is somewhat difficult to determine the proportion of acid present by the ordinary alkalimetric methods, but, by treating a known weight of the paste with excess of barium carbonate, and absorbing the evolved carbonic dioxide in a weighed potash bulb, the amount of sulphuric acid can be accurately obtained. Three samples of paste, which were found to be very suitable for ink making, gave the following figures:—

Sample A, 0.45	per cent. CO_2	= 1.0	per cent. H_2SO_4
" B, 0.319	"	= 0.71	"
" C, 0.255	"	= 0.52	"

The paste should not, therefore, contain more than 1 per cent. of H_2SO_4 , and when it is remembered that as much as 40 per cent. has been found in commercial paste, the importance of watching this factor becomes apparent. An excess of acid in the ink corrodes the pens, delays the darkening of writing, and sometimes perforates the paper. Apart from these objections it was noticed in the course of the research that up to a certain point the addition of sulphuric acid was advantageous, and then just the opposite. This is shown by the following figures, obtained by exposing equal measures of an experimental ink (0.536 grm. each of tannin and pure FeSO_4 in 50 cc. water, plus the amount of acid indicated) in cylindrical jars:—

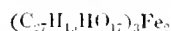
Acid added = CO_2	Time exposed.	Weight of ppt.	Per cent. of Fe in ppt.
Per Cent.	Hours.	Grm.	
0.0	214	0.1013	8.3
0.01703	618	0.0923	8.66
0.03406	618	0.0103	10.42
0.05109	618	0.0198	8.53
0.06812	2,000	0.0000	0.00

The stability of an ink precipitate depends upon the amount of iron which it contains, and which on no account should be less than 8 per cent. More than the highest amount of acid above indicated throws down a white granular precipitate.

Similar experiments to the foregoing with gallic acid revealed the fact that no precipitate whatever is obtained under precisely similar conditions. This point followed up explained in a measure why a gall infusion prepared with hot water is not suitable for a blue-black, whilst a cold-water infusion is. In the latter case a comparatively small percentage of tannin is extracted from the galls, while much is extracted with hot water, and the consequence is that on adding the indigo-blue the colour of the latter is not brought out as it should be. Substantially the same thing occurs with ink made with the respective acids, although the blue colour remains for a considerable time unimpaired in a tannin ink, and it appears to be due to the fact that ferrous tannate reduces indigo-blue to indigo-white, a change which the low reducing power of ferrous gallate does little to effect. The vegetable matter present in common inks facilitates the destruction, or, rather, alteration and precipitation, of the indigo, for the dye appears in the iron precipitate, and may be extracted from it with boiling water.

The investigation having demonstrated the superiority of tannin and gallic acid to galls, the opportunity was taken to determine the correct ratio of tannin and sulphate of iron to be used for ink. As in experiments previously mentioned, samples of ink were made containing different proportions of essential ingredients, exposed, and the percentage and nature of the precipitate determined. The results show that:—

1. The amount of precipitate increases as the proportion of iron to tannin is increased.
2. The composition of the precipitate is so variable as to preclude the possibility of its being a definite body. Increase of iron in the solution has not at first any effect on the composition of the precipitate, but afterwards iron is found in it in greater but not proportional amount.
3. At one point the proportions of iron in the precipitate and in solution are the same, and this is at between six and ten parts of iron to 100 parts of tannin.
4. The proportion of iron in the precipitate varies with the length of time the ink has been exposed. At first the precipitate contains 10 per cent. of iron, but by-and-by a new one having only 7.5 per cent. is formed, and in from 40 to 70 days we find one of 5.7 per cent., resembling—



Simultaneously iron increases in the ink (proportionate to the tannin). These results differ markedly from those of Wittstein, recorded in Gmelin's "Chemistry."

5. These results show, and practice confirms, that 16 parts of iron (80 ferrous sulphate) and 100 parts of tannin are best for ink manufacture.

The research now travelled in a direction which accumulating experience showed to be obligatory. Blue-black tannin ink lost colour, and the reducing nature of the tannin tended to the formation of a highly objectionable precipitate in the ink, which made writing anything but a pleasure. These two faults were doubtless linked together in some way, and seemed not to exist when gallic acid was used, for ink so made was found to precipitate only after long exposure, it required no free acid to keep the precipitate in solution, retained the indigo-blue colour for a long time, alkalis did not decompose the ink, and provided blacker and more permanent writing. It is also notable that one of the most popular English blue-black writing inks is a gallic acid one. Determination of the correct proportions of gallic acid and ferrous sulphate to use was the subject of prolonged experiments, which were conducted on similar lines to those already detailed. The conclusions as to precipitation were also similar. Thirty parts of iron (150 of ferrous sulphate) and 100 parts of gallic acid were found to be the most suitable proportions for ink-making. It is advisable, however, not to discard tannin altogether, owing to the slow blackening of the gallic-acid ink, and a little tannin gives initial blackening and body, while it is absolutely necessary

for copying-ink. Initial blackness can also be ensured by oxidising 24 per cent. of the ferrous sulphate without adding the extra acid necessary to the formation of a ferric salt.

The concluding portion of the research was devoted to the influence of sugar upon the permanence of ink, and the results of the experiments are summed up in the following sentences:—"It would be injurious to add 3 per cent. of sugar to a tannin ink, while from 4 to 10 per cent. would be quite allowable. Most copying inks contain about 3.5 per cent. of sugar—not far from the critical amount. With gallic acid more than 3 per cent. of sugar hardly varies the precipitate, but the importance of this point is somewhat diminished by the fact that the presence of sugar is by no means necessary in a writing-ink. Dextrin is a much superior substance to use. Curiously this body rapidly precipitates a tannin ink; hence it is useless for copying-ink, but for the gallic ink it is an excellent thickener."—W. S.

The Manufacture of Nitrobrumfluorescein. O. Mühlhäuser. Dingl. Polyt. J. **284**, 1892. 95.

Eosin is nitrated by the action of sodium or potassium nitrate and acetic acid, the operation being conducted in a pan A (Figs. 1 and 2) set in a water-bath, and the

Fig. 1.

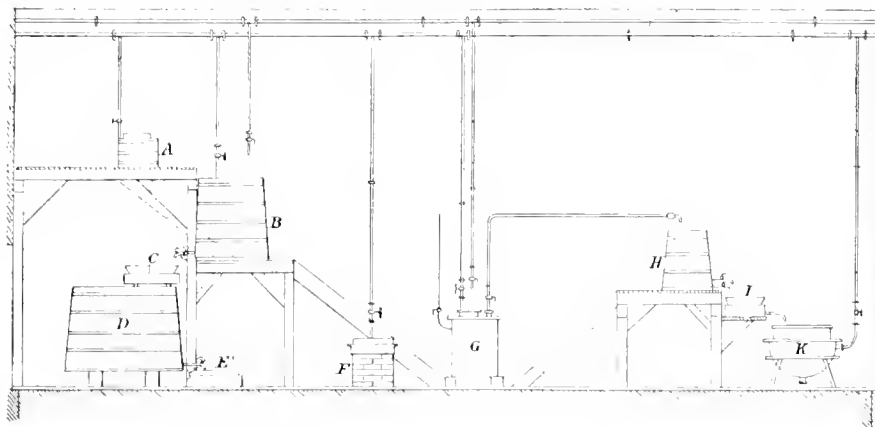
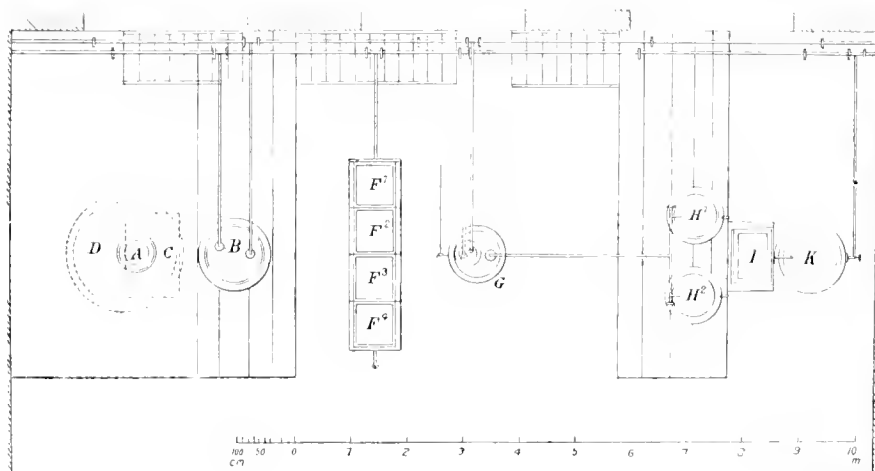


Fig. 2.



product being freed from acid by repeated washing with water in the wooden tub B. The precipitate is collected on the filter C, and the water used in washing allowed to stand over night in the vat D, the colouring matter still remaining in suspension being deposited and collected on the filter E, the contents of which are worked up in the succeeding operation, while the bulk of the material is dried on the drying plates F. The resulting nitro-eosin is then treated with dry ammonia gas in order to render it soluble. (O. Mühlhäuser, this Journal, 1892, 676). Should the eosin used have been somewhat impure, the free acid is treated as follows. The colouring matter is digested in the vessel G with a solution of soda insufficient for its saturation, blown over into the tub H, allowed to settle and deposit the undissolved portion of the colouring matter, and the solution passed through the filter J into the jacketed pan K, and evaporated to dryness. The potassium salt of the colouring matter may be obtained by decomposing the solution of the sodium salt in K with potassium carbonate solution. The colouring matter, however prepared, is finally ground in a ball mill or edge runner.—B. B.

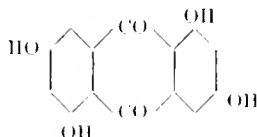
Determination of the Quantity of Indigotine in Commercial Indigo. O. Müller. J. Russ. Chem. Soc. 24, 1892, 275.

See under XXIII., page 778.

PATENTS.

Improvements in the Manufacture of Colouring Matters Derived from Anthraquinone. B. Wilcox, London. From The "Farbenfabriken vormals-F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 13,677, August 13, 1891.

This patent describes a new method of preparing hexahydroxy-anthraquinone (Eng. Pat. 18,729 of 1890; this Journal, 1891, 917) by applying the oxidising process mentioned in Eng. Pat. 8725 of 1890 (this Journal, 1891, 537) to the anthrachrysone first obtained by Barth and Semhofer (Annalen, 164, 109—115) by heating symmetrical dihydroxy-benzoic acid ($\text{CO}_2\text{H}:\text{OH}:\text{OH} = 1:3:5$) with or without sulphuric acid. From the method of its formation anthrachrysone would appear to have the formula—



If this compound be treated in a sulphuric acid solution with a large excess of sulphuric anhydride, the sulphuric ether of a compound is produced which bears the same relation to anthrachrysone that purpurin does to purpuroxanthin and is in fact hexahydroxyanthraquinone identical with that obtained by oxidising alizarin bordeaux with sulphuric acid or anthraquinone with sulphuric anhydride. Anthrachrysone possesses little value for dyeing with mordants, giving a pale red with alumina and a yellowish-brown colour with chromium whilst the new product gives a pure blue with the latter mordant on wool. Anthrachrysone dissolves in sulphuric acid with a red colour, in alkalis with a yellowish-red, and in baryta water with a brownish-red colour. The new product dissolves in sulphuric acid with a bluish-red colour, the solution having a vermilion-red fluorescence. The solution in alkalis is blue and barium salts give a bluish-black insoluble lake. By the action of fuming sulphuric acid on anthrachrysone one of the products obtained is the neutral sulphuric ether of the above dyestuff which can be converted into the colouring matter either by the action of alkalis and boiling with dilute mineral acids or by heating with sulphuric acid of 60° B. The following quantities are given for producing the dyestuff from anthrachrysone. 10 kilos. of anthrachrysone are added slowly at a low temperature to 200 kilos. of fuming

sulphuric acid containing 80 per cent. of SO_3 , and the mixture is allowed to stand for about four days, when it is diluted with 1,500 litres of ice-water. The precipitate is filtered off, dissolved in about 1,500 litres of water and a slight excess of soda lye and boiled. Sulphuric acid is then added in excess and the boiling continued for about half an hour, after which the colouring matter is filtered off and washed. It is not necessary to separate the anthrachrysone as the process can be worked through starting from dihydroxybenzoic acid by dissolving this substance in 20 parts by weight of the above fuming sulphuric acid and allowing the mixture to stand until the sulphuric ether of the hexahydroxyanthraquinone is formed, after which the melt is worked up as already described.—T. A. L.

The Manufacture and Production of New Dyes related to the Rhodamine Series. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 14,723, August 31, 1891. (Second Edition.)

The tetra-alkylated rhodamines when heated by themselves or with certain other substances lose one or more alkyl groups, and give colouring matters which dye yellow shades than the original compounds. Some typical examples are given. About 3 kilos. of tetra-ethyl rhodamine are heated in an enamelled vessel in an oil-bath to 230°—235° C. for 2½—3 hours, or until the crystals form a pasty bronzy mass. The melt is then cooled, broken up, and dissolved in 40 litres of water acidified with hydrochloric acid. After filtering the solution is precipitated with salt. These operations are to be repeated until the desired purity of shade on dyeing is obtained, and the product is then recrystallised from water. Another method is to heat about 3 kilos. of the rhodamine with an equal weight of aniline hydrochloride to about 190° C. for 2 hours. The melt is then worked up as above. The same reaction takes place if the rhodamine be heated under pressure with very dilute sulphuric acid at about 190° C., but in all these cases it is necessary to watch the reaction from time to time, as prolonged heating ultimately destroys the colour-yielding products insoluble in water.—T. A. L.

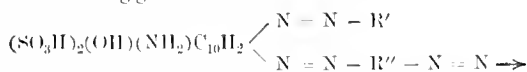
Manufacture of Blue Dyestuffs. J. A. Hewitt, London. From L. Cassella and Co., Frankfurt-on-the-Maine, Germany. Eng. Pat. 15,143, September 7, 1891.

ONLY green or bluish-green dyestuffs have hitherto been obtained from the diamido triphenylcarbinols. The present invention describes the preparation of pure blue colouring matters belonging to this class. They are obtained by condensing mono-methyl- or mono-ethyl-*o*-toluidine with *m*-hydroxybenzaldehyde, sulphonating the leuco bases and oxidising the resulting products to the colouring matters. A mixture of 12 kilos. of mono-ethyl-*o*-toluidine, 9 kilos. of hydrochloric acid (21 B.), and 5 kilos. of *m*-hydroxybenzaldehyde is heated for three days in a water-bath. After neutralisation with sodium carbonate and removal of the uncondensed oil by distillation with steam, the leuco base is filtered off, washed, and dried. The diethyldiamido-ditolylhydroxyphenylmethane thus obtained forms a nearly colourless crystalline mass melting at 153° C. It is easily soluble in caustic soda and also in dilute mineral acids. After powdering it is dissolved in 60 kilos. of sulphuric acid monohydrate and heated to 100° C. until a sample dissolved in water is no longer precipitated by sodium acetate. This takes about 4—6 hours, after which the melt is diluted with water and neutralised with calcium hydrate. The leuco sulphonic acid in the filtered solution is oxidised by the addition of 9.5 kilos. of lead peroxide and 20 kilos. of acetic acid. The lead is removed by the addition of sodium sulphate, and after filtering salt is added which precipitates the colouring matter. It dyes wool and silk a very pure blue. Other oxidising agents, such as bichromates, may be used in place of the peroxide.

—T. A. L.

Improvements in the Manufacture of Colouring Matters from Amido-naphthol-sulphonic Acids. S. Pitt, Sutton. From L. Cassella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 15,725, September 16, 1891.

AN extension of Eng. Pat. 6972 of 1891 (this Journal, 1892, 315) and referring to the employment in different ways of the amido-naphthol disulphonic acid II for the production of colouring matters. According to this patent one molecular proportion of the acid II is combined with one molecular proportion of a diazo-compound from aniline, amideazobenzene sulphonic acids, β -naphthylamine or its mono- or disulphonic acid, or from the nitrotoluidines. This combination takes place in an acetic acid solution, and when complete the whole is made alkaline and another molecular proportion of a diazo-compound is then run into the solution. By substituting a tetrazo compound for the second diazo-compound intermediate bodies are obtained of the following general formula—



which containing a free diazo-group are capable of combining with phenols or amines, &c. Another modification of the process is to combine a tetrazo-compound with the acid II (equi-molecular proportions of each) in presence of acetic acid and act with this intermediate compound on resorcinol, *m*-tolylene diamine, the chrysoidines, Bismarck browns, or *m*-hydroxydiphenylamine. These latter dyes

stuffs give brown shades on unmordanted cotton whilst certain of the combinations enumerated above give green, blueish-black, and violet-black shades.—T. A. L.

ERRATA.

Page 674, in description under Fig. 3, for "PLAN" read PLANT.

Page 675, col. 1, line 1, for "molten," read mother ;
line 10, for "plan" read plant.

Ibid., col. 2, in title, for "Müllhäuser," read Mühlhäuser.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

The Specific Rotatory Power of Silks of different Origins.
L. Vignon. Bull. Soc. Chim. 7, 1892, 139-141.

THE author has determined the optical activity of the sericin and fibroin contained in silks from various sources, in the manner described in a previous paper (this Journal, 1892, 427). The results are embodied in the following table:—

Nature of Substance.	Solvent.	Concentration.	$[\alpha]_D^{25}$.
1. Bombyx M. Var. <i>sericin</i>	Soda, 3 %	2.20	-38° 20
2. Bombyx M. China, <i>sericin</i>	"	2.80	-33° 40
3. Bombyx M. Japan, <i>sericin</i>	"	1.17	-51° 30
4. Yamma-Mai, Japan, <i>sericin</i>	"	2.18	-15° 10
6. Bombyx M. Tonkin, <i>sericin</i>	"	1.65	-67° 60
7. Bombyx M. Madagascar, <i>sericin</i>	"	1.32	-9° 00
8. Bombyx M. Bagdad, <i>sericin</i>	"	1.42	-35° 00
1. Bombyx M. Var., <i>fibroin</i>	HCl, 11 B.	3.96	-40° 00
2. Bombyx M. China, <i>fibroin</i>	"	1.00	-39° 50
3. Bombyx M. Japan, <i>fibroin</i>	"	4.00	-11° 40
4. Yamma-Mai, Japan, <i>fibroin</i>	"	1.00	-50° 00
1. Bombyx M. Var., <i>fibroin</i>	{ H ₂ SO ₄ , 66° B. 10 cc. Ice 20 cc. }	1.00	-56° 40
5. Bombyx M. China, "polyvoltin," 6th crop, <i>fibroin</i>	{ HCl, 22° B. 10 cc. }	1.00	-48° 20
6. Bombyx M. Tonkin, <i>fibroin</i>	HCl, 11 B.	1.65	-67° 50
7. Bombyx M. Madagascar, <i>fibroin</i>	"	1.00	-39° 10
8. Bombyx M. Bagdad, <i>fibroin</i>	"	3.99	-44° 20

The fibroin of "Yama-Mai" was found to be insoluble in hydrochloric acid; but soluble in cold strong sulphuric acid after some standing. The solution thus obtained is too dark for examination, but after the addition of ice, followed by hydrochloric acid, the colour disappears. *Bombyx M. Lar.* was examined under similar conditions for the sake of comparison.—H. T. P.

The Formation of Mildew in Woollen Goods. K. Schimke.
Färb. Zeit. 1892, 339.

THE formation of mildew in woollen, as in cotton goods, is due to the development of fungoid growths in the presence of air and moisture at a certain temperature. The most favourable time for the appearance of these fungi is in summer, and especially in the month of August they occur very frequently. Certain dyes like vat-blue are particularly liable to this growth, probably on account of the alkaline reaction of the dye-liquors. The danger can only be

avoided by not allowing the goods to lie in a heap for any considerable space of time. One of the primary causes of mildew can frequently be observed in the process of weaving moist cloth. Two different kinds of fungi may appear at this stage, according to whether the fabrics remain cold or get hot. In the first case the fibre is not attacked or disintegrated, and also the fungoid growth often extends over a considerable area. Dark shades are hardly ever affected. The mildew can easily be brushed off. Much more serious is the second kind, which appears in the form of smaller or larger patches, generally disintegrating the fibre. Mildew stains of this kind show after the milling as bare patches, and the fibre appears quite rotten. The same stains often are caused through the cloth, after the milling process, being left to lie unwashed. Undoubtedly the highly-alkaline reaction of the cloth at this stage is very favourable to the growth of the fungus. There occur, however, other stains in woollen cloth, which in their appearance are very much like mildew stains, but are due to quite different

causes, and only a microscopical examination can reveal the true nature of the stains. Under the microscope the fibre of mildewd wool is found to have lost its characteristic scales almost entirely, and to be split or dissolved into numerous individual cells, so that the ends of the fibres possess the appearance of a brush (Fig. 2), Fig. 1 representing the normal appearance of milled wool fibre. Such mildew stains are, in dyeing, quite indifferent to colouring matters, so that according to the degree to which the fibre has been affected the stains appear after dyeing of a lighter colour than the rest of the cloth, or they may remain altogether undyed. The behaviour of mildew stains towards various dyes was found as follows:—

Scarlet, dyed in one bath with cochineal, tin crystals and oxalic acid.	White spots of varying size.
Billiard-cloth green, dyed with acid green, sulphuric acid and Glauber's salt.	White spots, fibre very rotten.
Moss-green, dyed with indigo-carmin, fustic and alum, in one bath.	Light, greenish-yellow stains, the pile of which is entirely destroyed.
Vat-blue topped with logwood L.	Large and small stains, dyed an uneven light blue.
Vat-blue, medium shade	Irregular white spots.
Dove-grey dyed with alizarin-blue S.W.	Pale-blue spots.
Dark-brown dyed in one bath with fustic and camwood, with copper and iron sulphate.	Large and small light-brown stains.
Logwood black with ferrous sulphate.	Light bluish stains.

Fig. 1.

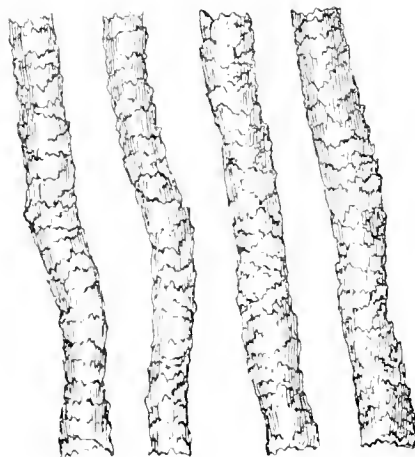
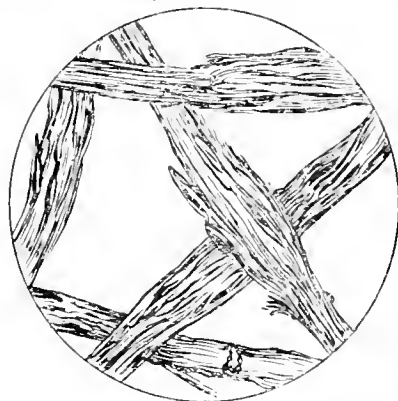


Fig. 2.



Fig. 3.



The mildew stains on the logwood black are very similar to the stains caused by soap remaining in the cloth in the washing. In all cases the microscopical examination of the above samples showed the scaleless and split fibres, as in Fig. 3.—C. O. W.

PATENTS.

An Improved Process for Cleaning, Restoring, and Bleaching Damaged Cotton or other Products from Cotton Seeds, Sponges, and all Textile Materials. W. H. Hughes and A. Rowbotham, Liverpool. Eng. Pat. 3960, March 5, 1891.

THE object of this invention is to restore, as far as possible, the quality of cotton damaged in harvesting or by sea-water, but the process is also applicable for the treatment of sponges and for other purposes.

As applied to damaged bales of cotton, an important part of the process is the opening of the bales. This is done by placing them in a keir, saturating the cotton with low-pressure steam, and then forming a vacuum. Sometimes the cotton is sprinkled with methylated spirits before being placed in the keir. The bleaching process consists in treating the material first with permanganate solution, and afterwards with sulphurous acid in the well-known way.—W. M. G.

Improvements in Arrangements and Mechanism of Apparatus for Dyeing and Bleaching and otherwise Treating Cotton, Wool, Silk, and other Fibrous Materials, in the Raw and Manufactured or partly Manufactured state. G. Young and W. Crippin, Manchester. Eng. Pat. 4928, March 19, 1891.

THE present specification consists of extensions, modifications, and improvements of Eng. Pat. 1157, 1890 (this Journal, 922, 923, 1891). Being based largely upon mechanical details it is not possible to give a clear idea of the present claims without a simultaneous view of the diagrams explanatory of the two patents.—W. M. G.

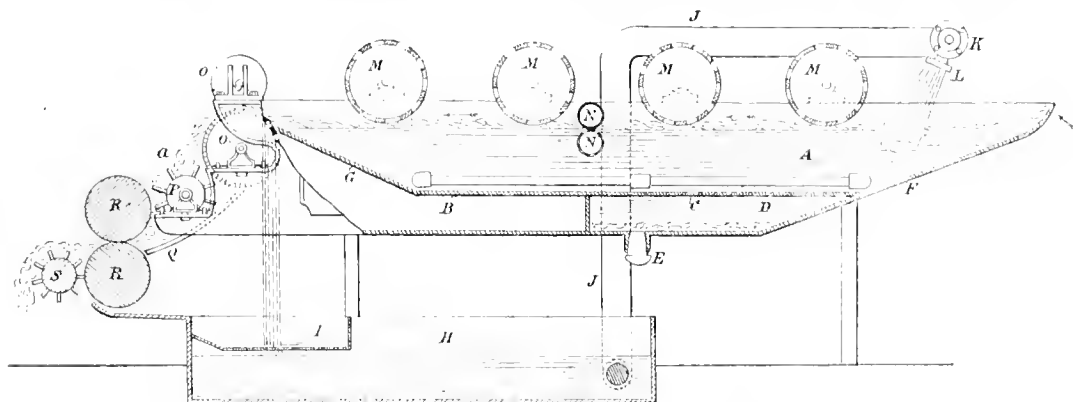
Improvements in Apparatus for Washing and Scouring Wool and other Fibres, such said Apparatus being applicable for Mordanting and Dyeing Wool and other Fibres, and also for Extracting or Separating Animal from Vegetable Fibre. J. and I. Smith, Halifax. Eng. Pat. 6601, April 17, 1891.

THE construction of the apparatus will be readily understood by reference to the accompanying illustration. The process-liquor is placed in tank H, from whence it is pumped up through pipe J, falling in a powerful spray through the rose L into tank A. Flowing along A the liquid falls over the end G through the strainer I back again into tank H. While the apparatus is in work the circulation of the liquid

in the direction indicated is continuous. The tank A is provided with a perforated false bottom which allows any sediment to collect in D.

The wool or other material is fed into the apparatus over the end F., and meeting with the spray (which extends

the full width of the tank) is wetted and opened out. It is then carried forward by the flow of the liquid, and is pressed underneath the surface by the perforated drums M. At the exit end it passes between the light nipping rollers G G, and lastly the heavy squeezing rollers R R.



MACHINE FOR WASHING AND SCOURING WOOL, &c.

It is claimed that this machine has a greater capacity than any at present in use, and that felting and breaking of the fibre is avoided. It is further stated that the apparatus is applicable to mordanting, dyeing, or carbonising operations.—W. M. G.

Improvements in Machinery or Apparatus for Cleansing and Lustring Dyed or Undyed Yarns of Silks, Cotton, or other Fibrous Substances. S. Fisher and H. Murgatroyd, Huddersfield. Eng. Pat. 6999, April 23, 1891.

THESE consist in certain structural modifications of the machines at present in use to overcome defects which experience has rendered evident.—W. M. G.

Improvements in Apparatus for Carbonising Shoddy. A. Hof, Dueren, Germany. Eng. Pat. 7461, April 30, 1891.

IN carbonising by the dry process it is usual to gasify the acid in a separate vessel and lead it into the extracting drums containing the shoddy, &c. The improvement consists in evaporating the acid by means of hot air in a portion of the drum itself, the acid chamber being separated from the space containing the material by a perforated plate. The acid is supplied in regulated quantity from a tank and enters the drum by a hollow shaft. The whole apparatus is covered in and is rotated by suitable means.—W. M. G.

Improvements in or Relating to Cellulose Manufacture. A. J. Boulton, London. From E. Rocca, Naples. Eng. Pat. 9139, May 29, 1891.

THE invention consists in a modification of the usual process for treating paper pulp, resulting in the production of a soft, porous, spongy substance resembling cotton wadding, which it is proposed to call "celluline."

Suitable proportions of fibrous cellulose and of cellulose from resinous plants are mixed together, and the mixture treated exactly as for the manufacture of paper until the pulp reaches the drying cylinders, from which it must be removed before it has quite lost its plastic state. The nature of the product depends upon the mixture of the raw material, the degree of purification, the thickness of the layer of pulp, and the heat used in drying.

The material is manufactured into felt, sponges, wadding, stuffing, &c., and may be made more flexible by addition of glycerin. When sterilised it may be used for bandages, &c.—W. M. G.

An Improved Process of Ungumming and Decorticating Textile Materials. A. M. Clarke, London. From La Société La Ramen, Paris. Eng. Pat. 10,556, June 20, 1891.

THE process is specially applicable to ramie or China grass, and has for its object the removal of the gummy pectic and extractive matter which cement the useful fibres together (retting). This is usual accomplished by the aid of alkalis, but in the improved process it is proposed to use basic borates, phosphates, arseniates, tungstates, molybdates, or more particularly manganates, stannates, or alkaline silicates.—W. M. G.

Improved Art or Process for Colouring Pictures on Textile Fabrics. A. Ophoven, Paderborn, Germany. Eng. Pat. 2939, February 15, 1892.

THE picture is produced upon the textile material by suitable chemical or mechanical means, and then Pastell colours corresponding to the design are rubbed into the texture of the fabric on the reverse side.—W. M. G.

Process of Treating Wool Washings. R. B. Griffin, Revere, Massachusetts, U.S.A. Eng. Pat. 8375, May 3, 1892.

THE wash-waters from wool-scouring are concentrated by evaporation and then mixed with an acid absorbent or "filler," preferably acid phosphate of lime. The mixture is heated until all the water is driven off, when the wool-grease may be removed by mechanical pressing or by extraction with volatile solvents. The remaining cakes retain all the potassium and ammonia salts originally contained in the wash waters, and thus form, in conjunction with the phosphate, a valuable manure.—J. L.

An Improved Fabric, applicable for Tubing, Belting, Valve Sheet, and other articles of Elastic Nature. R. Temmel, Berlin, Germany. Eng. Pat. 10,637, June 4, 1892.

See under XIII., page 759.

ERRATUM.

Page 680, col. 1, line 9, for "*Bombyx Dori*" read *Bombyx Mori*.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Some New Dyes fast to Milling and Washing. A. Kertész.
Färb. Zeit. 1892, 323—324.

UNTIL a few years ago the industries requiring dyes fast to milling and washing had only the natural colours to resort to, the reason, of course, being that the coal-tar colours then known did not stand those operations. The application of the alizarin colours on wool must therefore be considered a very happy idea, since, owing to their capability of forming insoluble lakes with various inorganic bases (mordants), these colours opened out quite a new field to the dyer of woollen fabrics. At present the alizarin colours are competing with the natural colouring matters with a considerable degree of success, and already a number of new dyes are coming forward, which although not belonging to the class of the alizarin dyes, also possess the valuable properties of being fast to milling and washing.

According to their chemical nature these dyes may be arranged into three different classes.

1. *The Tetrazo-Colouring Matters derived from Benzidine, or Benzdine and Diamine Colours of the Trade.*—It is well-known that the colours belonging to this group possess the valuable property of dyeing cotton without a mordant, and it has been found that these dyes are also capable of dyeing wool. The shades so obtained are all more or less fast to milling and washing, and are in this respect, without exception, superior to the ordinary wool scarlets, although frequently their fastness to light is deficient. This deficiency, however, is individual, it is not a property inherent in the group as a whole.

2. *Mordant-Dyeing Colouring Matters.*—Like the alizarin colours these dyes form fast chromium lakes. Whilst, however, the shades of the alizarin colours are only developed upon the fibre in the process of the formation of the lake, these dyes of the second class, independently of mordants, possess all the properties of colour. Our knowledge and the manufacture of these dyes is due to the efforts of Liebermann, Kostanecki, Witt, and Nietzki, who showed the formation of such dyes to be dependent on the presence in their molecules of two hydroxyl-groups in the ortho position.

3. *There exists a certain number of dyes fast to milling and washing which it is difficult to classify.*—The chemical constitution of these gives no clue to an explanation of their specific fastness under the above-mentioned circumstances. These colours possess also the advantage that they do not dye cotton, so that in the milling of mixed fabrics the cotton remains white. When dyed on a chrome mordant these colours probably become a trifle faster, without, however, the difference being very noticeable. These colours are dyed in an acid bath. As colours belonging to this class, particularly the diamine colours, must be mentioned, diamine-scarlet B, diamine-violet, and diamine-fast red being the best. Especially the latter, when dyed in a weak acid bath and topped with fluorchrome, is so remarkably fast to milling and light, that it is an excellent substitute for alizarin-red. Anthracene-yellow C is one of the mordant-dyeing colours, and therefore is best dyed on a chrome mordant, but it has been found preferable to chrome the wool after dyeing it. Anthracene-black produces without any mordant shades which are fast to milling. The colour also dyes on chrome-mordant, but the shades are not faster than without it. Anthracene-black in fastness to light is slightly superior to Alizarin-black.

Shades which are fast to milling may also be produced on cotton by means of the developed colours. Some of the substantive dyes are in themselves fast to washing, but not sufficiently to allow of their application in dark shades on milled goods. Some of these dyes possess, however, the property of being convertible, by means of nitrite of soda and hydrochloric acid, into diazo-compounds, and these again are capable of combination with

various amines and phenols. This fact was first realised by A. G. Green, and the well-known in-grain colours are the outcome of it. Many of the diamine colours can be applied in the same manner and by using Diamine-black RO, Diamine-black BO, Diamine-blue-black E, Cotton-brown N, or Diamine-brown V on the one hand, and combining it on the other hand after diazotisation with β -naphthol, naphthylamine ether, phenylenediamine, blue developer A N or fast blue developer A D, shades are obtained which are all very fast to milling, and also (especially the black and brown shades) very fast to light. These developed colours have already been employed on cops, skeins, hosiery, piece-goods, and velveteens with a considerable measure of success. It appears highly probable that the introduction of primuline and the developed diamine colours into the dyeing industry marks a new departure as important as the introduction of Magenta and Congo red.
—C. O. W.

The Tannins and Tanning Extracts and their Application in Dyeing Cotton. V. H. Soxhlet, Färb. Zeit. 1892, 325—346.

THE process of producing upon cotton shades varying from light grey to a greyish black, by treating the cotton successively in the solution of some tanning material and of certain iron salts, is certainly very old. With the introduction of the coal-tar colours the tannins became of very much greater importance on account of their property of fixing these colours, although the fugitiveness of the shades dyed in this manner was a great drawback. Not until the discovery of T. Brooks, that by treatment of the mordanted cotton in a bath of tartar emetic, the tannic acid could be fixed in the form of an insoluble compound, was it possible to produce fast shades with those colours. Naturally the colour of the tannin-antimony compounds obtained with the various tannins and tartar emetic, became now a matter of great interest to the dyer.

Examining the various commercial tannins a good idea as to their suitability for the purposes of the dyer can be obtained by means of comparative dye-tests. It is generally sufficient for this purpose to dye samples with the respective tannins and an iron salt, which shows not only the percentage of tannin contained in them, but also supplies information as to their most advantageous use in dyeing. When first the tannins were applied as mordants all basic aniline colours were dyed on a tannin-antimony mordant, to which later on for dark blue shades a passage through an iron salt was applied. To-day the tartar emetic bath has become obsolete in the production of dark shades, and after the tannin passage the yarns are taken through a bath of ferric sulphate, previously neutralised by the addition of a little chalk. With most of the blue basic dyes this method gives excellent results.

As the various tannin extracts vary considerably in strength it is necessary for the examination to reduce them all to a standard strength of 15° B. Those tanning materials which are still sold in the natural unextracted state are best carefully extracted and then evaporated on the water-bath until the standard strength of 15° B. is reached. The tannin extracted from galls is the type of those tannins which give blue or blue-black precipitates with iron persalts. The price even of the lower grades of commercial gallo-tannic acid is too high to allow of any general application. As it is, it is only used for light shades, but the beautiful dark bluish-black it produces with the persalts of iron would make it as useful for the production of dark shades of blue. Bleached gall-nut extract produces a remarkably white mordant with tartar emetic, and is particularly serviceable for the weighting of very light silks. The high price of this extract is prohibitive to its application in cotton dyeing. Sumac is no doubt the most generally employed and best known tannin mordant of the cotton-dyer. In spite of its low and varying percentage of tannin (from 15 to 25 per cent.) it is still used in very large quantities, probably on account of its accompanying impurities leaving the cotton fibre much softer than most other tannins. Decolourised sumac extracts are now manufactured which produce an almost white precipitate with tartar emetic.

Owing to the great liability of liquid extracts of sumae to ferment, whereby the tannic acid is converted into gallic acid, frequent examination is necessary, especially during the hot summer months. Purified chestnut extracts yield rather strongly-coloured precipitates with tartar emetic, and also the colouration with iron salts is darker than with either of the before mentioned tannins. Consequently for the dyeing of light shades with aniline dyes chestnut extract cannot be used, but its iron compound is all the more useful for the dyeing of dark blue and similar shades. Purified chestnut extracts have certainly not received the attention which they deserve, as with them no harshness of the yarns needs to be feared. Oak extracts, which are also sold in a purified form, are scarcely used yet in dyeing, although they may be recommended for their cheapness.

—C. O. W.

PATENTS.

Improvements in Machinery for Scouring, Dyeing, and Drying Hanks of Yarn. G. M. Marchant, Huddersfield. Eng. Pat. 12,908, July 30, 1891.

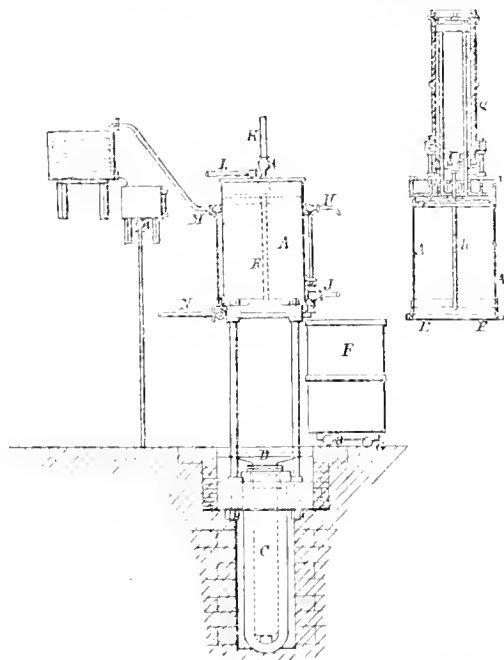
The hanks are slung on pairs of rollers attached to brackets which are carried by two discs, fixed near the ends of a horizontal driving-shaft. The whole apparatus is constructed to facilitate the transfer of the dye-frame and hanks from one vat to another. The brackets are adjustable to enable hanks of different lengths to be placed on the rollers. By means of cams, or otherwise, the brackets are caused to approach one another when submerged in the dye-liquor and to recede from one another when out of the liquor, to respectively decrease and increase the tension of the hanks. Hot air may be employed to dry the hanks after dyeing and whilst still on the rollers.

The mechanical arrangements are fully described in the original specification with the aid of four sheets of drawings.

—E. B.

Improvements in Apparatus for Bleaching or Dyeing Textile Materials and Fabrics or otherwise Treating the same with Liquids or Gases. D. Stewart, Glasgow. Eng. Pat. 16,463, September 29, 1891.

The goods to be bleached or dyed are placed inside a perforated shell F (see Figure), which is carried on a



APPARATUS FOR BLEACHING OR DYEING TEXTILES.

truck or on wheels on to the platen D of a hydraulic press C. The platen is then raised and the shell lifted into the vessel A, fixed directly above the platen which, when raised, tightly presses against the flanged bottom edge of A. H, J, K, L, M, and N are pipes, the first two connected respectively with a vacuum pump and steam boiler, and the rest with reservoirs or apparatus for supplying "bleaching or dyeing or other liquids or gases" and to vessels for receiving the same after application.

The shell F may be made with a central, perforated shell or tube, in which case a central, perforated pipe R is provided for the injection of the bleaching, &c., liquids into the goods, the liquids passing radially outwards through them. A piston P, actuated by hydraulic power, may also be placed within the vessel to express the excess of liquids from the goods.—E. B.

Improvements in the Bleaching of Vegetable Textile Materials. O. Muray, London. From H. W. Wilson, Lille, France. Eng. Pat. 16,700, October 1, 1891.

TEXTILE materials are simultaneously scoured and bleached by a solution of potassium or sodium hypochlorite, applied at a density of 1.01 to 1.03 and a temperature of 50° to 100° F., first under diminished pressure and then under a pressure of several atmospheres.—E. B.

Improvements relating to the Dyeing or Printing of Woollen and other Goods. H. H. Lake, London. From K. Oehler, Offenbach-on-Maine, Germany. Eng. Pat. 17,082, October 7, 1891.

WOOLLEN and mixed fabrics containing wool are dyed or printed aniline-black by oxidising the wool, and then padding or printing with a mixture, such as is commonly used for the production of steam aniline-black on cotton, and finally steaming. For oxidising the fibre, a 3 per cent. bath of hydrogen dioxide, rendered slightly alkaline with ammonia and at a temperature of 86° F., or a bath of 6 to 10 per cent. of bleaching powder, acidified with 9 to 15 per cent. of hydrochloric acid at 31 Tw., is employed. After this treatment, the fabrics are well washed, dried, and padded or printed, again dried, and steamed "for some minutes to three quarters of an hour or more," then washed and, "if necessary, soaped or passed through a weak acid bath." The following examples of appropriate padding and printing mixtures are given:—(Padding mixture) 405 grms. of "chlorhydrate of aniline or of toluidine or a mixture of both," 150 of sodium chlorate, 260 of potassium ferrocyanide, and sufficient water to make 3,150 cc., with the optional addition (to render the black more intense and to preserve the softness of the wool) of about 200 grms. of sugar and of glycerin, and some tartaric acid; (printing mixture) 800 grms. of dextrin solution (1 : 1), 200 of aniline hydrochloride, 75 of sodium chlorate, 130 of potassium ferrocyanide, 260 of water, and 40 of tartaric acid.—E. B.

Improvements in the Method of and Apparatus for Preventing the Escape of Noxious Gases in the Processes of Bleaching, and otherwise Treating Textile Fabrics. L. Kern, Hamburg. Eng. Pat. 22,263, December 19, 1891.

The hot gases are carried off from the bleaching (or carbonising, &c.) vessel by means of a pipe connected with a coke tower supplied with a spray of water or other liquid. By this means the gases are cooled, condensed, and absorbed, and a reduced pressure thus produced in the apparatus, which causes a considerable suction from the bleaching (&c.) vessel.

Diagrams are given illustrating the process as applied to the carbonising of woollen rags.—W. M. G.

Improvements relating to the Dyeing or Printing of Woollen and other Goods. H. H. Lake, London. From K. Oehler, Offenbach-on-Maine, Germany. Eng. Pat. 7638, April 22, 1892.

THE method of dyeing or printing an "ungreenable" aniline-black described in Eng. Pat. 17,082 of 1891 (see above) is applicable to hair and other animal fibres. Reserve-colours on an aniline-black ground may be produced on these fibres and on wool by a process "similar to that used in calico printing on the Prud'homme system." The materials are impregnated or printed with the aniline-black mixture, and, before being steamed, are printed with such "discharge" mixtures as the following:—(For white), 500 grms. of "leigomme" (dextrin) water (1:1), 200 of sodium acetate, 200 of potassium thiocyanate, 16 of "violet solution" (1:100); (for green), 250 of water, 50 of "benzol" green, 50 of glycerin, 250 of "leigomme," and 400 of sodium acetate. They are then steamed for 5 to 30 minutes, well washed, and in some cases (with the sulphonated dyes for instance) passed through dilute acid, again washed, and dried. As reserve colours for wool and mixed goods containing wool or silk, "most of the artificial dyes and the substantive natural dyes are suitable, but those requiring mordants are less suitable;" for mixed goods containing vegetable fibres, "basic dyes and dyes of the Congo group alone or combined with acid dyestuffs" are suitable.—E. B.

New or Improved Bleaching Compound. W. P. Thompson, Liverpool. From W. B. Brittingham, New York, U.S.A. Eng. Pat. 8964, May 11, 1892.

THIS improvement refers to the employment of alkaline tungstates, preferably in "combination" with chlorine, for bleaching purposes. The cloth, paper, or other unbleached material are agitated for 5–15 minutes in a solution of half an ounce of sodium tungstate in a pint of water, and bleaching powder or sodium hypochlorite added in the proportion of $\frac{1}{2}$ lb. to 4 gallons of water. The solutions are preferably heated. The efficiency of this mixture may be prolonged by the addition of a previously heated and subsequently diluted mixture of salt and sulphuric acid. Another way "for securing the necessary chlorine" consists in adding to the tungstate solution of 1 oz. of sodium carbonate, 1 oz. of hydrochloric acid, and 1 gallon of water. Another combination consists of a mixture of arsenious acid, sodium hypochlorite, and sodium tungstate.—H. A.

Improvements in Apparatus for Skein-dyeing. A. S. Lyon, Lowell, and J. H. Lorimer, Philadelphia, U.S.A. Eng. Pat. 11,318, June 16, 1892.

THE hanks are placed on rectangular boards F (see Figures), fixed by means of springs in sockets e^1 in metallic frames E. The sockets are connected by a metallic yarn-guard e^1 secured to or cast in one piece with them and supported out of contact with the boards. At the extremities of the frames are trunnions d^3 , which fit into holes formed in the ends of arms d^2 , projecting in opposite directions perpendicularly from the links in the sprocket-chains D. The latter consist of a series of alternate double d^1 and single d^1 links, the sprockets on two parallel wheels e^1 (not shown in Fig.) and e^2 entering between the double links. B is the ram and B the cylinder of a hydraulic hoist; b^1 and b^2 are stop-collars on the ram fastened on to the same respectively above and below the guide-ring a^2 , arranged in a hole a^1 in an upper floor A'. To the ram B is secured a bracket with horizontal arms and downward extensions in which the shaft of the reel C is journaled. Two vats—one for dyeing and the other for rinsing—are fixed on opposite sides of the cylinder, and at equal distances from it, thus rendering it convenient to rinse the skeins without emptying the dye-vat, which is accomplished by raising the ram and with it the dyeing apparatus high enough to clear the tops of the vats, turning through an angle of 180° and lowering into the water-vat.

By removing a certain equal number of single and double links from the sprocket-chains, and so causing the latter to

Fig. 1.

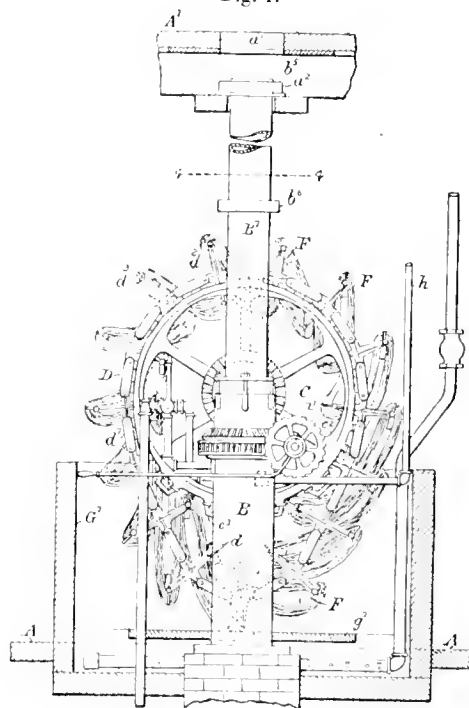
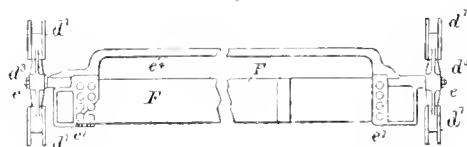


Fig. 2.



IMPROVEMENTS IN APPARATUS FOR SKEIN-DYEING.

form, or more nearly form, the rims of the sprocket-wheels, the tension of the skeins may be varied.—E. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Concentration of Sulphuric Acid in Apparatus made partly of Cast Iron, partly of Platinum. Scheurer-Kestner. Bull. Soc. Chim. 1892, 196–198.

THE author has endeavoured to combine in one apparatus the advantages possessed by platinum and by cast iron for the concentration of moderately strong and of very strong sulphuric acid respectively. The platinum apparatus of Kessler is combined with a Desmoutis apparatus having an iron bottom. A concentration of 95 per cent. may be obtained in the first part and 97.5 per cent. in the second part. The chief difficulty is to make the joints tight, for which purpose asbestos-packing is adopted.—V. C.

The Compressibility of Saline Solutions. H. Gilbant. Compt. rend. 114, 1892, 209–211.

See under XXIII., page 780.

The Influence of Nitrogen Tetroxide on the Specific Gravity of Nitric Acid. G. Lange and L. Marchlewski. *Zeits. f. ang. Chem.* 1892, 330—331.

See under XXIII., page 775.

The Composition of Liquid Ammonia of Commerce, and the Manufacture of Liquid Ammonia of 99.995 per cent. Strength. H. Von. Strombeck. *J. Frank. Inst.* 134, 1892, 58—64.

See under III., page 736.

PATENTS.

Process and Apparatus for the Manufacture of Cyanides. G. T. Beilby, Slatford. *Eng. Pat.* 4820, March 18, 1891.

THE process consists in passing dry ammonia gas through a heated mixture of 55—60 parts of previously well dried potassium carbonate, 20—25 parts of carbon and 20 parts of potassium cyanide. Instead of ammonia, the volatile alkaloidal bases from shale oil, peat tar, animal oil, &c., may be used. The potassium cyanide is employed only for the purpose of reducing the melting point of the mixture. The supply of ammonia is stopped when a product containing about 70 per cent. potassium cyanide is formed, which is settled, filtered from the carbon in suspension and run into moulds or drums. The escaping gases are passed through dust chambers for the collection of the cyanide carried away.

The apparatus consists of a series of cast-iron melting pots, provided with dip pipes for the supply of ammonia. Any undecomposed ammonia is utilised with the following pot of the series; after leaving the last it passes through the dust chamber and finally through a scrubber for the recovery of the last traces of ammonia. In the measure as the formation of potassium cyanide proceeds, fresh quantities of the materials are introduced through a hopper, until the pot is filled to its fullest working capacity.

Another apparatus consists of a vertical retort provided with perforated shelves; a revolving vertical shaft provided with arms, rakes the charge from shelf to shelf. The whole is set in a furnace. The molten mass meets in its downward course with ammonia, which is introduced from below and is gradually converted into cyanide. The materials are charged in continuously from the top and the cyanide is drawn off at the bottom.

In a further modification of the apparatus the revolving shaft is dispensed with.—H. A.

Improvements relating to the Extraction of Aluminium Hydrate or Aluminium Salts from Aluminium Silicates or Clay. E. Meyer, Berlin, Germany. *Eng. Pat.* 13,395, August 7, 1891.

THE alumina contained in clay can be rendered easily soluble in weak acid, by gently heating the clay with alkaline or alkaline earthy chlorides, or with aluminium chloride. The best results are obtained by saturating the finely-ground clay with 0.1 to 1 per cent. of a solution of aluminium chloride, drying and heating up.—H. A.

Improvements in Apparatus for the Extraction of Ammonia, applicable for Ammonia Soda Works and the like. G. I. J. Wells, Middlewich. *Eng. Pat.* 13,424, August 8, 1891.

IN the usual way of distilling ammonia from a solution of ammonium chloride by means of lime and steam, great inconvenience and loss of time is caused by the blocking up of the connection pipes between the "distiller" and the "heater." The inventor proposes to dispense with the connection pipes by placing the heater on the distiller, thus forming one apparatus of the two vessels. A further disadvantage arises from the blocking up of the dip pipes

which convey the mixed liquors down the distiller. Hitherto these pipes were permanently fixed to the distiller, but now they are proposed to be made removable, and can be exchanged when required. Additional facilities are also given for cleaning the revolving mushrooms in the upper part of the distiller, by constructing them of two pieces which can be disjoined. The top overflow pipe is furthermore provided with a rimmer for chipping off any scales which may form inside this pipe.—H. A.

Improvements in the Purification of Pyrolignites. F. H. Pickles, Fairfield, and R. H. Pickles, Marple. *Eng. Pat.* 20,753, November 28, 1891.

See under III., page 737.

Improvements relating to the Production of Soda and Chlorine, and to Apparatus therefor. H. H. Lake, London. From E. B. Cutten, New York, U.S.A. *Eng. Pat.* 88, January 2, 1892.

IN the electrolytic production of chlorine and caustic soda from a solution of sodium chloride, great difficulties are encountered by the formation of "chlorinated soda" or "ClNaHO" owing to the re-combination of the chlorine and caustic produced, and furthermore by the gradual weakening of the salt solution. The gist of all these improvements, which are embodied on two sheets of drawings, is to effect the separation of the chlorine and caustic soda by drawing off the first by means of a pump in the measure it is formed, and by allowing the caustic solution which is formed round the walls of the cell (the cathode) "to sink to the bottom of the cell by its own gravity," from whence it can be drawn off at leisure. Whilst this process of subsidence proceeds, strong salt solution is forced in the lower part of the cell, at a point below the cylinder which surrounds the anode, and ascending this, leaves at an elevated point to be collected and strengthened up by pumping it over rock salt. The body of the cell may be filled with salt, and some variations are given in the construction of the same.—H. A.

Improvements relating to the Production of Liquid Chlorine and to Apparatus therefor. H. H. Lake, London. From E. B. Cutten, New York, U.S.A. *Eng. Pat.* 89, January 2, 1892.

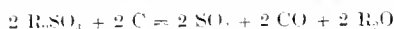
IN the production of liquid chlorine great difficulties are encountered by the rapid corrosion of the containing metal cylinders. The invention consists in apparatus for the production of thoroughly dried chlorine, which when liquefied and packed in dry cylinders does not cause corrosion. Chlorine from any source, preferably that obtained by electrolysis (see previous abstract), is passed through tubes surrounded by cold water, by which means part of its moisture is condensed. The gas is then passed over shelves charged with calcium chloride, and then through sulphuric acid. It subsequently enters a receiver from which it is forced by means of a compressing pump into a steel tank, where it liquefies under a pressure of 60 lb. The heat generated in the compression is abstracted by means of cold water circulating in coils, which dip in the liquid anhydrous chlorine. The uncondensed air and other impurities are allowed to escape through a safety-valve at the top of the tank, when occasion requires it.

The liquid chlorine is charged in the cylinders by means of dip pipes, and thus drives the air out of the cylinder, which escapes through a safety-valve. (This Journal, 1891, 546.)—H. A.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

The Action of Carbon on the Alkaline Sulphates in presence of Silica; the Action of Carbon on Sulphurous Acid; and the part played by these Reactions in the Preparation of Silicate of Soda and Glass. Scheurer-Kestner. Bull. Soc. Chim. 1892, 190—196.

THE hitherto accepted view with regard to the reactions studied in this investigation has been that the carbon which is added to the silica and sodium sulphate in a glass furnace facilitates the decomposition of the sulphate by reduction, and forms sulphur dioxide and carbon monoxide. The supposed reaction might be represented thus—



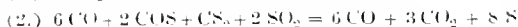
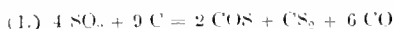
or, as carbonic acid is formed in the furnace gases, by the above equation in conjunction with—



The amount of carbon which is required in practice for complete reduction of the sulphate is, however, much larger than that demanded by either of these equations. The author shows that the sulphur dioxide is not formed by the reaction between the carbon, alkaline sulphate, and silica, and that it is only produced subsequently by reactions among the gases present. In the author's experiments the materials were placed in earthenware crucibles with lids hermetically closed. An iron tube passed through the lid. The crucible was heated and the gases coming off through the iron pipe were collected and analysed. Experiments were made with the proportions required by the first equation (see above) and with the larger quantity of carbon employed in practice. In both cases carbon monoxide and carbon dioxide were obtained together with the sulphur, both in the form of gas and deposited on the tube; but no sulphurous acid was present in either case. With the quantity of carbon demanded by the above equation only a part of the sulphate was decomposed.

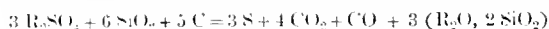
Berthelot has shown that when carbon acts upon sulphur dioxide at a red heat carbon monoxide, carbon oxysulphide, and carbon bisulphide are formed. At the higher temperature attained in the glass furnace, however, oxysulphide of carbon is decomposed, yielding sulphur and carbon monoxide. Carbon bisulphide at the same temperature is decomposed by oxygen (furnished in the decomposition of sulphuric anhydride) with formation of carbonic acid and sulphurous acid. Sulphurous acid is decomposed by carbon monoxide forming carbonic acid and sulphur. The author has shown experimentally the formation of carbon oxysulphide at a moderate temperature, using the materials and apparatus above described.

It is thought that the following equation may be taken to represent these reactions—



The above proportion, two of carbon monoxide to one of carbonic acid, is found to hold approximately.

The following equation is believed to represent the decomposition of the alkaline sulphates as far as the final products are concerned—

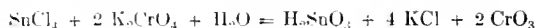


An excess of carbon must be carefully avoided in the manufacture of glass, a fact well known to the manufacturers, or sulphide is produced. The amount of sulphide does not, however, increase in anything like the same proportion as the carbon. According to Berthelot it is the carbon monoxide which reduces the sulphate to sulphide. The presence of excess of carbon increases the proportion of the carbon monoxide formed—V. C.

Compounds of Stannic and Chromic Oxides. Leykauf. J. Prakt. Chem. 19, 1892, 127.

CHROMIUM stannate can be obtained by igniting stannic chromate at a high temperature. It forms a dark violet mass from which glazes varying in colour from rose red to dark violet can be prepared. So-called "mineral lake" consists of chromic oxide associated with an excess of stannic oxide. When these two substances are ignited together in the proportion of one part of the former to 50 of the latter, a mass composed of a mixture of fine crystals and fused glassy particles of a beautiful permanent lilac colour is obtained. According to the author "pink colour" consists of the above-mentioned substance mixed with calcium stannate, and according to Malaguti may be prepared by igniting 100 parts of oxide of tin with 34 parts of chalk and 1—1.5 parts of chromic oxide or three to four parts of potassium chromate. Stannic chromate has been supposed to be produced by precipitating stannic chloride with potassium chromate. A yellow precipitate is certainly formed which on ignition becomes converted into chromic stannate, but according to Petrik the reaction that takes place is expressed by one or other of the following equations according as the neutral or acid chromate is used—

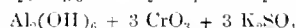
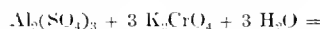
I.



II.



It therefore appears that the stannic acid only retains chromic acid mechanically. This is borne out by the analysis of the precipitate not thoroughly washed and dried at 100° C. It contains SnO_2 , 71—81 per cent; H_2O , 7.6—8.5 per cent.; CrO_3 , 6.4—12.1 per cent.; KCl , 3—8 per cent. On igniting this precipitate violet "mineral lake" and not chromic stannate is obtained. The author endeavoured to prepare similar bodies by heating together potassium chromate, potassium nitrate, and stannous chloride, but the substances obtained were poor in chromic oxide, two samples containing respectively 3.28 per cent. and 4.03 per cent. Even traces of chromic oxide suffice to colour stannic oxide. Petrik corrects the statement that the precipitate produced by the addition of potassium chromate to a solution of alum consists of aluminium chromate. He considers the reaction to take place as follows:—



The precipitate, after pressing and igniting, becomes green, and on washing out the excess of potassium chromate yields a red substance similar to that obtained when stannic oxide is used. It may also be formed by igniting precipitated alumina with a little potassium chromate. The production of a red or pink compound does not therefore depend on the presence of stannic oxide. A corresponding substance is produced by the precipitation of molecular proportions of magnesium sulphate and ammonia alum and the half an equivalent of chrome alum with ammonia, and ignition of the precipitate. When the magnesia is replaced by lime, strontia or baryta, substances are obtained which appear green by daylight and red by lamp light. It may be remarked that porcelain glazes coloured with chromic oxide appear green and grey when viewed by the above methods of illumination. The conclusion Petrik draws from his investigation, is that "pink colour" does not contain chromic stannate, but that a red chromium compound, apparently chromic oxide in a finely-divided state, is precipitated upon the stannic acid serving as a "base." The observation that the colour can be produced with alumina is of technical importance, inasmuch as upon it can be founded the preparation of an underglaze red of a refractory character.—B. B.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

The Colouration of Clay by Oxide of Iron. Dingl. Polyt. J. 284, 1892, 94, 95.

A PAPER by Seger on this subject was read at the general meeting of the German Association for the Manufacture of Bricks, Pottery, Lime, and Cement. Clays containing various amounts of iron were mixed in different proportions and the colour of the product after burning observed. The content of ferric oxide ranged from 6.8 per cent. to 21.3 per cent., reckoned on the clay after ignition. The results showed that the amount of ferric oxide has no marked influence on the colour after a limit of 9 per cent. has been reached. Moreover the colour does not merely depend upon the quantity of iron present, but on the constitution of the clay, its state of mechanical division, and the intensity and method of burning.—B. B.

The Porosity of Building Stones and their Resistance to Frost. Péroche. Monit. Oer. et Ver. (Dingl. Polyt. J. 284, 1892, 92).

THE author is of opinion that the resistance to frost does not always increase with decrease of porosity. Two kinds of natural building stones are found on the shores of the Oise. The upper layer is composed of a siliceous limestone known as "Vergelet," while the lower is termed "St. Leu." The first is porous and resists frost well, while the latter, though closer in the grain, exfoliates in layers parallel to the plane of cleavage of the stone. Michelot explains this anomaly as follows: The porous stone called Vergelet consists of rounded particles which are only cemented together at the surfaces in contact with each other, so that the water in expanding finds means of escape, whereas the second, though absorbing less water, does not allow of such expansion, and is accordingly disintegrated. The author concludes from these facts that the best method of preparing tiles to resist frost consists in the use of a ware with a porous body and a thick glaze on one side. This view is, however, objected to on the ground that the use of such a layer of glaze would hinder the expansion of the water. In exposed situations the only certain method of preventing damage would appear to be either to use unglazed tiles, or preferably stoneware, the whole thickness of which is dense and non-porous like porcelain.—B. B.

PATENTS.

Improvements in the Manufacture of Building Boards, Paper Barrels or Cylinders, and similar Hollow or other Articles from Paper Pulp. C. Weygang, Middlesex. Eng. Pat. 12,299, July 20, 1891.

See under XIX., page 771.

An Artificial Stone. J. D. Harries, Aberystwith. Eng. Pat. 12,633, July 25, 1891.

THE patented stone consists of a mixture of 1 part by measure of Portland cement with 3 parts of extracted metalliferous matrices, such as "clay, slate, quartz, or limestone," from which metals as "gold, silver, lead, tin, copper" have been removed. Water is added to form a paste and the whole allowed to set in moulds for three to six days.—B. B.

A New or Improved Chemical Treatment or Application for Cleaning Stone, Marble, Granite, and the like. E. Lodge and F. Jury, Huddersfield. Eng. Pat. 15,101, September 7, 1891.

THE use of hydrofluoric acid is patented for the purposes mentioned in the title.—B. B.

Improvements in Means or Apparatus for Forming Clay into Pots or Vessels. E. G. Cole, Tottenham, and H. Keston, Luton. Eng. Pat. 15,108, September 7, 1891.

A HORIZONTAL rotating table is carried by a vertical shaft, borne by a step-bearing formed on the upper side of the bearing of the main driving shaft of the apparatus, which is horizontal and carries a wheel which drives by frictional contact a disc keyed on the vertical shaft carrying the table. The disc is free to slide on the shaft and is kept down against the opposition of a spiral spring in contact with the frictional driving wheel by a shoe which can be forced down by a wedge-piece controlled by a rod with a head against which the body of the operator is pressed. When the pressure is released the disc rises out of contact with the driving wheel and the rotation of the table is discontinued.—B. B.

An Improved Process for the Manufacture of Artificial Stone and Marble. G. Solenz, Graz, Austria. Eng. Pat. 15,509, September 12, 1891.

A MIXTURE is made of 1 part of burnt magnesite, 4 to 5 parts of clean sand, and 2 parts of "chloride of magnesium lye of from 23° to 28° B." Articles such as tiles are formed by pouring the composition into wooden moulds which have been previously laquered, washed out with magnesium chloride solution, and oiled. The goods are ready for use 24 hours after moulding. Bricks with a glazed surface can be prepared from a similar mixture in hard wood or metal moulds. The better the surface required the stronger must be the solution of magnesium chloride. Imitations of veins and streaks may be produced by suitable pigments stirred into the mass or applied to the mould.—B. B.

Improvements in or connected with and Apparatus for the Burning of Cement-making Materials, Lime, Chalk, and the like. W. R. Taylor, Rochester. Eng. Pat. 16,375, September 26, 1891.

A KILN is provided with two side flues disposed one above the other between it and the chimney, which are fitted with doors so that the kiln gases can be diverted from one to the other. During the first stage of the process the material to be burnt in the form of blocks or bricks, perforated or corrugated, is dried, and as soon as carbon dioxide begins to come off the hot gases from the kiln are turned into the other flue, and the carbon dioxide drawn off with a fan. The bricks are then transferred to the kiln and burnt to clinker. The fuel used during the evolution of the carbon dioxide may be "coke, in combination with oxygen or other gas, or liquids, to support combustion." A retort, provided with doors, packed with asbestos, a manhole and pyrometer, may be substituted for the upper flue. The apparatus patented may be applied to existing dome kilns by placing one or more saddle-shaped chambers against the lower part of the kiln, and fitting the latter with a hood and a pipe in its upper part for drawing off the carbon dioxide. The fuel is burnt in the saddle-shaped chambers, and the products of combustion led into the kiln, and the evolved carbon dioxide drawn off by a fan. The chambers are provided with double walls filled with loose asbestos, into which a portion of the hot carbon dioxide may be forced to maintain the heat in the kiln. This part of the process may be omitted when oxygen is used.—B. B.

Improved Cement Composition for Coating the Interior of Ships and the like to prevent Corrosion. W. A. Briggs, Dundee. Eng. Pat. 18,284, October 24, 1891.

ABOUT 2½ parts of measure of crushed pumice stone are mixed with one part of Portland cement and used for the purpose set forth in the title. The advantage claimed is that the composition is only about half the weight of the mixture of cement and sand generally used.—B. B.

X.—METALLURGY.

Metallic Carbonyls. Ludwig Mond. The Engineer, June 10, 1892, 498.

THE following is an abstract of the report of a lecture given at the Royal Institution. After historically dealing with the researches on the action of carbonic oxide on metals the lecturer prepared some nickel carbonyl and proceeded to illustrate and describe its properties.

The gas, $\text{Ni}(\text{CO})_4$, burns with a bright, luminous flame, metallic nickel separating and becoming incandescent. Solids heated to 200° C. in it become coated with bright metallic nickel, while carbon monoxide is liberated. It condenses to a liquid in a freezing mixture, and can then be sealed in a tube. A mixture of the vapour and air explodes readily but not very violently. The pure liquid does not explode, but at high temperatures it decomposes. The vapour has a characteristic odour and is poisonous. It produces an extraordinary reduction of temperature when injected subcutaneously, sometimes as much as 12°. The liquid can be distilled, but not from solution in liquids of a higher boiling point as decomposition then occurs, finely divided nickel being separated and carbonic oxide evolved.

When attacked by oxidising agents, *e.g.*, nitric acid, chlorine, or bromine, or by sulphur, decomposition ensues, nickel salts being formed and carbon dioxide liberated. Metals, alkalis, non-oxidising acids, and the salts of other metals produce no change. Nickel carbonates of composition varying with the hygroscopic state of the atmosphere are formed by exposing the liquid to the action of the air. These precipitates dissolve easily in dilute acid. An intense blue colouration is obtained when nitric oxide is passed through a solution of nickel carbonyl in alcohol (Berthelot).

Nickel carbonyl is very diamagnetic, and an almost perfect non-conductor of electricity (Quincke). All other nickel compounds are paramagnetic. It is opaque for rays beyond the wave-length 3,820, and its flame gives a continuous spectrum (Living and Dewar).

The following are some of the physical constants of nickel carbonyl and ferro-penta carbonyl:—

	Nickel Carbonyl.	Ferro-penta carbonyl
Specific gravity.....	1.3185	1.466
Boiling point.....	45° C.	102.8° C.
Melting point.....	-25° C.	-21° C.
Molecular weight.....	170	196
Vapour density.....	6.61	6.5
Coefficient of expansion..	0.0018	..
Coefficient of dispersion..	1.1236	..
Molecular refraction $\frac{\mu}{D}$..	58.63	69.30
Magnetic rotary power....	38.21	..
Diamagnetic constant....	-3.131 $\times 10^{10}$	..

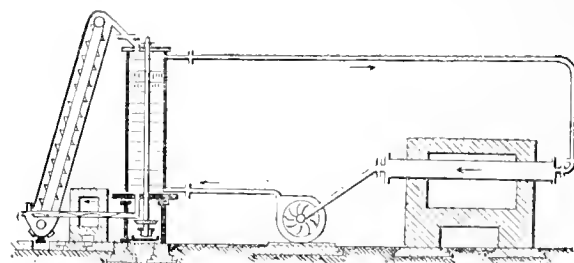
Difluoro hepta-carbonyl $\text{Fe}_2(\text{CO})_7$, mol. weight 398.

Perkin found the power of magnetic rotation of nickel carbonyl to be greater than that of any other substance he has examined, except phosphorus. Mond and Nasini found the atomic refraction to be about 2.5 times as large as in any other nickel compound, and the former proved it to have great refractive and dispersive powers. The atomic refraction of a liquid ferro-carbonyl bears about the same ratio to the atomic refraction of other iron compounds. This ferro-carbonyl is similar in preparation and properties to the nickel carbonyl, and at 180° C. the iron is thrown down in bright mirror-like form, carbon monoxide being liberated. Its composition is $\text{Fe}(\text{CO})_5$.

Ferro-carbonyl has been found in carbonic oxide which had been compressed in an iron cylinder, and is believed to be the cause of the red deposit sometimes found upon

steatite gas burners (Roscoe). It has been found in compressed gas used for the limelight (Thorne), and Garnier supposes that it may be found in blast furnaces when working too cold, and to be the origin of large deposits of iron oxide sometimes found in the tubes leading from the furnaces; but the author finds it difficult to believe that the temperature is ever low enough to permit of the formation of iron carbonyl. This body behaves towards acids and oxidising agents as does nickel carbonyl, but it dissolves in alkalis without evolution of gas, and in time a greenish precipitate, chiefly of hydrated ferrous oxide, falls. The liquid becomes brown on exposure to air, taking up oxygen when hydrated ferric oxide is precipitated.

The question of industrially extracting nickel from its ores by means of carbonic oxide was then dealt with. For solving this problem within the limits of the resources of a laboratory the discoverers devised apparatus, the principles of which are shown in the accompanying diagram.



It consists of a cylinder divided into many compartments, through which the properly prepared ore is passed very slowly by means of stirrers attached to a shaft. On leaving the bottom of this cylinder the ore passes through a transporting screw, and from this to an elevator which returns it to the top of the cylinder, so that it passes many times through the cylinder until all the nickel is volatilised. Into the bottom of this cylinder carbonic oxide is passed, which leaves it at the top charged with nickel carbonyl vapour, and passes through the conduits represented, into tubes set in a furnace, and heated to 200° C. Here the nickel separates from the nickel carbonyl. The carbonic oxide is regenerated and taken back to the cylinder by means of a fan, so that the same gas is made to carry fresh quantities of nickel out of the ore in the cylinder, and to deposit it in the tubes an infinite number of times. Upon these principles Dr. Langer has constructed a complete plant on a small scale, which has been at work in the lecturer's laboratory for a considerable time. The volatilising cylinder is divided into numerous compartments, through which the ore passes. The carbonic oxide gas is prepared in any convenient manner. When it comes out at the top of the cylinder it passes through a filter to catch any dust it may contain.

The carbonic oxide, on escaping from the depositing tubes, is passed through another filter, thence through a lime purifier to absorb any carbon dioxide which may have been formed. The whole of this miniature plant is kept in motion by means of an electric motor. By means of this apparatus nickel has been extracted from a great number of ores, in times varying, according to the nature of the ores, from a few hours to several days.

Plant to carry out this process on a large scale is now being erected in Birmingham. The advantages claimed are the great simplicity of the process, and the possibility of at once obtaining pure, firmly coherent, metallic nickel in any desired form, *e.g.*, tubes, copies of art work by deposition in heated moulds, &c., the latter advantage being expected to prove a serious rival to the present method of nickel-plating by electrolysis.

Specimens of the ores used in the process, tubes and plates, articles of pure nickel and articles plated with nickel produced in Mr. Mond's laboratory, were exhibited. Finally the lecturer drew attention to the prospect opened out of being able to meet the continually increasing demand for pure nickel, and pointed out how the most

valuable properties of the nickel-steel alloy for armour plates, &c., make an abundant and cheap supply of nickel a matter of national importance.—A. W.

The Effect of Heat on Mercury Compounds. F. Janda.
Iron, 40, 9.

In the new Idria method of assay, using a gold collecting dish, when heated with forge scale under a covering of zinc oxide, the sulphide, oxides, sub-chloride, and basic sulphate are completely decomposed, but the chloride loses 8 per cent., and the normal sulphate 4 per cent., volatilised unchanged. If the zinc oxide cover be omitted, the mercury is generally blackened with amorphous sulphide.

By heat without reagents, cinnabar is changed to mercury, sulphur dioxide, and a small amount of black sulphide. Mercuric chloride volatilises, about 5 per cent. only being reduced to metal, and mercuric nitrate is also very slightly decomposed by heat.

Mercurous salts are all decomposed by a red heat except the chloride, which sublimes unchanged. Mercuric sulphate turns yellow, then melts to a brown liquid, and on cooling becomes white again. At a higher temperature it sublimes unchanged, but more slowly than any of the other compounds. Turbith mineral completely but slowly volatilises with decomposition. The mercurial flue stuff, composed mainly of mercury, and its sulphide, basic sulphate, and sub-chloride, with impurities, and containing 86.5 per cent. of mercury, decomposes into mercury and mercury black—a finely-divided mixture of metal and sulphide—which, mixed and heated with lime, gives metallic mercury. The amalgam on the gold plate is bright, and has only a slight coating of hydrocarbon oil. The chloride and sulphate are not completely decomposed by lime alone, and a sublimate of the unchanged salt covers the amalgam.

Cinnabar and flue soot, when mixed with 25 per cent. of lime and 25 per cent. of lamp-black, and heated, yield the whole of their mercury, but the deposit is coated with black. By the same treatment the oxides and lower compounds completely decompose and yield a clear amalgam, but the higher chloride and basic sulphate lose 8 and 4 per cent. respectively.—A. W.

Experiments on the Elimination of Sulphur from Iron.
E. J. Ball and A. Wingham. The Iron and Steel Institute Spring Meeting, 1892.

This paper is the result of an experimental investigation made about four years ago at the Royal School of Mines. A few experiments were carried out at the Brynbo Works in an endeavour to combine desulphurisation with the Darby recarburisation process, but they were not satisfactory. The authors first found that potassium cyanide placed on the surface of molten cast iron almost completely removed the sulphur, the three experiments cited showing a reduction to about one hundredth of the quantity originally present. The volatility of the cyanide, however, was so great that the proportion required could not be reduced within practicable limits, and the authors, therefore, endeavoured to find some flux which would retain when molten a quantity of cyanide sufficient to effect desulphurisation. Sodium carbonate, lime, and blast-furnace slag were each tried, the first being found the most effective. With the less basic lime slag the diminution in the percentage of sulphur varied with the amount of cyanide used. These experiments also showed that with soda flux the addition of large excess of cyanide was useless, probably owing to the waste due to its volatility. These results led to experiments being made to ascertain the action of sodium carbonate alone. A very considerable diminution in the quantity of sulphur occurred. With quantities of soda varying from one-thirtieth to one-tenth of the weight of the iron, the reduction was practically the same, i.e., from 1.11 to 0.15 per cent. They then found that with a repetition of the treatment the percentage of sulphur was not practically further diminished, and apparently sodium carbonate alone would not completely remove the sulphur. A mixture of it with potassium cyanide, however, proved much more satisfactory. They

sometimes used the ferrocyanide as a more convenient salt than the cyanide, and this gave the same result. Hence it was evident the cyanide greatly assisted the action of the carbonate. The same beneficial effect, but to a greater extent, was noticed when caustic soda was substituted for the carbonate, so that less cyanide was necessary, and this led to the belief that the cyanide might be dispensed with altogether. Subsequent experiment showed that under certain conditions the caustic soda by itself would act successfully. Previously it had appeared that the cyanogen had some direct action in removing the sulphur, but this indicated that the real agent was metallic sodium formed *in situ* by reduction of the soda by carbon and iron. This was established by the introduction of metallic sodium in the form of an alloy with lead into the molten iron, the sulphur being thereby totally eliminated. The experiments cited were selected from a much larger number, the contact of the alkaline slag with the iron usually extending over about 20 minutes, and on comparing the results it is remarkable how frequently the sulphur is reduced to 0.15 per cent., thus suggesting that this residual quantity may be in a different state of combination. To eliminate this residual sulphur it seems necessary to use more powerful reducing agents so as to get rid of any oxidising substances which may be present. To the laboratory potassium cyanide was used, and by its great reducing power, or by facilitating the formation of metallic sodium or potassium, enabled the operation to be completed at comparatively low temperatures. At the higher temperature, in practice, however, its volatility would militate against its use, and very probably it might not be needed at all, because as the temperature increases the alkali becomes more active. Basic lime slag with soda present would not act in the laboratory, but at higher temperature it is probable such a slag would become active in removing sulphur, provided oxidising influences were avoided. There is evidence that magnesium yielding fluxes can so act, but it is believed to be essential that all chances of external oxidation and also all oxides of iron should be absent. A trace of oxide of iron might exist in the metal even with 3 or 4 per cent. of carbon present, and indirectly be the origin of the reluctant 0.1 per cent. of sulphur, and a basic lime slag *per se* would probably be insufficiently active to remove this sulphur except with difficulty, and it might be necessary to use some soda with it. Even then the tenacity of the supposed trace of oxide might render this sulphur capable of resisting this attack, and the employment of a still more powerful reducing agent might be necessary. The authors performed an experiment with ferro-manganese, which (or spiegel) was the only agent which suggested itself as a practical reducing agent, and the cast iron was submitted to the action of carbonate of soda before and after the addition of the ferro-manganese. By carbonate of soda alone the sulphur was reduced from 0.58 to 0.14 per cent., and then by it, in conjunction with rich ferro-manganese, from 0.14 to 0.06 per cent.

In the blast furnace, working hot, with excess of lime and fuel, it is well known that the sulphur is kept low, and such working gives a more basic slag; but all oxidising influences are not, and probably cannot be, absolutely eliminated, hence some sulphur remains with the iron, and the same is the case in the furnaces used for the conversion into steel. Whether the removal by manganese, on the addition of spiegel after the blow in the converter, is by direct action of manganese or by the manganese producing complete deoxidation, and so allowing the slag to act, it is difficult to decide, but, at any rate, the metal is then for the first time in the necessary state for desulphurisation, and the sulphur begins to come out. Probably it is because these conditions were not fulfilled that the Brynbo experiments were unsatisfactory. There were signs of a diminution of sulphur, but the idea was to combine desulphurisation and recarburisation in one operation.

The authors hope that the publication of the results of their experiments may throw some light upon this subject, and point out that being on so small a scale the waste was excessive, and therefore the results should not be scrutinised too closely as to their practicability. They show, however, that under the conditions of contact of the

molten metal with an alkaline or basic slag, and all materials and surroundings in a perfect state of deoxidation—a basic process in direct contrast to the basic phosphorus process—any amount of sulphur can be removed from pig iron. If in the basic-lined converter the oxidising conditions could be transformed to reducing ones, the sulphur and not the phosphorus would probably be removed. Since the reduction was effected by metallic sodium produced *in situ*, it would obviously be most advantageous to carry out the desulphurisation process with pig iron and not from blown metal or steel. The authors believe it will always be found easier to remove sulphur from pig iron than from steel, whatever the method employed.

In the discussion the difficulty of the 0.1 per cent. on a large scale and the importance of the reducing conditions were questioned. Snelus thought there was more in these results than appeared on the first glance. He did not think the fundamental conditions of sulphur and phosphorus and their affinities as regards their elimination from iron had ever been understood sufficiently. It appeared that sulphur was more firmly held in combination as a sulphide than when in an oxidised state, as in the case of phosphorus. Hence under the reducing conditions in a blast furnace, the bulk of the sulphur might easily be removed by calcium or sodium as sulphides, and so pass into the slag. Under proper conditions manganese would remove the sulphur, but its affinity to hold the sulphur was not as strong as calcium or sodium, which, as shown in the paper, would hold it most strongly under the right conditions of a reducing atmosphere. He thought it a disadvantage to have oxide of iron present.

Sir Lowthian Bell submitted the possibility that sulphur might be removed from iron without having formed sodium at all. He had detected cyanides of potassium and sodium in the blast furnace, and their formation was due to previous formation of sodium. For several years he had aspirated a quantity of blast-furnace gases through mercury, but if sodium were present it was in too small quantity to be arrested by the mercury.

The peculiarities of the manganese process were referred to in such examples as a pig iron containing both 0.4 per cent. of sulphur and 6 per cent. of manganese, which metal had been afterwards used to remove sulphur with satisfactory results. Hadfield's manganese steels had also been known to contain sulphur notwithstanding the large quantity of manganese present, and it was possible that the question of the trace of oxide raised in the paper might have something to do with these irregularities. The importance of chemists examining into these questions was pointed out.—A. W.

Production of Platinum in Russia. J. Soc. Arts. 40, 807.

The platinum beds of the Ural mountains, according to the *Journal de la Chambre de Commerce de Constantinople*, are the only ones in the world in which this metal is found in grains. Platinum is found in Brazil and in the Cordilleras in the hard serpentine rocks, but never in the form of grains. The platinum beds of the Ural mountains are found in various districts. The platinum found in these places is in the form of grains, in sand frequently containing gold. The weight of these grains is from 17 to 21 grains, to every 1,640 kilos. of sand. The richness of the platinum beds varies in the same proportions. In some, the thickness of the turf covering the sand does not exceed from 2.16 metres to 2.88 metres, while in others it varies from 10.80 metres to 14 metres, so that it becomes necessary to work underground. The thickness of the platinum sands does not vary much. During the last 12 years the annual production of platinum has averaged about 3,194 kilos., of which half has been derived from the beds in the north of the Ural mountains belonging either to the State or to private persons. Throughout the whole world only about 3,270 kilos. of platinum are annually used, but it is anticipated that this amount will soon be considerably increased, and it is stated that the platinum beds of Bisserski can alone supply the total quantity required

for the consumption of the world. When the demand for platinum was insignificant and the price very low, the gold miners who found platinum while seeking gold, frequently, it is stated, used the former, instead of lead, as shot for firing at wild birds. All the platinum extracted from the Ural mountains, after having paid a tax of 3 per cent. in kind, is sent as raw ore to St. Petersburg for treatment and shipment to foreign markets.—W. S.

Specific Heat and Latent Heat of Fusion of Aluminium. J. Pionchon. Compt. rend. 115, 1892, 162—165.

THE metal employed by the author for his determinations was obtained from the French foundry of Froges (Isère), which contains scarcely 0.9 per cent. impurities, consisting chiefly of iron and silicon. The total quantity of heat required to bring the metal from 0° to the fusion point (625° C.) was 239.4 calories (expressed as $q_{625} = 239.4$), the specific heat immediately before and after the fusion being about the same, $\gamma_{550} = 0.2894$ and $\gamma_{650} = 0.308$. Although from the difficulty of fusing aluminium experienced in practice, it might be expected that the latent heat of aluminium is very high, that it was found to correspond to 80 calories, equal to that of water, will excite some surprise.—F. W. P.

Aluminium: its Manufacture and Uses from an Engineering Stand-point. A. E. Hunt. J. Frank. Inst. 133, 241—271.

THE author commences his paper by stating it as his opinion that the "problem" of manufacturing aluminium of high quality at small cost has already been solved by the method of electro-deposition from a molten electrolyte. It is possible by this method to obtain cheaply aluminium of over 99.9 per cent. purity, the impurity being only silicon, and the author believes that within the next few years it will be possible to reduce the cost to between 18 and 20 cents per pound. The object of the paper is to point out some of the ways in which aluminium can be used in the arts.

For many purposes it is not so advantageous to use pure aluminium as an alloy of the metal with a small percentage of other elements, such as titanium, copper, or chromium. These do not detract seriously from the non-corrodibility of the metal while they add considerably to its strength and hardness, and give it a better colour.

The properties of aluminium which are likely to make it most useful in the arts are:—

- (1.) Its relative lightness.
- (2.) Its non-tarnishing quality as compared with other metals, being more slowly oxidised in moist atmospheres, and not being acted upon by sulphur fumes.
- (3.) Its extreme malleability.
- (4.) Its easy casting qualities.
- (5.) Its influence in various alloys.
- (6.) Its high tensile strength and elasticity when compared weight for weight with other metals.
- (7.) Its high specific heat and electrical and heat conductivity.

Section for section, aluminium is unfortunately only about as strong under tensile strain as cast iron, having less than half the strength of wrought iron under ordinary circumstances. The author gives tables and curves showing the strength under various stresses of forged, cast, and drawn aluminium.

An aluminium wire, alloyed with a small percentage of silver, titanium, or copper, can be produced having, weight for weight with copper wire, an electrical conductivity of 170, that of copper being 100. When it is taken into consideration that the tensile strength of the copper will be less than one-half that of the aluminium-titanium alloy, and that the conductivity of iron or steel in the same scale would be only about 17, it would seem that a field of usefulness for electrical conductors is open to the metal.

A striking property of aluminium, likely to render it serviceable in the arts, is its low specific gravity. Wherever

momentum is to be overcome, as in the reciprocating parts of many forms of machinery, aluminium can be advantageously used.

Aluminium does not oxidise seriously, so that a bright polish can be maintained for some time if suitable polishes are used. The metal withstands the action of wind and weather, and it is not much acted upon by boiling water or steam. It has therefore been successfully used as a packing in steam connexions, where lead has been rapidly cut out. It withstands the action of organic secretions better even than silver, which has led to its use for surgical purposes, and it has also been successfully used for the manufacture of cooking utensils. It does not corrode more readily in the presence of organic acids than copper or tin, and its salts are not injurious. It also makes a much more durable and satisfactory roofing than the sheet copper now generally used. Its high thermal and electric conductivity have already been referred to, and it is also found to be practically non-magnetic. Its sonorousness renders it well adapted for the sounding boards of musical instruments, and its extreme malleability makes it possible to beat it into leaf nearly as thin as gold leaf, or to draw it into the finest wire. It can be readily welded by the apparatus of the Electric Welding Company, and can be cast in moulds of dry sand. It, however, requires some experience on the part of the founder before perfectly sound castings can be made. Until lately it was not easy to solder aluminium, but this difficulty has now been overcome by the use of a very hot soldering bolt, and crystals of chloride of silver as a flux.

One of the greatest uses for aluminium in the arts will be in the form of alloys. It is possible to make an aluminium bronze of 130,000 lb. tensile strength and 5 per cent. elongation in 8 inches. Such a bronze would be perhaps the best metal for cylinders to withstand high pressures. A small percentage of aluminium added to the ordinary Babbitt metal will greatly increase the durability of the alloy. If added to steel castings it is found to prevent blowholes and unsound tops of ingots. Its addition to the alloys known as pewter, Britannia metal, white metal, delta metal, &c., has been found to have a useful effect. It has been used with advantage as an addition to the zinc in galvanising baths, and has also been used as a coating for iron by itself. It has been successfully used to replace lithographic stone, and mixed with chlorate of potash it may be used instead of magnesium to produce a flash-light for photographic purposes.

The paper concludes with a repetition of the statement that the problem of the future is to utilise the metal in the arts with financial success, "rather than in devising more economical methods of manufacture."—D. E. J.

The Preservation of Sodium. W. Vaubel. *Zeits. f. ang. Chem.* 1892, 200.

The author recommends a liquid paraffin known as "Vaseline oil" for the preservation of sodium, the use of ordinary petroleum oils, &c., giving rise to brown incrustations, which mean a loss of sodium. In the vaseline oil first mentioned the metal can be preserved for years unaltered.

—A. L. S.

Von Schulz and Low's Method of Estimating Lead in Ores. J. E. Williams. *Eng. and Mining J.* 53, 1892, 641.

See under XXIII., page 775.

The Separation and Estimation of Lead, Silver, and Zinc in Minerals composed of Galena and Blende. E. Aubin. *Bull. Soc. Chem.* 7-8, 1892, 134.

See under XXIII., page 775.

Micrographic Analysis of Alloys. G. Guillemin. *Compt. rend.* 115, 1892, 232-234.

See under XXIII., page 774.

Aluminium and Beer. *Zeits. f. ang. Chem.* 1892, 299.

See under XVII., page 766.

The Almaden Quicksilver Mines. *Chemist and Druggist*, 1892.

THE quicksilver mines of Almaden are situated to the north of the town of the same name. The veins of mercury run irregularly in several directions; those that are now being worked cover an area of from 550 to 600 feet in length by 40 to 45 feet in width. Their depth is still unknown, as after the exhaustion of one vein the borings are continued until a lower one is reached. Several veins are not payable ones, and are, therefore, left undisturbed. The average thickness of payable veins varies from 40 to 130 feet. The lowest point reached at present is about 1,100 feet below the surface. Both the quality and the percentage yield of mercury improve with the depth of the vein, and in the tenth and eleventh galleries (the lowest as yet worked) the mercury actually runs out of the rock like gum from a tree, and is caught in small leather receptacles. The colour of the rock varies from blackish grey to vivid red, and the redder its colour the richer is the yield of the metal. Mercury is often found in Almaden as a sulphide. Three veins are being worked at present. The ore is carried from the mines to gigantic smelting ovens, where it is distilled by the application of intense heat. The product of distillation passes through a long system of tubes, at the end of which it forms drops, which are caught upon small tubes fixed in containers. The annual production is from 55,000 to 60,000 *frascos*, or metal bottles, containing 4 *arrobas* each. About 3,000 hands are employed at the mines at present, 2,000 of these working below the surface.

PATENTS.

An Improved Process for Treating Copper and its Alloys to Prevent Oxidation and Deoxidation thereof during Heating or Annealing. H. H. Lake, London. From G. W. Cummins, Vienna, N.J., U.S.A. Eng. Pat. 8989,* (Amended), June 10, 1890.

THE improved process consists in surrounding the copper or its alloys during the process of annealing with steam, atmospheric air being excluded or not during cooling as may be desired. Other non-reducing gaseous fluids, such as carbonic acid and nitrogen, may also be used when their cost is not too great.—J. H. C.

Improvements in Utilisation of Tin Plate Scrap. F. W. Harbord and W. Hutchinson, jun., Wolverhampton. Eng. Pat. 12,917, July 30, 1891.

THE scrap is melted with a suitable proportion of cast or pig iron, and the metallic product worked up into steel by the basic process; or the mixture may be treated directly in a basic Siemens furnace without previous melting; lime and oxidising agents are added when necessary. The tin and zinc are partly volatilised and partly pass away in the slags produced.—J. H. C.

Improvements in Alloying Aluminium with other Metals. G. L. Adderbrooke, London. Eng. Pat. 15,782, 17th September 1891.

THE improvements consist in alloying known combinations of nickel and aluminium with tin and copper so as to make them more readily workable without adding unduly to their cost. For castings 92 per cent. of aluminium, 4 per cent. of nickel, 3 per cent. of tin, and 1 per cent. of copper

are found suitable. The nickel is first brought to a white heat, and a little aluminium is added; the two metals combine with incandescence. The remainder of the aluminium, which has been previously melted, is then added. The tin and copper are also melted together and cast into the form of sticks, and subsequently stirred in the molten aluminium and dissolved therein. The resultant metal should be cast into ingots and remelted twice before use. If a softer or more malleable mixture is required the nickel may be reduced to $1\frac{1}{2}$ per cent. and the tin in like proportion. For some purposes the copper may be omitted.—J. H. C.

An Improved Process of Treating Copper Ores and Mattes. L. A. Pelatan, Paris. Eng. Pat. 17,450, October 13, 1891.

NATURAL copper waters and copper-liquors obtained from pyritic ores by the ordinary processes of oxidation and lixiviation are run into troughs where they are acted upon by ordinary copper matte which has been previously crushed or granulated. The copper in the liquor precipitates on the matte, while the iron of the matte goes into solution. After the whole of the copper has been thus precipitated the liquor is drawn off and fresh liquor is supplied, until there is no further action, and there remains as the final residue of the operation copper highly concentrated, partly in the metallic state and partly in various stages of sulphurisation. If obtainable, ores of a composition analogous to that of the mattes may be used in place of them.—J. H. C.

An Improved Metallic Alloy, more especially intended for Use for Gas or Petroleum Engine Igniters or like Articles subjected to great Heat. C. W. Pinkney, Smithwick. Eng. Pat. 17,955, October 20, 1891.

THE alloy consists of nickel and iron, preferably in equal proportions: it is most conveniently formed by first melting the nickel and then adding the iron in a divided state.

—J. H. C.

Improvements in Preparing Ores, Oxides, and Compounds of Iron for Smelting. J. Woodecock, Low Moor, Yorks, J. Smith and W. McD. Mackey, Leeds. Eng. Pat. 2583, February 10, 1892.

THE ores, &c. are mixed with about three parts by weight of small coking coal, fluxing materials being also added when required; and the mixture is coked in the ordinary way.

—J. H. C.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

On the Laws of Electrolysis. A. Chassy. Compt. rend. 114, 1892, 998—1000.

BEQUEREL has shown that when a substance of complex formula M_pR_q is electrolysed, M being the electro-positive and R the electro-negative radicle for every equivalent of hydrogen disengaged in a water-voltmeter in the circuit, there is disengaged one equivalent of the radicle R and $\frac{q}{p}$ equivalent of the radical M. According to Wiedemann and other physicists, however, there are exceptions to this law, for with certain salts the quantities of the radicles disengaged under the given conditions are, $\frac{q}{p}$ equivalent of R and one equivalent of M.

The author therefore wishes to substitute for these two statements a single law which will satisfy all known cases.

If in the formula M_pR_q , M_p is replaced by H_x in order to obtain a certain known hydrogen compound (an operation which can always be carried out without ambiguity), M_p and H_x may be called corresponding quantities. Thus in the quantity Fe_2Cl_3 (ferrie chloride), Fe_2 may be replaced by H_3 and here $\frac{2}{3}$ Fe is the corresponding quantity to H, while in $FeCl$ (ferrie chloride) Fe corresponds to H. In the same way in all salts of sodium, Na corresponds to H. To obtain these corresponding quantities it is not necessary to know the formula corresponding to the electrolytic molecule; thus whether ferrie chloride be Fe_2Cl_3 or Fe_3Cl_6 , the quantity of iron corresponding to one equivalent of hydrogen is always the same. The determination of these corresponding quantities is thus independent of all theory. The following is the law which the author proposes:—Whenever any substance whatever is electrolysed, there is always disengaged one equivalent of hydrogen or the corresponding quantity of the electro-positive radicle.

This law is applicable to all known cases, and agrees with the laws of Bequerel and Wiedemann, and also with that of Faraday relative to compounds of the simple formula M R. It may also be applied to a certain number of substances where very complex secondary reactions are set up. Suppose it is desired to know the quantities of the radicles disengaged from a body of formula M_pR_q . Let the liquid be placed in two vessels connected together by a siphon, and let platinum electrodes be used. In the vessel surrounding the cathode there is a certain quantity of the body M_pR_q and in addition a certain quantity of M, these two substances reacting on one another to form secondary compounds. Then, by making the necessary analysis to obtain the weight of all the substances in the vessel, it is easy to deduce by simple calculation the quantity of the body M disengaged by the current.

The law has been verified for potassium ferrocyanide, potassium ferriyanide, sodium nitroprusside and several other substances, amongst which may be mentioned the case of the ferrie nitrate $Fe_2O_3 \cdot 2NO_3$. The quantities of the radicles of this salt which appear at the electrodes are $\frac{2}{3}$ Fe and $\frac{1}{3}$ ($2NO_3 + 3O$). This does not agree with either the law of Bequerel or that of Wiedemann, but is in accordance with the law proposed by the author, and serves as an instance of the advantage of its use, and of its general applicability.—D. E. J.

Micrographic Analysis of Alloys. G. Guillemin. Compt. rend. 115, 1892, 232—234.

See under XXIII., page 774.

Aluminium: Its Manufacture and Uses from an Engineering Standpoint. A. E. Hunt. J. Frank. Inst. 133, 241—271.

See under X., page 752.

PATENTS.

Improvements in the Manufacture of Carbons for Electric Arc Lamps. W. Lloyd Wise, London. From W. Gröndbach, Dinslaken, Germany. Eng. Pat. 12,019, July 15, 1891.

HOLLOW rods, that is to say, rods formed with a core hole, are made by pressing, and are then baked, after which the substance employed for the core is charged into the core hole, a second baking being unnecessary. The charging is effected by means of a machine having a plunger capable of pressing the dry mixture of finely-pulverised carbon and other substances while allowing the air to escape past it.

—G. H. R.

Improvements in the Treatment of Solutions containing Nickel and Iron for the Obtainment of Useful Products therefrom. J. H. Johnson, London. From T. Parker and E. Robinson, Wolverhampton. Eng. Pat. 14,159, August 21, 1891.

SOLUTIONS of nickel and iron such as those obtained from the process described in a previous patent (Eng. Pat. 5199 of 1890) are precipitated by any suitable agent. Magnesite is added to precipitate the iron, and the filtrate is electrolysed between carbon electrodes after the addition of the chloride of an alkali. The nickel is precipitated and the solution is filtered off and evaporated to the required bulk for crystallisation as Epsom salts.—G. H. R.

Improvements in or connected with Electrolysis. From E. A. Le Sueur, Ottawa, Canada. Eng. Pat. 15,050, September 5, 1891.

THE evils arising from diffusion or leakage from the negative electrode side to the positive are minimised by maintaining the solution in the positive sections in practically the same condition chemically throughout electrolysis. In the case of the electrolysis of common salt, hydrochloric acid is added to the solution on the positive electrode side of the diaphragm, to neutralise the caustic soda which diffuses through the diaphragm.—G. H. R.

Improvements in Galvanic Batteries. G. Cohen, Manchester. Eng. Pat. 15,407, September 11, 1891.

THE elements are zinc and carbon, and the space between them is filled with a mixture of three parts sal-ammoniac and two parts calcium chloride dissolved in ten parts of water. About ten parts of plaster of Paris are then added, forming a solid exciting compound.—G. H. R.

Improvements in Ozonising Apparatuses. I. Eblis, Liège, Belgium. Eng. Pat. 16,806, October 3, 1891.

See under XVIII., page .

Improvements in and relating to Electric Accumulators. H. H. Lake, London. From La Société dite Electriciteits-Maatschappij, Gelnhausen, Germany. Eng. Pat. 17,160, October 8, 1891.

THE invention consists in filling up the spaces between the ribs of the lead grids used for the positive electrodes with a mixture of lead peroxide and red lead, and in the employment of finely-pulverised metallic lead as a filling for the negative electrodes.—G. H. R.

Improvements in or connected with Cells for Electrolysing Chloride Solutions. From T. Parker and A. E. Robinson, Wolverhampton. Eng. Pat. 6507, March 28, 1892.

THE improvement consists in making the anodes of phosphides of chromium, either pure or mixed with carbon, in order to prevent their being attacked by the liberated chlorine.—G. H. R.

Apparatus for the Production by Electrolysis of Chlorine and Alkalis. C. Kellner, Vienna, Austria. Eng. Pat. 9346, May 17, 1892.

THE apparatus in which the electrolytic decomposition of the solution is effected, consists of an iron trough having cast on one of its side walls partitions which terminate at some distance from the opposite side wall. This trough with its partitions constitute the cathodes, and in the intermediate spaces there are arranged frames of suitable acid and alkali-resisting material, such as glass or stone ware, which contain the anodes and diaphragms. The entire space between the diaphragms is filled with powdered carbon, in which are inserted rods or plates of carbon which serve as anodes. The diaphragms are made of slate or glass pierced with holes, which are so arranged that the holes in one diaphragm come opposite the solid portions of the next.—G. H. R.

Process for the Separation of the Alkali obtained by Electrolytical Decomposition of Halogen Compounds from the Electrolyte which has not been Decomposed. C. Kellner, Vienna, Austria. Eng. Pat. 9347, May 17, 1892.

THE object of this invention is to overcome the difficulty experienced in separating the alkali produced by the electrolytical decomposition of halogen compounds from the electrolyte which has remained undecomposed, as for example when obtaining caustic soda by the electrolytic decomposition of common salt. The liquor containing caustic soda coming from the electrolytic decomposing apparatus, is conveyed by means of a pipe to a precipitating apparatus where it is heated to cause the crystallisation of the sodium chloride. The pasty mass so obtained is conveyed into a displacing apparatus provided with a perforated false bottom covered with woven wire. A quantity of brine equal to the amount of caustic soda found by experience to be retained by the crystals is now added, and the displaced caustic liquor passes over into another vessel, is again evaporated and the entangled caustic soda is again displaced, and so on until a caustic soda solution of very considerable strength is obtained. The sodium chloride residue is re-electrolysed.—G. H. R.

Improved Process and Apparatus for the Electro-chemical Production of Bleaching Agents. C. Kellner, Vienna, Austria. Eng. Pat. 16,200, May 28, 1892.

ACCORDING to this invention the ions separated by the electrolysis are brought into contact with one another outside the decomposing cell to form a hypochlorite. The chlorine gas issuing from the vessel in which the electrolysis takes place, passes into the bottom of an absorption tower. The alkaline liquid coming from the cathode compartments, and containing the separated caustic soda, passes into an agitator where it is stirred violently to free it from any hydrogen gas which may have been carried over with it. From here the alkaline liquid is conveyed to the top of the scrubber and trickles down through the ascending chlorine gas.—G. H. R.

Improvements in Primary Voltaic Batteries. H. Weymer, London. Eng. Pat. 10,850, June 8, 1892.

ANY element can be removed or replaced in electrical connection with the others without involving any screwing or unscrewing, as in all cases the connections are made by hooks dipping into mercury contained in grooves cut in the cover of the battery box. The plates pass through slots cut in this cover and are suspended from it by the hooks.

—G. H. R.

Improvements in Secondary or Storage Batteries. From H. H. Lloyd, Philadelphia, U.S.A. Eng. Pat. 11,147, June 14, 1892.

THE improved battery plate consists in a conducting support which is perforated so as to form a lodgment for the active material which may be cast chloride of lead, with or without an admixture of chloride of zinc; and in order to retain the active material in the perforations, a rabbet or match joint is formed between the adjacent portions of each of the pieces of active material and the support. The support is protected from the action of the current by means of an acid-proof insulating cover, which is perforated by groups of small holes where it covers the active material.—G. H. R.

An Improved Process of Purifying Water. C. G. Collins, Woodburgh, New York, U.S.A. Eng. Pat. 11,989, June 28, 1892.

See under XVIII., page 770.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

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-
- Carbon Tetrachloride as a Solvent.* Ekeuroth. Pharm. Zeit. 1892, 338.
- CARBON tetrachloride is now produced so cheaply, that it may be recommended as a solvent for the extraction of fat from food materials, &c. The author recommends it with the more confidence also, since it is not inflammable. It is a colourless liquid of agreeable odour, bearing a certain resemblance to chloroform. It boils at 76.5° C. and has a specific gravity of 1.6319 at 0° C.—W. S.
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- PATENTS.
- Refining and Deodorising Refuse Oils and Fats.* E. S. Wilson, Camberwell, Surrey. Eng. Pat. 5340, November 12, 1883.
- THIS is an amended specification of the patent referred to in this Journal, 1884, 450.—J. L.
-
- Improvements in the Method of and Means for Manufacturing Soap.* J. Cathrein, Salzburg, Austria. Eng. Pat. 14,902, September 3, 1891.
- THE improved soap claimed by this patent belongs to that class of soaps which contain mineral oil, of which the patentee incorporates 100 per cent. with the fat stock. Special mixing apparatus has been designed.—J. L.
-
- Improvements in Apparatus for Distillation of Fatty Acids and other Substances.* L. Hugues, Paris. Eng. Pat. 15,287, September 9, 1891.
- THE novelty of this patent consists in the arrangement of two stills side by side in one furnace. Both stills are completely fitted up, and can be alternately connected with the same condensing apparatus. The material undergoes a preliminary heating by the gases of combustion in one still, whilst the material in the second still is being distilled by

means of superheated steam in the usual manner. The charge of the second still having been distilled off, the first still can be worked immediately by turning the superheated steam into it. The condensation of the vaporised acids is effected by the injection of cold water into the first receiving vessel or main condenser. Any vapour that may have escaped condensation is finally condensed in a second receiver arranged below the first receiver and communicating both with the top and bottom of the latter. An ejector worked by water under pressure ejects the condensed material and the water into a collecting tank.—J. L.

Improvements in the Manufacture of Lubricants. R. Hutchison, Cowlares, Lanark. Eng. Pat. 16,034, September 22, 1891.

THE composition of the improved lubricant for railway axles is 30 parts of mineral oil 0.905, 14 parts of oleic or similar fatty acid, and 1 part of slaked lime (weighed before being slaked). With 1 part of the prepared grease are intimately mixed 9 parts of "pinate of soda or of potash."—J. L.

Improvements relating to the Purification of the Residues or Cakes obtained from Fatty Substances, Oleaginous Fruits, or Grains. La Société Anonyme des Parfums Naturels de Cannes, Paris. Eng. Pat. 16,552, September 29, 1891.

To free the cakes, &c. which have been extracted by means of volatile solvents from the last trace of the solvents, steam is employed with or without a vacuum. To prevent all condensation, the cakes, &c. are previously heated by means of the superheated solvent to a suitable temperature, and then steam is admitted. The steam may be also superheated to prevent any condensed water being retained by the cakes.—J. L.

The Manufacture of an Improved Soap. W. R. Dodd, Stamford Hill. Eng. Pat. 16,557, September 29, 1891.

THE improved soap consists of ordinary hard or soft soap with which borax and camphor are incorporated.—J. L.

Improvements in the Art of Treating Vegetable Oils. G. W. Scollay, New York, U.S.A. Eng. Pat. 9292, May 17, 1892.

THE patentee uses in refining cotton-seed oil or similar oils certain ochres, as hematite and limonite, which are intimately mixed with the oils. The ochre may in some instances previously be mixed with dry caustic soda or borate of soda.—J. L.

Improvements in Detergent Compounds. W. P. Thompson. From W. B. Brittingham, New York, U.S.A. Eng. Pat. 10,765, June 7, 1892.

THE claims of this patent cover the mixture of the tungstates of sodium and potassium with soaps, it having been ascertained that these tungstates are possessed of considerable detergent properties.—J. L.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

The Oleo-Resin of Canarium Muellieri, Bailey; together with Notes on Manila Elemi. J. H. Maiden. Proc. Roy. Soc. Queensland, 3, 1891—1892, Part 3.

THE true source of Manila elemi being still a matter of uncertainty, the author has examined the resin which exudes from *Canarium Muellieri*, a tree growing on the Johnstone River, Queensland. This substance is of the consistence and general appearance of honey, and has a pleasant odour resembling that of turpentine and lemons. By digestion in cold alcohol, the latter becomes much more prominent, almost making the resin valuable as a perfume. The oleo-resin is readily soluble in petroleum spirit, chloroform, ether, absolute alcohol, and rectified spirit, but only partially so in 50 per cent. alcohol. On exposure to the atmosphere the scent becomes very much fainter, and by evaporation of the volatile oil, the resin steadily loses in weight, the loss in six months being 7.165 per cent. At the temperature of the water-bath, the whole of the oil is driven off only with difficulty, but by treatment of the oleo-resin with dilute alcohol and subsequent distillation at a temperature of 110°—123° C., it may be split up into 26.67 per cent. of a lemon-scented volatile oil, and 73.33 per cent. of resin. This residual resin is transparent and resembles in appearance gelatin. It is extremely brittle and contracts strongly on cooling. Its melting point is 75°—76° C., and it is soluble in the same liquids as the original oleo-resin. Examined under the microscope, it is seen to be perfectly devoid of crystalline form, thus distinguishing it from Manila elemi, which on treatment with rectified spirit yields (British Pharmacopœia, 1885) acicular crystals consisting of amyrin or elemi (Flückiger, Pharm. J. [3], 5, 142.)

—F. H. L.

Pentasilphide of Antimony. Th. Willm. J. Russ. Chem. Soc. 24, 1892, 371—388.

THE author undertook to discover the reason why when vulcanising caoutchouc and india-rubber with pentasilphide of antimony, varying results are so often obtained. He found that the method used for testing the good quality of pentasilphide of antimony by ascertaining the quantity of sulphur extracted from it by carbon bisulphide, is inaccurate and misleading. The author proposes to ascertain the total sulphur by oxidation with fuming nitric acid in a sealed tube. The liquid is then evaporated with strong hydrochloric acid till the nitric acid is completely expelled, and the sulphur precipitated as barium sulphate. In good samples of the pentasilphide the usual quantity of sulphur must be a little over the theoretical number, and when acted on with carbon bisulphide there must remain behind pure antimony trisulphide.—P. D.

Production of India-Rubber in Borneo. J. Soc. Arts, 40, 820.

THERE is a royalty charged on rubber collected from the jungles of Borneo of 10 per cent. *ad valorem*. The different species of the plant found are, according to the United States Consul at Singapore, (1) *Manungan pulan*, which comes chiefly from North-west Borneo; it is a *Willughbeia barbidgei*, and is specially identical with the "gutta-singgarip" of the peninsula; (2) *Manuan buyok*, said to yield the best gutta of the Borneo forest; it is a *Leuconotis engenifolius*; this species is also found in small quantities on the peninsula; (3) *Manungan manga*, which yields a very good gutta, is possibly a *Willughbeia*, as also is *Surupit*, for the latter yields the same milky exudation as *Manungan pulan*, but is said to be a bad gutta and seldom collected. *Bertabu*, or *Petabo pulan*, is referred to as of little value as gutta, except perhaps for adulterating the better kinds. The other

kinds of gutta met with in the Malay Peninsula are —(1) *Singgarip patch*, or *Gutta sudak*; (2) *Singgarip hitam*; and (3) *Gutta jelutong*—the latter is only used for adulterating. The gutta-percha production and export is much larger than the trade in india-rubber properly so called. The name is given to the inspissated juice, which is produced chiefly by *Dichopsis gutta*, called by the natives *Getah taban merah*, and often confused with caoutchouc. The tree is of large size, from four to five feet in diameter, and from 100 to 200 feet in height. When growing in the forest it has a clean straight stem, and it may be generally distinguished by the rich brown colour of the under surface of the leaves. The flowers are small, white, and divided into six petals and six sepals. The seeds—generally two in each fruit—are oily, and are eaten by birds and monkeys. It flowers in March, and the fruit ripens in June. The method of collecting the gutta is as follows:—A tree having been selected is felled, and as it lies on the ground, rings about an inch broad are cut in the bark at intervals all along the whole length of the trunk and of the branches, with a parang or Malay knife. These cuts soon become filled with the white, cream-like sap, and in about half an hour the gutta will have separated from the aqueous portion of the sap, and may be removed by rolling a small ball of it round in the cuts, to the edge of which the coagulated gum adheres and forms a disc, varying in size according to the number of scores it is rolled in. These discs are then boiled in water and made into balls, and sold by the collectors to the persons who export it to Singapore and Penang. The gutta is at first white, but soon changes to pink, and finally to a brownish red. The amount yielded by a single tree about 100 feet high, and whose age was estimated to be over 100 years, was 2 lb. 5 oz. of fairly clean gutta, valued by a Malay dealer at 3s. 3d. per pound. The product, therefore, of the whole tree is worth only 7s. 6d. Other species of the gutta tree in the Straits Settlements are (1) *Getah taban putih* (white); (2) *Getah taban sutra* (silk); (3) *Getah taban chayas* (liquid); and (4) *Getah taban simpur*. It is stated by the director of the Botanical Gardens at Singapore, that there are over 92 species altogether on the peninsula.—W. S.

PATENT.

An Improved Fabric, applicable for Tubing, Belting, Valve Sheetting, and other Articles of an Elastic Nature.
R. Temmel, Berlin, Germany. Eng. Pat. 10,637, June 4, 1892.

ARTICLES composed chiefly of india rubber, such as tubing, belting, &c., without their elasticity being destroyed, are rendered stronger and more durable by the insertion in them of strips of cane-wood, "preferably of the species known as Tokio cane." In the case of tubing, the strips (which measure up to 20 ft. in length) are wound spirally round a core of any suitable india rubber-coated fabric, and then covered by one or more layers of the india rubber coated fabric, and the whole finally vulcanised together. Tubing thus constructed offers great resistance both to internal and external pressure, this resistance being due to the flat shape of the cane strips and to their firm attachment to the rubber. Driving-belts are manufactured by embedding strips of cane-wood longitudinally side by side in two or more sheets of canvas, which have been previously coated on both sides with "liquid india-rubber." For valve-sheetting, the strips of cane-wood are either laid side by side in the middle of the sheets, or are interlaced in the same during the process of manufacture.—E. B.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENT.

A New and Improved Mould for Moulding Leather, Paper, and such like Pulp. G. Mahaffy, W. Rabley, and J. Westaway, London. Eng. Pat. 11,361, July 4, 1891.

THE invention consists in constructing the moulds of a porous material, such as wood of a suitable texture placed endways of the grain, so that the air and moisture contained in the pulp may penetrate the mould and be thus eliminated.

Drawings are given showing the application of the invention to the production of boot-heels from leather pulp.

—W. M. G.

XV.—MANURES, Etc.

Valuation of Superphosphates, Special Manures and Mixed Fertilisers of High Grade. Ann. Report of the Connecticut Agri. Exper. Stat. 1890, 20—21.

IN these manures the total valuation is obtained by adding together the trade values of the several ingredients. Organic nitrogen is taken at the price of nitrogen in raw materials of the best quality; insoluble phosphoric acid from rock phosphates at 1d., from other insoluble phosphates at 1½d. per pound; potash as chloride at 2½d., and any potash in excess of that required to satisfy the chlorine at 3d. per pound. Ground bone is sifted into four grades, the nitrogen and phosphoric acid in each grade are reckoned at their various trade values, then multiplied by the percentage proportion of the respective grades, and the sum of these separate computations is taken for the total valuation. The valuation price is generally below the selling price, the difference represents the manufacturing and other charges. In 1890, 12s. to 18s. per ton covered the cost of mixing, bagging, handling, and carting, and the average selling price of ammoniated superphosphates and guanos was 33·80 dols., the average valuation, 28·57 dols., whilst in the case of special manures the average cost was 39·18 dols., the average valuation, 32·90 dols. Valuation is useful:—1. For making comparisons between various manures; 2. For ascertaining whether a manure is worth its cost, as a trade commodity, for the more its cost exceeds its valuation the less the economy of its purchase. For the first purpose the same values must be used, but for the second purpose market variations have to be considered. It must be remembered that analysis does not accurately decide either as to the condition of the different ingredients, or about the mechanical state of the manure, therefore the valuation must not be too literally construed. D. A. L.

The Occurrence of Fluorine in Different Varieties of Natural Phosphates. Ad. Carnot. Compt. rend. 114, 1892, 1003—1006.

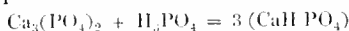
THE author has applied the comparatively easy method of estimating fluorine recently described by himself (this Journal, 1892, 710) in the analysis of various mineral and organic substances containing fluorine. The results of the examination of *mineral phosphates* are described in the present note.

I. Apatites.—The analysis of apatites (the fluorine being estimated directly) entirely confirms the theoretical formula $\text{Ca}(\text{F}, \text{Cl}) + 3(\text{P}_2\text{O}_5, 3\text{CaO})$ or $\text{Ca}_5(\text{O})_3\text{P}_3(\text{F}, \text{Cl})$, in which fluorine may be replaced by an equivalent quantity of chlorine and a little of the lime by magnesia or oxide of iron. **II. Phosphorites.**—Here complete analyses were not made, but only determinations of the phosphoric acid

and fluorine. It is found that semi-crystalline fibrous phosphorites have almost the same composition as apatites; whereas earthy and compact phosphorites contain a much smaller quantity of fluorine. III. *Sedimentary phosphates*.—These generally contain the same amount of fluorine as apatites containing an equal proportion of phosphorus. Careful analyses of phosphates from several localities have already been made by M. Henri Lasne, who came to the conclusion that sedimentary phosphates are in reality fluorophosphates having the same definite composition as apatite, *i.e.*, containing one equivalent of fluorine to three of phosphorus. The author's analyses entirely confirm these views.—D. E. J.

The Solubility of Tricalcium Phosphate and of Bicalcium Phosphate in Solutions of Phosphoric Acid. M. H. Causse. Bull. Soc. Chim. 1892, 165—169.

For determination of the solubility of the tricalcium phosphate six solutions were prepared containing 5, 10, 15, 20, 25, and 30 grms. of phosphoric acid in 100 cc. Stronger solutions could not be used owing to the deposition of crystals of monocalcium phosphate. An excess of tricalcium phosphate was added in small quantities to each of the six solutions which were allowed to stand for 24 hours. The lime in the filtrate was estimated as oxalate, and the phosphoric acid was titrated with uranium solution. The amount of action which has taken place can be calculated from the equation—



The maximum amount of tricalcium phosphate is converted to monocalcium phosphate by a 10 per cent. solution of phosphoric acid. Solutions prepared as above were heated to 100°C. in closed vessels. It was found that it was only in those solutions which contained free acid that an appreciable amount of bicalcium phosphate was formed.

The experiments on the solubility of bicalcium phosphate were conducted in precisely the same manner. The solubility of this salt is much less than that of the tricalcium salt. The maximum solubility is reached with five per cent. of free phosphoric acid. In the heat, the quantity of bicalcium phosphate formed increased regularly with the strength of the solution.

The author concludes from this investigation that tricalcium phosphate dissolves in solutions of phosphoric acid much more readily than the bicalcium phosphate, and that this difference of solubility depends upon the conditions of equilibrium between water, phosphoric acid, and monocalcium phosphate. The water appears to be the most important factor; it divides its action between the bicalcium and the monocalcium phosphate, and the only other determining condition is the proportion in which these two salts are present.—V. C.

Note on the Estimation of Potash. J. Jean Z. Trillat. Bull. Soc. Chim. 7—8, 1892, 228.

See under XXIII., page 775.

The Phosphates of Algeria and Tunis. Chem. Trade Journal, 1892.

It is significant of the interest now being taken in the deposits of phosphate of lime that the greater part of the *Bulletin de la Société Géologique de France* for the first half of last year should be given to a description of the phosphates of Algeria and Tunis by M. Philippe Thomas, and at the same time in the quarterly journal of the Geological Society of England should be a paper on the phosphatic chalk at Taplow, by Mr. A. Strahan.

These deposits recently found in Tunis and Algeria bid fair to rival those of Florida, and though they are both primarily Eocene deposits, they differ considerably in geological conditions; both, however, seem to be derived from the leaching of a phosphatic limestone. The new beds described by M. Thomas resemble very closely the

deposits of Ciply in Belgium and Taplow in England, except that they seem far more extensive. They are found on the "hauts plateau" of Tunis, and are distant about 200 kilos. from a seaport. A portion of them has been exhaustively examined by competent engineers. There are other tracts discovered but not yet thoroughly examined.

The phosphate occurs in well-defined strata, overlaid and underlaid by a more or less crystalline limestone, all tilted at an acute angle, so that the outcrop is distinct and readily traced, examined, and worked. This outcrop has been carefully examined and measured for a distance of 30 kiloms., though traced for about 60 kiloms. The beds in which the belts of phosphatic chalk occur have a thickness of from 30 to 50 metres. The richest bed had a mean width of 10 metres and will average 50 per cent. of phosphate of lime. This by washing can readily be increased to 60 per cent. or 65 per cent. tricalcic phosphate, and there is an abundant and constant supply of water. These phosphates contain less than 1 per cent. of iron and alumina, and very little silica. The engineers sent by the French Geological Survey estimate that there are at least 10,000,000 tons of 60 per cent. phosphate in sight, and it is presumed that as the strata are tilted the deposit will continue in depth, but they have only estimated what can be extracted without machinery. A railway is projected to reach these beds. Concessions for mining them have already been secured from the Government by a French syndicate, and it is expected that very shortly active development will begin and these phosphates placed on the market. Native unskilled labour is abundant and cheap.

MM. Tissot and Mercier, who have also examined these beds, prophesy that Tunis, which in the time of the Romans was known as the granary of the world, but which is now sterile, will regain its old fertility, as it is phosphate which has been lacking.

A great number of fossils were found and determined in the phosphate beds, and there is a large amount (8 per cent.) of organic matter present in composition. The phosphate is of a greyish to yellowish colour, with brownish pebbles, and seems to be physically identical with the deposits at Taplow and Ciply; there is the same matrix of phosphatic chalk, with fish coprolites and broken fragments of bone and teeth, fish scales, &c. The occurrence is also noted of a number of "pebbles" of a phosphate chalk, covered with a crust of dark coloured resinous phosphate which seems identical with some varieties of Florida "pebble."

The discovery is very interesting, and this section will probably provide at no very distant date vast quantities of phosphate, and may prove a formidable rival to South Carolina and Florida.

Researches on the Adherence to the Leaves of Plants, especially of the Potato, of Copper Compounds intended to Cure their Diseases. Aimé Girard. Compt. rend. 114, 1892, 234—236.

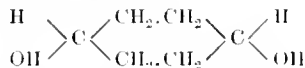
See under XVIII., page 770.

XVI.—SUGAR, STARCH, GUM, Etc.

Quinitol, the Simplest Sugar of the Inositol Group. A. von Baeeyer. Ber. 25, 1892, 1037—1040.

It having been shown by Maquenne (this Journal, 1890, 311) that the sugar- β -inositol—contains an aromatic nucleus, it being probably hexahydroxyhexamethylene, it was to be expected that derivatives of hexamethylene containing fewer hydroxyl-groups would also possess the characters of sugars. To put this question to the test, the author reduced *p*-diketohexamethylene (a compound obtained by hydrolising ethyl succinosuccinate) by adding

sodium amalgam to its aqueous solution, a current of carbonic anhydride being passed through meanwhile. The *p*-dihydroxyhexamethylene—



which is named quintol, when purified by means of its diacetyl derivative, melts at 143°—145°, and sublimes without decomposition. It tastes sweet at first and then bitter, and does not reduce Fehling's solution. The author is now engaged on the reduction of phloroglucinol, in the hope of obtaining another sugar, and by such a process as this, it may be possible to effect the synthesis of quercitol and similar sugars. It should be mentioned that the crude quintol is a mixture of two isomerides, only one of which is here dealt with.—A. R. L.

Notes on Analyses of Sugar, Molasses, Confections, and Honey. H. W. Wiley and others. U. S. Depart. of Agriculture. 1892, Bulletin 13, 673—676, 681—682, 710—719.

The total absence of any added matters to commercial sugars is shown by 500 analyses of samples purchased in different parts of the United States. An article was sold some years ago in large quantities under the name of "new process sugar" which was made by mixing corn-starch sugar, at 3—5 cents a pound, with cane sugar, then worth 10 cents a pound. Corn-starch sugar has never found a ready sale on account of the difficulty of drying it, and the manufacture of the anhydrous substance has proved a commercial failure. The low price of cane-sugar has heretofore prevented its adulteration with starch products. Modern methods of sugar-boiling at a low temperature (115°—120° F.) and the use of animal charcoal enable a great deal of low-grade sugar and water to be incorporated with sugars of a low price, which are, however, almost white, and find a ready sale for culinary purposes. The question being one of economy only, it may in general be said that a higher price is paid for the same amount of saccharine matter in the purchase of low-class than in that of high-class sugars. It is believed that maple sugar is adulterated with cheaper varieties, but the chemical identity of the sugar contained in the adulterant precludes its detection. If, however, the substance which gives to maple sugar its characteristic flavour could be quantitatively estimated, adulteration with a sugar containing none of it might be detected. Extract of hickory bark is said to possess the same flavour as maple sap, and in the event of adulteration with this, another difficulty would be presented.

The Colouring of Sugars.—The process of blue-ing to impart a whiter and brighter appearance is usually effected by suspending ultramarine in water, and applying it as a final wash in the centrifugal machine immediately before stopping it. In addition to this, some sugar-makers suspend a small quantity of ultramarine in water and draw it into the vacuum-pan a few minutes before the "strike" is finished, and it is not unusual to find sugars so excessively blued that they yield a blue syrup on solution. Ultramarine is, however, non-poisonous. The yellow clarified sugars of the plantations are treated in the centrifugal machine with a wash containing "tin crystal" (stannous chloride), and such of these sugars as are not treated with tin soon become a dead or greyish yellow; the latter are, however, only manufactured for the refiner. Stannous chloride is the principal constituent of the various sugar colours known as "rock compound," "Smith's sugar colour," &c. Tin can rarely be detected in sugars coloured in this way, and the yellow colour is probably produced by the action of stannous chloride on the sugar itself. In the manufacture of Demerara crystals stannous chloride is employed in the vacuum-pan, and it has now superseded sulphuric acid for this purpose. The stannous chloride passes into the molasses and becomes an objectionable constituent of this product. Lock and Newlands Brothers (Treatise on Sugar, p. 291) mention a harmless organic

yellow colouring matter which is used in the manufacture of imitation Demerara crystals, but it appears not to be used on the sugar plantations of the United States.

Open-kettle sugar is largely made in Louisiana by planters, the boiling being effected without vacuum apparatus, and the molasses, which fetches the highest price in the New Orleans market and for which there is some demand especially among bakers, is separated by simple drainage.

The price of maple sugar is out of all proportion to the amount of saccharine matter which it contains. The great stores of this variety of sugar offered for sale in comparison to the very limited supply have probably aroused the popular suspicion as to its adulteration mentioned above, but its annual output in the United States (20,000 tons) would be sufficient to supply a great demand; outside the area of its manufacture, it is chiefly used as a delicacy.

Molasses and Syrups.—It has already been mentioned that stannous chloride occurs in molasses, and copper (derived probably from the copper pans and coils used in evaporating the juices) is also sometimes present. Starch glucose is often found in syrups, and besides being cheaper than the genuine constituents of molasses (though at present the difference in value is small), it gives to the syrups a fine body and a light colour. A molasses or syrup, therefore, made chiefly of glucose, and flavoured with the refuse molasses of a refinery, makes a very attractive article for table use, and it is impossible to condemn glucose as regards its wholesomeness. Syrups containing glucose may be detected analytically by their high dextro-rotation both before and after inversion, as well as by the comparatively small quantities of sucrose which they contain. The following is a list of the bleaching agents supposed to be most commonly used for molasses:—(1) Sulphur fumes; (2) stannous chloride (about 1 oz. of a saturated solution to a barrel of molasses); (3) sulphites and sulphuric acid; (4) sulphite of soda and zinc-dust, with subsequent addition of oxalic acid to precipitate the zinc.

In his analyses of samples of molasses given in this report, F. G. Wiechmann states that from indications he has obtained as to the reactions of some of the samples with acids and alkalis, he is of opinion that tropaeolin dyes were used in colouring them (compare Cassal, Analyst, 1890, 141).—A. R. L.

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Pine Tree Honey-Dew and Pine Tree Honey. H. W. Wiley. Amer. Chem. J. 1891, 24; this Journal, 1891, 560.—A. R. L.

Methylsaccharine. O. Weber. Ber. 25, 1892, 1737.

See under XX., page 772.

Determination of Small Amounts of Sugar. M. Müller and F. Ohlmer. D. Zucker. Zeits. ang. Chem. 1892, 309.

See under XXIII., page 778.

The Influence of Acetates of Lead on the Estimation of Invert-Sugar by the Fehling-Sorhlet Method. A. Bornträger. Zeits. ang. Chem. 1892, 333—335.

See under XXIII., page 778.

The Separation of Iso-Maltose from the Diastatic Conversion Products of Starch. C. J. Lintner and G. Düll. Zeits. ang. Chem. 1892, 263.

See under XVII., page 766.

Determination of the Freezing Point of Dilute Aqueous Solutions, and the Application thereof to Cane Sugar. F. M. Raoult. Bull. Soc. Chim. 7—8, 1892, 130.

See under XXIII., page 780.

Vegetable Amyloid. E. Winterstein. Ber. 25, 1892, 1237—1241.

See under XVII., page 763.

XVII.—BREWING, WINES, SPIRITS, Etc.

The Chemistry of Fermentation. E. Buchner. Ber. 25, 1892, 1161—1163.

THE optical isomerides of various organic acids behave differently with moulds. Pasteur was the first to make use of this property when he separated the two tartaric acids.

It appeared probable that other organic acids which were as closely related, but in a different manner, would also behave differently with moulds.

Experiments made with maleic and fumaric acids showed that *Penicillium glaucum* grew vigorously in a solution of fumaric acid to which the proper nutrient salts had been added, but that under exactly the same conditions it would not grow in solutions of maleic acid, whilst in solutions of the mixed acids it grew easily. These experiments suggest a general method for separating such closely related organic acids, and will probably lead to other results of interest.

—A. L. S.

Vegetable Amyloid. E. Winterstein. Ber. 25, 1892, 1237—1241.

AMYLOID is a constituent of the cell wall, and yields a blue colouration with iodine. Reiss found that on digestion with sulphuric acid it yielded dextrose, but he does not appear to have worked with a pure body, and did not isolate the sugar.

The author has prepared the pure body from the seeds of *Tropaeolum majus*. They were powdered and successively treated with ether, hot alcohol, dilute ammonia, cold 1 per cent. soda solution, and cold water. The residue was extracted with hot water; the solution contained the amyloid, and was precipitated with alcohol and the precipitate dried. Amyloid thus prepared forms a white amorphous mass, which is insoluble in cold water and dissolves in hot water, forming a mucilaginous solution. It gives the same reactions as starch with iodine, and with Griessmeyer's reagents. The solution is dextro-rotatory, having $[\alpha]_D^{20} = +93.5$. It is unacted on by diastase. Oxidised with nitric acid it yields 10 per cent. mucic acid, and boiled with hydrochloric acid it yields 15.5 per cent. furfural. It contains 43.2 per cent. of carbon and 6.07 per cent. of hydrogen and no nitrogen.

Heated with 2½ per cent. of sulphuric acid, it is hydrolysed, and from the sugar syrup, galactose can be isolated; there is also present a pentose which appears to be xylose, and there are some evidences of the presence of dextrose. Amyloid prepared from *peonia officinalis* yields on hydrolysis a syrup having approximately the same composition. This seems to indicate that the substance described is a pure body. It appears to have the same constitution as starch, but composed of the elements of galactose and xylose instead of dextrose.—A. L. S.

The General Character of the German Wines. Zeits. Anal. Chem. Reported by Dr. Barth, 31, 1892, 143—157.

THE communication is accompanied by an exhaustive table of analyses, giving the specific gravity, alcohol, extractive matters, free acid, mineral constituents, phosphoric acid, glycerol, &c., of the different wines of the German wine-producing districts, and for each year from 1884 to 1890. Of these years 1884 produced the best wine, the remaining years standing in the following order of excellence:—1886, 1887, 1889, 1890, 1885, 1888.

Extract.—This varies considerably, the mean amount being 2.2 to 2.4 per cent., occasionally sinking as low as 1.5 and rising to 5.7 per cent.

The connection between the specific gravity of wine must, and the amount of dry solids it contains has not been properly determined, but the amount in 100 volumes of must closely approximates to that contained in 100 parts by weight of beer wort as given by Schultze's table.

By using these factors and determinations of sugar by the usual gravimetric method, it is possible to obtain an approximation to the amount of non-sugar present. Musts of 50°—85° Oechsle have from 2 to 3 per cent. of non-sugars of which rather more than one-half are neutral bodies.

Alcohol.—The amount of this is naturally dependent on the amount of sugar contained in the must which is influenced by a variety of conditions. The mean amount is 7.5 to 8 per cent., running in some cases to 12 per cent. and falling as low as 2.5 per cent.

The Relation between the Alcohol and Glycerol in a normal wine lies between 7 and 14 parts of glycerol to 100 parts of alcohol. In an abnormal wine from Longeville the proportion was as low as 5.8 parts, and in 1888 Alsatian wine was as high as 15.5 parts glycerol to 100 parts alcohol; though no doubt in the latter case, the proportion of alcohol had been originally higher, some of it having been destroyed by *mycoderma vini*.

Mineral Constituents.—These usually average 0.2 per cent. The addition of sugar lowers the quantity and the addition of the after-wine or yeast-wine raises it.

The riper and finer the grapes the larger is the quantity of phosphoric acid contained in the must and wine. Red wine contains more phosphoric acid than white wine.

The average amount of phosphoric acid is 0.02—0.04 per cent.; some wines contain as little as 0.004 per cent. and some as much as 0.09 per cent.

Relation between the Must and the New Wine.—The yield of alcohol is usually rather less than accords with Pasteur's numbers (48.4 per cent. of the sugar) owing to a small quantity of the sugar remaining unfermented. The amount of acid diminishes in musts of high or normal acidity, but does not alter with those of low acidity.

Changes during Storage.—The amount of acid still diminishes, and this is more marked with the more strongly acid wines; the diminution is not exactly balanced by the alteration in the amount of extract and consequently it appears as if some of the acid were destroyed by micro-organisms. The amount of alcohol also slowly diminishes; in a normal wine, the loss is 0.2—0.3 per cent. between the first and third racking.

Effects of Wine Diseases on the composition of the Wine.

Mycoderma vini destroys the alcohol, and also, if very vigorous, the acids and extract.

Mycoderma aceti converts the alcohol into acetic acid. If this appears early in the fermentation, the production of glycerol is diminished and part of the sugar is converted into optically inactive bodies.

The Ropy Ferment arises in wines owing to a variety of causes, usually when the normal fermentation is in some way stopped. Wine frequently becomes ropy if bottled too early.

The Blackening of wine is produced by the presence of iron and tannates.

The Brown colour of wine is due to rotten grapes. It may be removed by clarifying the wine with isinglass and racking it into a clean cask.

The production of a bitter taste in red wine is due to a decomposition of the tannin. The bacteria which produces this may be killed by Pasteurisation.

The so-called Bückser, a stench of sulphuretted hydrogen. This sometimes arises when the must ferments in the presence of sulphur, and is more easily produced with a vigorous fermentation than in a less active one. It may also be produced by the presence of metallic iron and an excess of sulphurous acid. The stench may be removed by drawing off into a clean cask and adding sulphurous acid.

Wine which remains for too long a time in contact with yeast, sometimes becomes yeast-bitten.

Lactic acid is also produced in wine when the normal fermentation is unduly prolonged.—A. L. S.

Symbiosis and Symbiotic Fermentation. M. Ward. Trans. Inst. Brew. 5, 1892, 55—82.

THE term symbiosis is used to signify the association of two organisms to the mutual advantage of both. Recent research has led us to believe that this is of more common occurrence than had been previously thought, and that many cases which were considered to be parasitism appear to be of a symbiotic nature.

A great number of examples of symbiosis are here given, amongst which is described the ginger-beer plant, recently investigated by the author (this Journal, 1892, 255). This consists of a symbiotic association of a yeast and bacterium, which is closely related to the lichens. (Bacteria have been recently shown to be modified algae, whilst lichens are a symbiotic association of a fungus and alga).

The bacterium of the ginger-beer plant forms thick gelatinous sheaths, and if grown in a saccharine solution, these render the whole solution gelatinous. There is no doubt that this is a symbiotic association, as both the yeast and bacterium grow better when mixed than when separate. If the yeast be placed alone in a saccharine solution, the fermentation will not proceed beyond a certain point, whilst

if the bacterium be present, this goes on much further. This might be accounted for by the bacterium removing products which prevent the further action of the yeast.

In the discussion which followed this paper, A. G. Salamon stated that in a stinking beer he had found empty yeast cells and micrococci, and he considered that the micrococci had bored their way into the yeast cells and therein produced a decomposition of the protoplasm which gave rise to the stink.—A. L. S.

Fractional Fermentation: a Contribution to the Study of the Amyloins (Malto-dextrins). G. H. Morris and J. G. Wells. Trans. Inst. Brew. 5, 1892, 133—172.

FERMENTING worts have been analysed at different stages of the fermentation; the results show that at the commencement the sugar fermented as calculated from the alcohol formed has a higher cupric reducing power and a lower optical activity than maltose; during the main portion of the fermentation the optical activity and reducing power of the sugar fermented, calculated in the same way, are the same as these factors for maltose; and that during the slow after-fermentation the sugar fermented as calculated from the alcohol produced has a lower cupric reducing power and higher optical activity than maltose.

These observations are explained by the fermentation of the ready formed sugars of the malt during the first stages, by the fermentation of the free maltose during the main portion of the fermentation, and by the fermentation of the malto-dextrins during the final stages.

These various stages of the fermentation are found to be very much influenced by the nature of the yeast, the temperature, and the character of the fermenting liquid.

The action of two pure yeasts from the Berlin experimental station has been studied. One of these (Frohberg yeast) attenuates malt wort from 10 to 15 per cent. lower than the other (Saaz yeast). If when the fermentation of a beer pitched with Saaz yeast had stopped, a little Frohberg yeast were added, the fermentation recommenced and went as far as it would have done had Frohberg yeast been used from the start. It is found that the refusal of the Saaz yeast to ferment further is due only to the want of fermentable matter, and that when it stops, all the free matter has been fermented; the cause of the further fermentation when Frohberg yeast is added is the degradation and subsequent fermentation of the malto-dextrins.

The properties possessed by these yeasts render them of great value in the analysis of malt wort, as the one may be used to determine free maltose and the other the fermentable malto-dextrins.

In a note the authors state that the inability of the Saaz yeast to ferment malto-dextrin arises from its want of diastatic power. Frohberg yeast and most brewery yeasts possess this power.—A. L. S.

A Contribution to the Study of Deplastered Wines. H. Quantin. Compt. rend. 114, 1892, 369—371.

DEPLASTERING of wines generally has for its object the elimination of any potassium sulphate present in excess over the limit allowed by law. According to the author, not only chloride, nitrate, and carbonate, but also tartrate, acetate, and phosphate of barium are employed for this purpose. In order to determine which particular barium salt was employed the author proceeds as follows:—In the first place, it is of importance to examine the lees or dregs of the wine for barium, because it is usually only in the dregs that the barium can be detected, in the form of an insoluble salt. If no dregs are available, it is very difficult to form an opinion as to the nature of the deplastering agent employed. Barium having been detected the wine is examined for chlorides, any excess of which points to the use of barium chloride. Barium carbonate is indicated by the absence of tartar and a deficiency of acidity in the wine, as well as by the presence of traces of dissolved barium. If the acidity be normal, and chlorides be absent, the dregs from the sample are washed free from

soluble sulphates, and digested with strong ammonium chloride solution. The subsequent presence of barium in this solution indicates the use of barium tartrate. If the above tests yield negative results, 100 cc. of the wine are exactly neutralised and evaporated to dryness on the water-bath. The residue is extracted with absolute alcohol, the solution evaporated to dryness, and the residue heated with phosphoric acid. An evolution of acetic acid may show:—

1. That barium acetate was used for deplastering purposes. 2. That the sample was partially neutralised in order to mask excessive acetification. In the first case the percentage of total potash in the wine will be normal; in the second case, the alkaline carbonates in the ash of the sample will be high. If the result be still negative, nitrates (derived from barium nitrate) are estimated by Pelouze-Schlösing's method. Finally, the use of barium phosphate is indicated by its presence in the lees. It is detected by igniting a portion of lees, moistening with ammonium sulphate, again igniting and extracting the phosphate by warm dilute hydrochloric acid. The wine itself, in such cases, generally contains an excess of alkaline phosphates.

—H. T. P.

The Process of Mashing and Fermenting from the Distillers' Point of View. W. J. Sykes. Trans. Inst. Brew. 5, 1892, 175—186.

In this paper the author considers the factors which favour:—

1. The maximum extraction of starch from the materials used, and its conversion as far as possible into maltose.

2. The maximum production of alcohol.

1. To realise the first point the malt employed should be as highly diastatic as possible. It should be grown at a low and even temperature (65°—68° F.) and the aërospire allowed to develop three-quarters to full length, but not more, or loss of diastase will ensue. Afterwards the malt should be dried at a temperature not exceeding 123° F. Green malt is much used on the Continent, but it is not so well suited for the production of vigorous yeast, and should not be employed at all if the yeast crop be intended for bakers' purposes. The mashing heat must be as low as possible consistent with proper extraction of the starch. In practice it is usual to start the mash cold, or nearly so, heat quickly to 122° F. and then very gradually to 150° F. or even 158° F. in the case of very strong mashes. Excess of acidity must be carefully guarded against, for even a comparatively small percentage of acid (lactic, butyric, &c.) greatly cripples the diastase. The subsequent sterilisation of the wort by boiling is, of course, not admissible; but the bacterial organisms present (with one or two exceptions) are sufficiently paralysed for practical purposes by keeping the mash for half an hour at 150° F.

2. The fermentation process may be divided into the three stages of yeast reproduction, main fermentation, and after-fermentation. A large yeast reproduction at the beginning of the fermentation is most essential, and is secured by suitable temperature and proper aëration of the wort. 82° F. appears to be the best temperature (Pedersen), and it is for this reason that often in practice the yeast is added to the wort on the cooler when its temperature has fallen to 82° F. According to Hayduck the richness of the yeast and wort in nitrogenous constituents also has an important bearing on the reproductive and fermentative energy of the yeast. The yeast used should be vigorous and well matured and as pure as possible; for any considerable bacterial contamination not only hinders yeast reproduction, but ultimately leads to the excessive formation of bodies other than alcohol (acid, &c.). In this connexion cleanliness of plant is of the greatest importance.

In the main fermentation the bulk of the maltose is fermented, and it appears from Foth's researches that the maximum yield of alcohol is obtained at 81.5° F. This holds good in practice, and it is therefore necessary to keep the temperature of the wort down by careful attenuating. Yeast reproduction practically ceases when 5 per cent. by volume of alcohol has been formed (Hayduck).

After-fermentation, which lasts about four days, is most advantageously carried on at 77°—87° F. During this period the more stubborn bodies, dextrin and isomaltose

(this Journal, 1892, 171; also 627) are fermented, the former, itself infermentable, being previously converted into maltose by the action of the diastase remaining in the wort. This explains why the wort is not boiled after mashing. An excess of acid in the wort must therefore be avoided for the same reason as before—because it cripples the diastase.

Theoretically, 1 lb. of starch will yield 0.5678 lb. of alcohol; but in practice, under the most favourable conditions, only 88.3 per cent. of this amount is obtainable, whilst in bad working, this may sink to 72.5 per cent. The sources of loss are:—non-extraction of a portion of the starch; incomplete fermentation; conversion of a portion of the carbohydrates into by-products, such as acetic and other acids, fusel oil, &c.; consumption of a portion of the sugars by the yeast for food; and loss of alcohol by evaporation.—H. T. P.

The Fermentability of Dextrins. L. Mediens and C. Immerheiser. Zeits. Anal. Chem. 30, 1891, 665—668.

In the course of their analytical practice the authors condemned some samples of wine as containing potato glucose, the presence of which was inferred from the marked dextro-rotatory action of the samples on polarised light. This conclusion was disputed, however, because it was observed that the optical activity of the wines could be reduced to zero by fermentation with pressed yeast; and it was suggested that the original dextro-rotation was due to a "difficultly fermentable dextrose" derived from the grapes. To decide the question, several of the samples were "pitched" with pressed yeast and fermented for several weeks. In each case the polarisation dropped to zero. That the substance thus fermented away was dextrin, however, and not dextrose, was proved by the fact that the original wines on complete inversion, exhibited a distinct increase in reducing power. Besides, v. Raumer has recently shown (Zeits. ang. Chem. 1890, 421) that the dextrin of potato glucose is by no means perfectly stable under the influence of pressed yeast. Further experiments were made with two inferior potato glucoses. Solutions were prepared containing 40 grms. in 250 cc., and pitched with 10 grms. of pressed yeast. Fermentation was allowed to proceed for the first six days at the ordinary temperature, afterwards at 30° C. The following results were obtained:—

	I.	II.
Original polarisation	+ 17.70	+ 17.70
Polarisation after 6 days	+ 3.55	+ 32.30
" " 11 "	+ 1.79	+ 1.79

On the 14th day the solutions were filtered and treated with 8 grms. of yeast each. Polarisation after 23 days, + 0.55, and + 0.25. Again filtered and 10 grms. fresh yeast added to each. Polarisation after 32 days $\pm 0^\circ$, $\pm 0^\circ$.

Similar results were obtained with the dextrins isolated from the above glucoses by means of alcohol. The authors, therefore, adhered to their original opinion that the wines in question were adulterated with glucose.—H. T. P.

Note on the Fermentability of Dextrins. C. J. Lintner. Zeits. ang. Chem. 1892, 328—330.

REFERRING to Mediens and Immerheiser's recent communication (Zeits. Anal. Chem. 1891, 665; this Journal, see preceding abstract), the author is of opinion that their experiments by no means demonstrate the fermentability of dextrins. In the first place, the "non-sugars" existing in the commercial glucose employed in the said experiments were assumed, without sufficient proof, to be dextrins; but recent researches, especially by Wohl (this Journal, 1890, 957—958), have shown that these non-sugars consist in reality largely of "reversion-products" formed from dextrose by the action of acid. These bodies resemble dextrin, but are probably not identical with it. Apart from the above consideration,

however, the use of pressed yeast (*i.e.*, a mixture of numerous species of yeast and bacteria) as fermenting agent, is sufficient to condemn Medicus and Immerheiser's conclusions, for it is well known that under the combined influence of yeast and bacteria, even starch itself is attacked. From his own researches the author is of opinion that dextrin produced from starch by diastatic action is not fermentable by *S. cerevisia*, and this statement is probably also true in the case of acid-formed dextrin.—H. T. P.

Precipitation of Raffinose by Ammoniacal Lead Acetate.

T. Koydl. Oesterr. Z. Zucker. 1892, 92.

See under XXIII., page 778.

Note on Wines containing Potato Glucose. W. Fresenius. Zeits. Anal. Chem. 30, 1891, 669—672.

In this paper the author describes some experiments which confirm, and to some extent complete, the results obtained by Medicus and Immerheiser (see preceding abstract). The conclusions arrived at are:—

1. The so-called "unfermentable" constituents of commercial potato glucose are completely fermentable by means of pressed yeast, but are not affected by beer yeast.

2. The said unfermentable bodies, when present in wine, are destroyed and consequently disappear under the influence of film formation, due to exposure to air. This point is of importance, in so far that samples of wine on which a film has appeared should not be employed for analysis, especially when an opinion is required regarding the presence or absence of potato glucose.—H. T. P.

On Beers Brewed in Portugal. H. Mastbaum and F. Dickmann. Zeits. ang. Chem. 1892, 201—203.

Up to quite recent times, beers brewed in Portugal, both on the top and bottom fermentation systems, were of very indifferent quality. However, within the last year or two, German brewers have found their way into the country, and some very fair bottom fermentation beer is now produced. The following table contains the results of analyses of some of these beers:—

	Jansen, Pipa.	Jansen, Pilsen.	Trindade, pretin- garrafada.	Trindade, Munich.
Colour.....	Light	Light	Dark	Dark
Specific gravity at 15° C. ...	1.0064	1.0121	1.0215	1.0169
Acid as lactic acid	0.343	0.188	0.148	0.142
Alcohol, per cent.....	3.88	4.60	3.82	4.06
Extract	3.28	5.04	7.42	5.84
Ash.....	0.187	0.241	0.243	0.210
Phosphoric anhydride	0.044	0.050	0.043	0.084
Glycerol	0.015	0.033	0.025	0.050
Maltose	0.62	1.04	2.12	1.51
Dextrin	1.61	2.50	3.63	2.38
Nitrogen.....	0.050	0.093	0.091	0.102
Wort solids	10.85	14.03	14.30	13.61
Degrees of fermentation....	69.77	64.07	50.20	57.18
Sugar: Non-sugar in the wort.....	1:0.32	1:0.40	1:0.55	1:0.46
Nitrogen in the wort, per cent.....	0.54	0.66	0.61	0.74
Ash in the wort, per cent. .	1.72	1.71	1.63	1.76
P ₂ O ₅ in the wort, per cent. .	0.44	0.35	0.29	0.61
State of the beer	Turbid	Clear	Clear	Clear

—A. L. S.

On the Apparent Proportion between the Dextrose and Levulose in Dark Brown Malaga Wine and other Similarly Prepared Wines. A. Bornträger. Zeits. ang. Chem. 1892, 207—208.

THE great proportion of sweet wines contain an excess of levulose over dextrose. There are, however, wines which apparently contain an excess of dextrose over levulose. It is difficult to see how this can be the case if the wines only contain these two sugars, as dextrose is more easily fermented than levulose, and consequently it has usually been assumed that starch sugar has been added to such wines. The author finds that dark brown Malaga wine and other similar wines apparently contain more dextrose than levulose; but he finds that this is owing to the production of dextro-rotatory unfermentable sugar produced by heating the must in the process of manufacture. He proposes to carefully investigate this point.—A. L. S.

The Separation of Iso-Maltose from the Diastatic Conversion Products of Starch. C. J. Liutner and G. Düll. Zeits. ang. Chem. 1892, 263—268.

ISO-MALTOSE was first discovered by one of the authors (this Journal, 1892, 171, 627) in beer and wort, from which it was separated as "iso-maltosazone." In the present paper voluminous details are given of the process by means of which the authors succeeded in isolating iso-maltose from the products of the diastatic conversion of starch. Briefly, a starch conversion (made at 67° C.) was concentrated, after previous removal of the maltose by fermentation, and submitted to dialysis, the diffuse and residue being subsequently repeatedly fractionally precipitated with strong alcohol. By this means two fractions of constant specific rotatory power were finally obtained. The one fraction (remaining in solution) $[\alpha]_D = +140^\circ$, consisting of iso-maltose; the other (precipitate) $[\alpha]_D = +190^\circ$ of dextrin. No intermediate dextrins possessing an optical activity between 140° and 190° could be detected amongst the starch products. This fact renders the existence of the so-called "malto-dextrins" extremely problematical.

Iso-maltose has not yet been obtained in the crystalline state. Absolute alcohol precipitates it from its solutions in the form of a viscid syrup which solidifies after several days standing in contact with absolute alcohol. Iso-maltose possesses a sweet flavour. Its specific rotatory power in 10 per cent. solution is $[\alpha]_D = +139^\circ$ — 140° , and its eupric oxide reducing power (in 1 per cent. solution) is equal to 83 per cent. of that of maltose. Iso-maltose is very sensitive to heat, being distinctly caramelised at temperatures exceeding 90° C., and when quite dry it is exceedingly hygroscopic. It is fermentable by yeast, and diastase converts it into maltose. In conclusion, the authors give details of the most suitable method of preparing iso-maltose from starch.—H. T. P.

Aluminium and Beer. Zeits. ang. Chem. 1892, 299—300.

BEER may be kept in clean aluminium flasks without contracting any unpleasant taste. It was found that some beer kept for three weeks in an aluminium vessel had taken up but the smallest traces of aluminium; the highest amount that could be found being 0.8 mgrm. per 100 cc. of the beer.—A. L. S.

The Influence of Different Temperatures on the Condition of Malt and the Composition of the Wort obtained therefrom. E. Prior. B. Brauer, 1892. Zeits. ang. Chem. 1892, 312—318.

A MALT was dried for 24 hours on the upper floor of an Engellhardt kiln at 20° R., and then on the lower floor without raising the heat and with closed draught for 12 hours more and finished with 4 hours at 35° R. The malt was analysed both before and after drying; the reducing sugars were respectively 12.58 and 13.74 per cent. on the anhydrous malt and the fermentative powers were respectively 88.9 and 134.0. These numbers are in

accordance with the knowledge acquired in practice, that by properly conducted withering the soluble matter of the malt is considerably increased.

Malt was dried with a free supply of air at various temperatures ranging from 35° to 80° R. The dried malts were analysed and the following relations were observed as the drying temperature was raised :—The water in the dried malt diminished, the fermentative power decreased, the duration of saccharification increased, the proportion of maltose to non-maltose decreased, as did also the absolute amount of maltose contained in the extract; the colour of the resultant wort increased and the number of brown corns likewise. These malts were mashed and the worts obtained examined. The reducing sugar calculated as maltose was found to be in part easily fermentable and in part unfermentable. In the wort prepared from malts dried at the higher temperatures the amount of fermentable maltose is less and of unfermentable maltose is greater than in wort prepared from malt dried at a lower temperature.

The relation between the fermentable and unfermentable maltose is not a fixed and definite quantity, but depends on the yeast employed: thus with two yeasts, A and L, yeast A always fermented about 6 per cent. of the total maltose more than yeast L, no matter at what temperature the malt had been dried.

The author considers that the only products of the mashing process are maltose, an unfermentable reducing body, and dextrin. The unfermentable reducing body must be either iso-maltose or malto-dextrin. Now the result of the fermentation of wort prepared from the malts dried at different temperatures show that the decrease in the amount of fermentable maltose in the high dried malts is balanced by the sum of the increase in the amount of unfermentable maltose and dextrin. Also, if the unfermentable residue be tested with phenyl-hydrazine it is found that maltose and other sugars are absent, but that iso-maltose is present.

From these facts the author concludes that there is no such substance as malto-dextrin present in the worts, but that the unfermentable reducing substance is iso-maltose.

In the preparation of the above worts, the whole of the diastase acted on the malt between 45° and 70° and the mash was kept at the last temperature for one hour. Under these conditions the amount of maltose formed was the maximum possible and was practically constant at whatever temperature the malt was dried at so long as there remained an excess of diastase, being about 75 per cent. of the total extract; the remaining 25 per cent. consisted of dextrin, albuminoids, ash, &c., and is the minimum amount which will be produced in any transformation, and consequently may be taken as a constant constituent of all worts. The remaining 75 per cent. is subject to alteration in composition when the drying has destroyed a portion of the diastase, in which case a portion of the maltose will be replaced by an equivalent amount of dextrin.

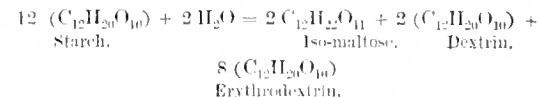
Besides the maltose produced during mashing, there is present in the malt a certain amount of ready formed sugars. The amount of these was determined and the proportion of them that is fermentable. It was found that the amount of fermentable maltose ready formed in the malt dried at 45° to 50° was 10 per cent., and that this decreased as the temperature of drying increased, being 8.3 per cent. in malt dried at 75°; the decrease the author considers converted into caramelised bodies. The amount of unfermentable maltose ready formed in the malt was practically the same in malt dried at any temperature between 45° and 75°, being 1.8 to 2.0 per cent.

By comparing the results thus obtained with the previous ones, it appears that as the amount of fermentable maltose decreases in the higher dried malts, its place is taken by an equivalent quantity of dextrin; the numbers being for malt dried at 45°, 52·8 per cent. maltose and 12·0 per cent. dextrin; and at 75°, 40·0 per cent. maltose and 25·4 per cent. dextrin, whilst the amount of iso-maltose produced at the same time is practically constant, being about 12·8 per cent.

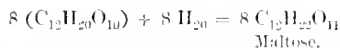
The amounts of transformation products obtained from malts containing an excess of diastase is 52.3 per cent.

maltose, 12.9 per cent. iso-maltose, and 12.0 per cent. dextrin, being in the proportion of 8 molecules maltose, 2 molecules iso-maltose, and 2 molecules dextrin.

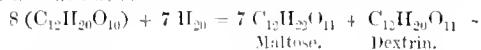
The transformation of starch may be accordingly represented by the equation—



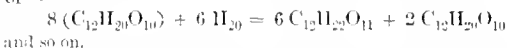
and—



If the amount of diastase is insufficient, the last equation becomes modified; thus—



or—



Further analyses of the worts were made in which various portions of the diastase, from none to nine-tenths, were destroyed, and it was found that the amount of iso-maltose was practically the same in all the worts, but that the relative amounts of maltose and dextrin varied according to the amount of diastase present. These facts bear out the above theory.—A. L. S.

Wort and Beer. C. Amthor. Zeits. ges. Brauw. 1892;
Zeits. ang. Chem. 1892, 318—320.

SAMPLES of fermenting wort taken at different stages of the fermentation were examined. It was found that the matter fermented during the first day had a less optical activity than maltose; that the matter fermented on the succeeding three days had about the optical activity of maltose, and that the matter fermented during the slow fermentation succeeding had a greater optical activity than maltose, and that in the last stages of the fermentation the optical activity of the fermented matter was double that of maltose.

Further experiments showed that the low optical activity of the matter first fermented was due to the ready-formed sugars of the malt, *i.e.*, cane sugar, dextrose, and levulose. Further, it was found that young beer, finished beer, and beer of some age, when digested with invertase, showed a diminution in optical activity and a gain in reducing power. This cannot be due to cane sugar, which must long ago have been fermented; it must be due to some other constituent of the beer, which may be malto-dextrin or isomaltose.—A. L. S.

Boric Acid in Wines. M. Gassend. Bull de Pharm.
de Bordeaux, 128.

THE author has discovered that boric acid exists in the normal condition in wines. When the residue from a quantity of wine treated with alcohol and sulphuric acid, fails to impart a green colouration to the flame of the former, the presence of the acid may still be indicated by the reaction with turmeric paper and by its spectroscopic character. This discovery is pointed out as interesting, considering the recently introduced French Statute forbidding the addition of boric acid to wines.—W. S.

Determination of Phosphoric Acid in Wine. M. M. Morgenstern and Pavlinoff. J. Russ. Chem. Soc. 1892, 341.

See under XXIII., page 777.

Determination of Chlorine in Wine. W. Siefert. Zeits. Anal. Chem. **31**, 1892, 186.

See under XXIII., page 778.

The Influence of some Metallic Salts on the Lactic Fermentation. C. Richet. *Compt. rend.* **114**, 1892, 1494—1496.

See under XVIII., page 770.

ERRATUM.

Page 699, col 2, line 25 from bottom, for "*Bacillus Amylozymicus ferment*" &c, read *Bacillus Amylozymicus ferments*, &c.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOODS.

Changes in Chalybeate Waters during Storage. J. Riban. *Compt. rend.* **114**, 1892, 1483—1485.

With respect to the changes undergone by mineral waters in the bottle, a subject recently brought forward by Parmentier (*Compt. rend.* **114**, 1363), the author recounts his experiences with chalybeate waters. From the analysis of twelve different waters obtained from the best Parisian pharmacies, he shows that nearly all the iron that was originally held in solution in the water had been precipitated, and the small quantity that remained in solution was generally in the ferric state. These waters must therefore be considered as unreliable therapeutical agents. The ferrous iron in solution was determined with permanganate, and the total iron by the same standard reagent after reduction with zinc. The presence of organic and sulphurous matters in the waters does not in the author's opinion practically affect the analytical results by this method, when the operation is conducted in the cold, as the decolouration of the permanganate by most organic matters is slow and progressive.—F. W. P.

Changes in Chalybeate Waters during Storage. J. Riban. *Compt. rend.* **115**, 1892, 185.

In reply to a further communication by Parmentier (*Compt. rend.* **114**, 1483; see preceding abstract), the author says that he obtained the samples for analysis from a pharmacy in order that the ordinary conditions of the therapeutical employment of foreign mineral waters should be attained. The analytical method he maintains to be sufficiently reliable and his results to have been confirmed by Le Chatelier (*Compt. rend.* **115**, 124). The author condemns the practice of surcharging mineral waters with carbonic acid as altering the composition of the water and thus affecting the conditions under which its therapeutical action has been established.—F. W. P.

Bibliography of Honey: arranged Chronologically. U.S. of Agriculture Bulletin **13**, 1892, 871.

See under XVI., page 761.

PATENTS.

Improvements in the Preparation of Fish for Use as Food. P. W. Schönauf, Flensburg, Germany. Eng. Pat. 13,811, August 15, 1891.

THE cleaned fish are packed with dry salt, dried at 110°, ground into fine fibres, and mixed with vegetables in the proportion of 1 lb. of dried fish to 3 lb. of vegetables; condiments are added and the mass worked up into cakes

which are baked at 110°. The cakes are preserved in a gelatin "obtained by a decoction of the cuticle surrounding the bone of fish, with the addition of a minute quantity of alum and carbonate of soda."—A. G. B.

A Method and Apparatus for Manufacturing Malt Coffee. E. Wilhelm, A. Brongier, and H. Trillich, Munich, Germany. Eng. Pat. 14,755, September 1, 1891.

THE malt is soaked in water at 40° and dried in a coffee-roaster until the grains are glassy brown, when it is sprinkled with hot water and the roasting continued in order to loosen the cuticle of the malt. A liquid having the aroma of coffee, and prepared as described below, is then sprayed into the roaster, which is kept revolving; when the spray is discontinued the malt is further heated until dry. The roaster is removed from the fire, and after the malt has cooled somewhat, a little cocoa-butter or other fatty matter is introduced, and the rotation continued until the malt-coffee has been coated with a fatty layer.

The coffee-liquid is made by condensing the vapours arising in the roasting of coffee. The condensed liquid is concentrated by distillation and neutralised by sodium bicarbonate. Sufficient sugar is then added to make a syrup. Extract of unroasted coffee may be substituted for the condensed vapours.—A. G. B.

Improvements in Milk Sterilisers. A. Cornaz, Neuchâtel, Switzerland. Eng. Pat. 16,787, October 2, 1891.

THE steriliser consists of a cylindrical jar having its top enlarged in the form of a conical collar shaped "like the frustum of a cone," and making an angle of about 135° with the wall of the jar. The milk is boiled in this until sterilised, overflowing being avoided by the conical top. The apparatus is provided with an ordinary saucepan handle.

—A. G. B.

An Improved Process for the Preservation of Meat. S. Pitt, Sutton, Surrey. From J. Mariosa, Sao Paulo, Brazil. Eng. Pat. 3462, February 22, 1892.

THE meat is dipped into, or painted with, a paste made of 40 parts of sodium bicarbonate and 60 parts of saccharine matter, such as sugar, and enough water to produce a syrupy condition. The piece thus coated is hung in the air for an hour and then in an artificial current of air, until the surface is thoroughly desiccated.—A. G. B.

Improvements in the Manufacture of Compound Cakes for Cattle Feeding and the like. J. Bibby, Liverpool. Eng. Pat. 9667, May 21, 1892.

THE present process of making compound cakes consists of five distinct operations, namely:—(1) Grinding the particular oil-seed; (2) pressing the same to extract the oil; (3) re-grinding the cake thus made into meal for mixing; (4) mixing the same with farinaceous matter, ground cereals, &c.; (5) Re-pressing the whole into a compound cake.

This invention dispenses with operations (3) and (4) by grinding the seeds first, then mixing them with each other and with the farinaceous or other material, in the desired proportion, and finally crushing the mixture to obtain oil and the compound cake.—A. G. B.

Improvements in or relating to the Manufacture of Salt (Chloride of Sodium). W. P. Thompson, Liverpool. From A. L. Lawton, Rochester, U.S.A., and W. S. Dodge, Washington, U.S.A. Eng. Pat. 9884, May 24, 1892.

THE improvements refer to the production of table salt from impure rock salt, by fusing the same with an admixture of $\frac{1}{2}$ —2 per cent. of lime or other alkaline matter, and

settling out the impurities. The clear fused salt is then run out and reduced to small globules by means of an "atomiser" worked by an air-blast.

The apparatus consists of an inclined retort provided with horizontal steps for the reception of the salt. This is introduced on the top by means of a hopper. The salt is brought to fusion by means of a fire from the bottom part of the retort, and the fused material is collected in a receptacle where the impurities settle out.

All vessels are lined with a basic infusible material such as lime and clay, to prevent the formation of sodium silicate.—H. A.

Improvements in and relating to the Production of an Alimentary Product from Indian Corn or Maize. H. Bates, Indianapolis, U.S.A. Eng. Pat. 10,788, June 7, 1892.

THE corn is first hulled and degerminated, then fed into a broken-flighted conveyor trough where it is sprayed with water by means of a rose situated immediately above the point of delivery from the hopper. In traversing this conveyor the wetted grains are tumbled together and the moisture thus equalised. To avoid "possible undue saturation," the grains are delivered from the tail end of the broken-flighted conveyor into a dry continuous conveyor trough, from which they pass into another continuous conveyor, provided with half a dozen shoots located immediately above the flattening mills. Expedition is the advantage claimed.—A. G. B.

Improvement in Means for Preserving Meat and the like. J. Y. Johnson, London. From H. Salzer, Baltimore, U.S.A. Eng. Pat. 11,988, June 28, 1892.

THE meat is subjected to dry steam in a closed vessel allowed to cool and compressed in moulds for about six hours. It is next wrapped in a suitable material such as paper and enclosed in a tightly-fitting jacket of fabric impregnated and coated with plaster of Paris. When the plaster has set the coated article is put into a can; grease (suet, lard, or tallow) is run in and the whole sterilised before being sealed. So much grease is absorbed by the plaster that the contraction on cooling does not destroy the protective coating as is usually the case. Metallic foil can be substituted for the can, but in this case another plaster coating must be applied outside the layer of grease, to prevent the latter from making holes in the foil during the heating necessary for sterilisation. When a can is used it is desirable to prevent contact of the package with the interior of the can, for "it is well known that meat enclosed in cans undergoes distinct changes, and acquires a foreign and disagreeable flavour, induced by contact with the metal. The latter is a good conductor of what may be termed telluric influences, and these changes are believed to be due, in part at least, to that fact." The inventor fixes projections of a non-conducting substance to the interior of the can to prevent this contact.—A. G. B.

(B.)—SANITARY CHEMISTRY.

The Impurities of Town Air. Dr. G. H. Bailey. The British Association (Chemical Section), Edinburgh, 1892.

DR. BAILEY said that during the past year the Air Analysis Committee of Manchester, in conjunction with the Royal Horticultural Society, had been engaged on the analysis of the air of large towns. From the results of several hundreds of analyses in London, Manchester, and Liverpool, the following conclusions were drawn:—(1) That in clear breezy weather the amount of sulphurous acid was less than 1 mm. per 100 cub. ft. of air; (2) than in anti-cyclonic periods it rose very considerably, and in times of fog the maximum of 34 to 50 mm. had been recorded for the worst districts of Manchester and London respectively; (3) that wherever an open space or a less densely populated area occurred there was a very marked diminution in the amount of impurities in the air; (4) that an increase in the amount of sulphurous acid was accompanied by at least as large an

increase in the amount of organic impurities in the air; (5) that smoke, promoting as it did the formation of fog and preventing free diffusion into the upper strata of the air, must be regarded as the principal cause of the impure state of the atmosphere in large towns.—W. S.

PATENTS.

Improvements in Apparatus for Purifying Water or other Liquids. R. S. Brownlow, Manchester. Eng. Pat. 15,172, September 8, 1891.

THIS is an addition to a previous patent (16,006, 1890; this Journal, 1891, 128), and relates to a continuous, sewage depositing apparatus. The improvements consist in an alteration of the number, form, and arrangement of the baffling plates, with the object of rendering the passage of the sewage through the apparatus more smooth and tranquil.—H. T. P.

Improvements in the Oxidation of Sewage and Impure Waters, and of Material for Use in the Treatment of such Sewage and Impure Waters. F. P. Candy, Balham, Surrey. Eng. Pat. 15,391, September 11, 1891.

THIS invention relates to the manufacture of a precipitant and oxidiser for sewage. For this purpose, ferrous sulphate, or chloride in solution is mixed with about 15 per cent. of its weight of true sulphuric or hydrochloric acid, respectively, and churned in a cylinder with an excess of manganese dioxide, or ferric hydrate, until 50–80 per cent. of the ferrous salt is oxidised to the ferric state. Oxidation may also be effected by slowly filtering the acidified solution through a layer of the oxides. Bauxite may likewise be added to the mixture, with sufficient sulphuric acid to convert it into aluminium sulphate. In treating sewage, a quantity of the above compound containing from 2 to 14 grains of the original ferrous salt may be added to each gallon of sewage. A solid preparation, suitable for transport, is obtained by grinding together the ferrous salt, acid, and manganese dioxide (5–8 per cent.), or ferric hydrate (15–20 per cent.), and allowing the mass to set. According to this invention, sewage may also be purified by agitation in a suitable vessel with granular manganese dioxide, the average time of contact being about five minutes.—H. T. P.

Improvements in Ozonising Apparatuses. J. Ehlig, Liège, Belgium. Eng. Pat. 16,806, October 3, 1891.

THE ozonising apparatus consists of a wooden box supported on four feet, and entirely open towards the bottom. The cover is pierced with a hole in which is screwed a trumpet-shaped mouth-piece or inhalation tube. A sealed glass tube containing air or other gas under more or less pressure, or in which a more or less perfect vacuum has been produced, passes through holes in opposite sides of the chamber. To one end of this tube is attached a terminal which is connected to the positive pole of a coil or other source of electricity. Inside the box, parallel to, but not quite touching the tube, are two insulated metallic plates, one on each side. These plates are connected to the negative pole of the coil. When an electric current is passed into the apparatus a silent discharge takes place between the tube and the metallic plates, resulting in the ozonisation of the surrounding air. The latter is then inhaled by means of the mouth-piece mentioned above. The claim is for "a hermetically closed glass tube, enclosing a gas at a pressure lower than that of the atmosphere, which tube is connected to one of the poles of a coil or other source of electricity."—H. T. P.

Improvements in the Utilisation of Sewage Sludge, and in the Production of Filtering and Purifying Material therefrom. T. B. Wilson, Manchester. Eng. Pat. 17,275, October 10, 1891.

THE sludge from sewage containing iron, or that has been purified by the addition of ferric chloride or other iron-salt is employed for the production of a filtering material for

water, sewage, &c. To this end the sludge is pressed, dried, and if deficient in iron, a quantity of waste ferric oxide, or iron ore added. The dried material is subsequently calcined in a closed retort or by other suitable means, air being excluded as soon as the mass attains a dull red heat. After ignition, the material is allowed to cool out of contact with the air to avoid oxidation. The product thus obtained consists mainly of an intimate mixture of carbon and magnetic oxide of iron, and forms a valuable filtering material.—H. T. P.

An Improved Process of Purifying Water. C. G. Collins, Woodburgh, New York, U.S.A. Eng. Pat. 11,989, June 28, 1892.

ACCORDING to this process, which is more particularly applicable to the purification of water for domestic use, manufacturing purposes, &c., use is made of the combined influence of oxygen and an electric current. The apparatus employed consists of a long, preferably closed tank, containing a series of carbon or platinum electrodes which are connected alternately to the positive and negative poles of a dynamo, or other source of electricity. The ends of the tank are provided with water inlet and outlet taps respectively; whilst oxygen under pressure is supplied by a pipe entering at one end and running nearly the whole length of the chamber, the portion inside the chamber being perforated to allow of the escape of the gas. It is claimed that under the conditions obtaining in the above apparatus, the nascent oxygen, liberated by the electric current, combines with the oxygen introduced and dissolved in the water, forming from the very beginning a maximum amount of ozone, under the influence of which the impurities present in the water are rapidly and thoroughly destroyed or rendered insoluble. On the score of rapidity and efficiency the method is said to be greatly superior to any processes involving the use of either oxygen, or electricity, alone.—H. T. P.

(C).—DISINFECTANTS.

Researches on the Adherence to the Leaves of Plants, especially of the Potato, of Copper Compounds intended to cure their Diseases. A. Girard. Compt. rend. **114**, 1892, 234—236.

OWING to the increase of the ordinary disease of potatoes, due to the heavy rains in July and August of 1890, the author was of opinion that it might be interesting to endeavour to find out whether the various copper compounds proposed for destroying the parasitic ailments of plants possessed any power of adhering to the leaves, and what consequent reliance might be placed upon them.

To determine this he carried out experiments last year, which consisted in submitting the plants to the action of artificial rains of calculated intensity and duration, having previously treated them with different copper compounds, and determining by chemical analysis the quantity of copper adhering to the leaves both before and after the washings by these rains. Three types of rain were adopted: (1) a violent storm rain, corresponding to a fall of 17 mm. of water in 22 minutes; (2) a steady downpour, giving a fall of 15 mm. in six hours; and (3) a gentle rain giving a fall of 10 mm. in 24 hours. The watering apparatus consisted essentially of an inverted flattish cone revolved at the rate of eight times per minute by a hydraulic motor, from which the water can issue uniformly in drops, from the lower surface. The author's conclusions are:—

1. That the proposed copper compounds have very different powers of adherence to the leaves of plants.
2. That it is under the action of violent rains and mechanical disturbance that the copper deposited disappears.
3. That, among these compositions, that which gives way the most is the copper-lime wash; that a diminution in the proportion of lime slightly increases the solidity, and that the addition of aluminous compounds is of no practical use.
4. That the copper-soda and the verdigris washes adhere nearly twice as well as the copper-lime wash, and that, best of all, is the copper-lime-sugar wash of M. Michel Perret.

The author is therefore of opinion that it is to these three last compositions that practical people who desire to preserve their potatoes from the fungus, should turn.

—D. E. J.

The Influence of some Metallic Salts on Lactic Fermentation. C. Riche. Compt. rend. **114**, 1892, 1494—1496.

FROM the study of the influence of metallic salts on lactic fermentation the author has determined that although very small quantities of certain metallic salts retard or wholly prevent the development of the ferment, still smaller quantities even act as accelerators of the fermentative action. The ferment appeared indifferent to salts of copper and mercury in quantities inferior to 0.00025 grm. per litre, in doses of 0.0005 grm. per litre these salts possessed an accelerative action, and in quantities of 0.001 grm. per litre their antiseptic properties first became evident. The fermenting liquor consisted of milk from which the casein had been precipitated by warming with acetic acid, and the filtrate then neutralised with bicarbonate of potash. The respective quantities of the different salts were subsequently added to the solution, the liquids sterilised in Pasteur's flask, inoculated with the lactic ferment, and kept at a temperature of 40° C. At the end of a definite period the free lactic acid was titrated with an alkaline solution, with phenolphthalein as indicator. The toxic action of the metallic poison does not appear to affect the chemical activity of the ferment, but rather its powers of multiplication. The biological relations as regards the toxicity of metals do not follow chemical laws, as certain metals which are chemically very similar have a very different toxicity, and it is especially noteworthy that the rarer metals, to which the ferment is probably not so well accustomed, appear more toxic than the common metals. The prohibitive dose of zinc is 1 grm. per litre, whilst 0.15 grm. per litre of cadmium sulphate completely prevents fermentation. Ferric and manganese salts are also less toxic than cobalt and nickel salts.

—F. W. P.

The Antiseptic Properties of Formic Aldehyde.

A. Trillat. Compt. rend. **114**, 1892, 1278.

See under XX., page 772.

PATENTS.

New or Improved Compounds to be used for Disinfecting, Deodorising, Germicide, Sanitary, Manuring, and like Purposes. T. McMurray, Glasgow. Eng. Pat. 13,139, August 4, 1891.

THE disinfectant in question forms a moist, granular mass, obtained by grinding together blast-furnace slag (previously reduced to powder by running it whilst fused into water), lime, or limestone, and some form of carbon, with a sufficiency of a solution of sulphuric, boracic, or other acid. It is employed by scattering it over the floors of stables, urinals, &c., and over dung heaps, &c. The free acid in the preparation absorbs and fixes the ammonia given off by excreta, &c., and increases their manurial value. The inventor also employs blast-furnace slag and lime, either separately or together, mixed with the acids as a disinfecting whitewash for the walls of stables, &c.—H. T. P.

An Improvement in the Preparation of a Compound for the Destruction of Blackbeetles, Cockroaches, and other Insects. E. Decesari, London. Eng. Pat. 8602, May 6, 1892.

THE above compound consists of the following ingredients:—1 lb. lump borax, dissolved in 2 pints of water, 1 lb. of size, $\frac{1}{2}$ lb. of honey, 10 grms. of "mercuric chloride," and 12 lb. of borax powder. For use hot water is added, and the mixture applied to the places frequented by the above insects.—H. T. P.

XIX.—PAPER, PASTEBOARD, Etc.

Witz's *Oxycellulose*. A. Naentikov. J. Russ. Chem. Soc. **24**, 1892, 256—275.

The author prepares an oxycellulose by the action of a dilute solution of caustic lime upon the filter paper of "Schleicher and Schüll." Analysis has shown the formula of this oxycellulose is $C_6H_{10}N_6$.—P. D.

PATENTS.

Improvements in the Manufacture of Building Boards, Paper Barrels or Cylinders, and similar Hollow or other Articles from Paper Pulp. C. Weygang, Middlesex. Eng. Pat. 12,299, July 20, 1891.

THE various improvements detailed in the specification have for their object the production from paper pulp of articles of a harder and more impermeable nature than heretofore, and which are also waterproof and grease-proof. Several of the processes involved are already covered by Patents Nos. 7904, 1886; 12,159, 1886; 12,190, 1888; 3004, 1890; and 14,753, 1890.

Many modifications of the processes and mixtures employed are detailed, but the following may serve as an illustration:—About 80 per cent. of glutinous matter, prepared by treating peat or horse-manure with an alkali, is mixed with about 20 per cent. fibrous paper pulp, adding also about 10 per cent. (of the total weight) of resin size. Towards the end of the mixing about 10 per cent. of aluminium sulphate and 3 per cent. farinaceous matter are also added, when the mixture is ready to be moulded into boards, casks, &c.

The mixture may be made more water-resisting by adding a chromium salt or may be coloured by incorporating suitable pigments with the pulp. Grease-proof properties are obtained by addition of animal glue, &c.—W. M. G.

Improvements in the Treatment and Utilisation of Esparto Liquor and other similar Waste Liquors and By-Products. W. H. Higgin, Bolton. Eng. Pat. 13,409, August 8, 1891.

THE object of the invention is the recovery of the alkali, partly as such and partly as acetate of sodium.

After evaporating to dryness the residual mass is calcined at a carefully regulated heat, which should vary somewhat according to the character of the liquors. For esparto liquor residue a temperature of about 400° C. should be used. This results in the production of a porous, easily pulverised, coke-like "char" containing about 15 per cent. anhydrous acetate of sodium.

A low temperature is to be avoided because the acetate is impure and a less yield is obtained, while a too high degree of heat decomposes the acetate.

After dissolving out the acetate the black insoluble residue is burnt, leaving as a white ash much of the alkali originally employed.—W. M. G.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Preparation of Carvacrol. M. A. Reyehler. Bull. Soc. Chem. **7**, 1892, 31—34.

CARVOL hydrochloride when heated with about one-fifteenth of its weight of zinc chloride and a little glacial acetic acid is readily and completely decomposed into carvacrol and hydrochloric acid. The hydrochloric acid begins to be evolved at 95° C. and is all given off at 110—120° C., the whole decomposition being effected in about 20 minutes and without the least explosive violence. The carvacrol obtained is best purified by dissolving it in caustic soda.

Numerous other substances can be substituted for the zinc chloride, such as sulphuric, phosphoric, or hydrochloric acid, zinc dust, or finely granulated tin. Carvacrol in alcoholic solution is coloured green by ferric chloride, only after the addition of water to the mixture.—C. A. K.

Some Derivatives of Carvacrol. M. A. Reyehler. Bull. Soc. Chem. **7**, 1892, 34—36.

Thymoquinone is readily obtained from carvacrol by oxidation with a mixture of sulphuric acid and potassium bichromate, allowing two-thirds of a molecular weight of bichromate per molecular weight of the phenol. It is best to warm the carvacrol first with sulphuric acid and separate the para-sulphonic acid formed and then to oxidise this and distil the resulting quinone over by steam. The yield is 68—70 per cent. on the carvacrol taken.

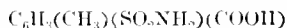
Dimethyl-thymo-hydroquinone is obtained by the action of methyliodide and methyl alcohol on thymohydroquinone in presence of sodium at 100° C. in sealed tubes. It boils at 248—250° C. and has a sp. gr. 0.998 at 22° C. It is of interest since it occurs in essence of arnica, together with phlorol isobutyrate.—C. A. K.

Digitalin. H. Kiliani. Archiv. de Pharm. **230**, 1892, 250.

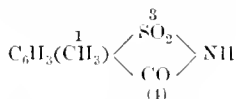
SCHMIEDEBERG has shown that the leaves and seeds of *Digitalis purpurea* contain a preponderating amount of an inactive glucoside *digitonin* together with other substances which act upon the heart—crystallisable *digitoxin* and two amorphous glucosides *digitalin* and *digitalein*. The last two are of greatest therapeutic importance, and the author has succeeded in preparing them in a state of purity. He finds the commercial digitalin generally contains two amorphous glucosides in addition to the above substances and that Schmiedeberg's digitalein is also a mixture. On the other hand the digitalin previously described is a distinctly individual substance possessing in a marked degree the power of acting upon the heart. It forms a white amorphous powder which melts and becomes yellow at about 217° C. It dissolves in about 1,000 parts of water and in 100 parts of 50 per cent. alcohol. When dissolved in a little 80 or 90 per cent. hot alcohol, a thick magma of structureless granules separate on cooling. The uniformity of this deposit is a characteristic test of the purity of the substance. The impurities of digitalin may be detected by the following tests:—(1.) A few granules when mixed with about 2 cc. of a caustic potash solution (1:10) should retain their whiteness for at least one minute; the presence of the amorphous glucosides is shown by the rapid appearance of an intense yellow colouration. (2.) When digitalin is made into a thick paste with water and a mixture of 22 parts of amyl alcohol to 100 parts of water is added and the whole allowed to stand in a closed flask for 24 hours distant crystalline warts appear if digitonin be present even in very minute proportion. Digitalin is almost insoluble in chloroform or in ether; it is precipitated from the alcoholic solution in a granular form on the addition of ether. Contrary to previous statements the taste of digitalin is but slightly bitter, the previously described intensely bitter and disagreeable taste being due to the presence of the accompanying glucosides. Digitalin dissolves in concentrated sulphuric or hydrochloric acid with a golden-yellow colour which rapidly changes to blood-red in the latter case. On the addition of a drop of nitric acid, ferric chloride, or bromine water to the yellow solution an evanescent brilliant purple colouration results. Digitalin is decomposed by hydrochloric acid into a crystalline body *digitaligenine*, melting at 210—212° C., glucose, and a sugar resembling rhamnose, and having the formula $C_{21}H_{35}O_5$. Analyses of digitalin point to the formula $(C_{21}H_{35}O_5)_n$. A résumé of physiological experiments with digitalin, which is now made for medicinal purposes under the name of "*digitalin verum*," is given. These point essentially to its action being unaccompanied by any injurious secondary effects, the latter being most probably due to the presence of admixed glucosides.—C. A. K.

On *Methylsaccharine (Toluic Sulphimide)*. O. Weber.
Ber. 25, 1892, 1737—1745.

THREE years ago a method was patented by the Badische Anilin und Soda Fabrik (Ger. Pat. 48,583) for the production of a homologue of Fahlberg's saccharine. The process consists in converting *p*-toluidine-*m*-sulphonic acid into the corresponding cyanotoluene sulphonic acid by the diazo-reaction; the last-mentioned compound is then converted into the sulphonamide, whence by hydrolysis, the acid—



is obtained, and this on heating yields methylsaccharine—



The author finds that methylsaccharine resembles saccharine in taste, is very slightly soluble in cold water, but readily so in hot water; it dissolves easily in alkalis, alcohol, benzene, ether, and glacial acetic acid, sublimes well, and melts at 246°, as stated in the specification. A series of derivatives furnished by interactions of purely scientific interest are described in the remaining portion of the paper: among these may be mentioned that when methylsaccharine is dissolved in water (3 parts) and heated at 80° on the water-bath together with a 7 per cent. solution of potassium hypochlorite (10 parts), it gives *p*-toluidine-*m*-sulphonic acid; whilst when commercial saccharine is similarly treated, a mixture of 1:2 anilinesulphonic acid, *p*-sulphamidobenzoic acid, *p*-chlorobenzoic acid, and *p*-sulphobenzoic acid is obtained, thus proving that it is not a homogeneous compound.—A. R. L.

Action of Pyridine Bases on Certain Sulphites.

G. Denigès. Compt. rend. 114, 1892, 1018—1020.

The author has already described the action of aromatic amines on metallic sulphites. In the present note he describes the action of pyridine bases on the same sulphites.

Sulphite of Zinc-pyridine, $\text{SO}_3\text{Zn}, \text{C}_5\text{H}_5\text{N}$.—30 grms. of crystallised zinc sulphate are dissolved in 700 cc. of water; 25 cc. of pyridine and 60 cc. of a solution of sodium bisulphite (density 1.38) are added. A white precipitate is immediately formed, which when washed and dried is found to have the composition indicated by the formula $\text{SO}_3\text{Zn}, \text{C}_5\text{H}_5\text{N}$. It crystallises in quadratic needles which have a negative optical sign.

The other pyridine bases act in a different manner on the mixture of sodium bisulphite and zinc sulphate. Crystals of pure zinc sulphite are produced having the formula $(\text{SO}_3\text{Zn})_2 + 5 \text{H}_2\text{O}$.

If any soluble salt of manganese is used instead of zinc sulphate, crystals of sulphite of manganese, $\text{SO}_3\text{Mn} + 3 \text{H}_2\text{O}$ are produced.

Sulphite of Cadmium-pyridine, $\text{SO}_3\text{Cd}, \text{C}_5\text{H}_5\text{N}$.—With cadmium there is produced a salt having the composition $\text{SO}_3\text{Cd}, \text{C}_5\text{H}_5\text{N}$. If less than the indicated quantity of pyridine is used there is formed by the action of cold, a precipitate which left to itself becomes crystalline and answers to the formula $(\text{SO}_3\text{Cd})_2 + 3 \text{H}_2\text{O}$.

The sulphite of zinc-pyridine is much more stable than the corresponding cadmium compound. When the other pyridine bases are mixed even in excess with sulphite of cadmium, no combination takes place.—D. E. J.

A Soluble Naphthol Antiseptic. M. Staekler. Compt. rend. 114, 1892, 1027—1028.

THIS communication presented by M. Schützenberger refers to the calcium salt of α -mono-sulphonate of β -naphthol $\text{C}_{10}\text{H}_6\text{SO}_3\text{H}(\alpha)\text{OH}(\beta)$. It was prepared by M. Bang, in view of various experiments by the author on antiseptics. M. Bang indicates two conditions as necessary for obtaining a

pure product:—1st the previous formation and use of absolutely pure β -naphthol, and 2nd, the perfect isolation of the α - from the β -modification of the sulphonate.

This substance has been studied as an antiseptic, under the name "*Isaprol*" by Dr. Dujardin Beaumetz in hospital practice.

It is neutral, very soluble in water and alcohol, unaltered by heat, non-irritant, uninjurious to the digestive organs, of little toxic power, and passing off easily in the urine. In the case of a rabbit, the fatal dose by hypodermic injection after some hours was 50 centigrams.

In conjunction with Dubief, the author studied the action of this antiseptic in connection with the culture of certain micro-organisms. The results were briefly these:—In 5 centigrams of broth, the culture is retarded by 10 centigrams of the product, for Asiatic cholera, *herpes tonsurans* and the bacillus of typhoid. It is arrested by an addition of 15 centigrams for Asiatic cholera, *herpes tonsurans*, the bacillus of typhoid, the "*Streptococcus aureus*," the charcoal bacterium, and retarded in the case of the pyocyanic bacillus. By 30 centigrams it is arrested in the case of all the foregoing microbes.

For man, the product acts as a medicament in doses of 1 to 4 grms. It is useful in the different forms of rheumatism, and also acts as a febrifuge in typhoid fever.

—W. S.

The Antiseptic Properties of Formic Aldehyde. A. Trillat. Compt. rend. 114, 1892, 1278—1281.

IN 1888 the author remarked that the addition of formic aldehyde to urine retarded its putrescence, and in consequence of this observation discovered the remarkable antiseptic properties of the aldehyde, which are said to be superior to those of corrosive sublimate. A series of experiments showed that broth to which $\frac{1}{120,000}$ th part of formic aldehyde had been added remained sterile for several weeks, whereas decomposition commenced after five or six days when $\frac{1}{60,000}$ th of corrosive sublimate had been added. The germicidal action of formic aldehyde is most evident with the anthrax bacillus, and the bacilli of the saliva and sewage. Dr. Berlioz has also determined that cultivations of the cholera bacillus are rendered sterile by a 0.003 per cent. solution of formic aldehyde. The urine of guinea-pigs into which 0.5 grm. per kilo. of the aldehyde has been injected does not putrefy. Its antiseptic character in very dilute solution suggests its applicability to the preservation of milk and other articles of food. The extractive and natural colouring matters of wine are precipitated in a few hours by a 0.025 per cent. solution, on which the author bases a method for the examination of wines. Formic aldehyde coagulates albumen, forming a transparent gelatinous mass, and also blood. It also forms a compound with fresh hides analogous to leather. A more delicate reagent for formic aldehyde than the reduction of ammoniacal nitrate of silver is an aqueous solution of aniline, with which it forms a white precipitate, $\text{CH}_2:\text{NC}_6\text{H}_5$, a reaction also common to acetic aldehyde.—F. W. P.

The Determination of the Total Alkaloids in Cinchona Bark. W. Haubensack. Pharm. Centralhalle, 32, 1892, 294.

See under XXIII., page 779.

Impurities of Chloroform. Brit. Assoc. Edinburgh, 1892.

PROFESSOR W. Ramsay, of University College, London, has found that the only impurity in a number of samples of chloroform received from hospitals where deaths had occurred was carbonyl chloride. It was impossible to look for an unknown impurity in a number of small samples of chloroform, and therefore he had exposed a large quantity of perfectly pure chloroform to daylight in presence of air. After some months a considerable quantity of carbonyl chloride was formed, no other product (except a trace of hydrochloric acid) having been detected. It was possible

to test for carbonyl chloride by pouring baryta on the surface of a suspected sample, when a white filament would appear at the line of division between the chloroform and the watery solution. Most of the samples received by him gave this test, and it was a significant fact that most of the samples were the products of large consignments to the hospitals. He was inclined to believe that the cause of death was the spasmodic contraction of the glottis produced by the carbonyl chloride after the lungs had been thoroughly charged with chloroform. This paper was discussed by Dr. W. W. J. Nicol, Dr. Arthur Richardson, Mr. Vernon Harecourt, and others.

PATENTS.

A New Self-acting Apparatus for the Automatic Production of Oxygen. F. Fanta, London. Eng. Pat. 10,667, June 23, 1891.

The specification contains full details of the apparatus employed by the patentee in the manufacture of oxygen from atmospheric air according to the process previously patented (Eng. Pat. 3034, February 19, 1891; this Journal, 1891, 854), and is accompanied by numerous diagrams of the plant.—C. A. K.

Improvements in the Manufacture of Piperazine or Spermine. W. Majert, Berlin. Eng. Pat. 11,957, July 14, 1891.

The piperazine derivatives used in the preparation of piperazine according to the patentee's previous specification (Eng. Pat. 15,404, September 29, 1890; this Journal, 1891, 791) may be substituted by the di-, tri-, and tetra-sulphonic acids of diphenyl or of ditolylpiperazine. These sulphonic acids are obtained by the action of fuming sulphuric acid on diphenyl- or ditolyl-piperazine or their salts, and are decomposed, after being converted into the alkaline salts, by means of alkali or by the oxides of the alkaline earths. The freed piperazine is distilled over with steam, and then further treated as described in the previous specification.—C. A. K.

Improvements in the Manufacture of Oxygen. G. Webb and G. H. Rayner, London. Eng. Pat. 13,036, July 31, 1891.

The improvements relate to the manufacture of oxygen from the atmosphere according to Tessié de Motay's method, and is concerned essentially with the preparation of the material used to absorb the oxygen. This is obtained by dissolving caustic soda in water at 100° C. and adding to the solution manganese peroxide and sodium manganate in stated proportions. The whole, after being well stirred, is evaporated to dryness and heated to a bright red or white heat. After the heating the mass is broken up into small pieces about the size of a walnut, and these pieces which are slightly adhesive rolled in powdered peroxide of manganese. This last operation is of great importance, since the pieces are thereby prevented from coalescing and caking when strongly heated. The material is placed in retorts having each two inlet and outlet tubes, and dry air freed from carbon dioxide is passed into it, the retorts being kept at a dull red or crimson heat. The oxidised material is subsequently decomposed by steam and the liberated oxygen collected, any of the ordinary forms of apparatus being used for this purpose.—C. A. K.

Improvements in the Manufacture of Artificial Musk. A. Baur, Mulhouse, Alsace. Eng. Pat. 13,613, August 12, 1891.

The phenol ethers of methyl-propyl, methyl-butyl, and methyl-amyl phenol yield trinitro-compounds having a musk-like smell (this Journal, 1890, 545, and 1891, 1024). The nitro-derivatives of the ortho- and para-phenol ethers have no marked smell, but the meta-derivatives in

general have. These last are prepared by the action of aluminium chloride on the meta-substituted phenol ethers, such as meta-cresol, and the chloride or iodide of the hydrocarbon, such as tertiary butyl chloride, the resulting ether being nitrated in the usual way. The trinitro-derivatives of the propyl cresol, butyl cresol, and amyl cresol ethers have been thus prepared. Instead of the above process the phenols themselves can first be prepared and converted into the ethers after nitrating, or the phenol ethers may be treated with propylene, butylene, or amylene, in presence of aluminium chloride, and subsequently nitrated.—C. A. K.

ERRATUM.

Page 707, col. 1, middle of col., insert the word "of" before "mildew and similar growths."

XXII.—EXPLOSIVES, MATCHES, Etc.

The Determination of Nitrogen in Nitrocellulose. G. Lunge. Zeits. ang. Chem. 1892, 261—262.

See under XXIII., page 778.

PATENTS.

Improvements in Explosives. H. de Mosenenthal, A. G. Salamon, and J. J. Hood, London. Eng. Pat. 13,038, July 31, 1891.

This invention consists in the use of thoroughly washed and dried Weldon mud. This compound will absorb from 2½ to 3 times its weight of nitroglycerin, and may be used in the manufacture of dynamite with or without the admixture of kieselguhr, its available oxygen tending to augment the energy of the explosive.

In the preparation of explosives containing sulphur, this manganese compound when charged with sulphuretted hydrogen and subsequently exposed to the action of air or oxygen so as to precipitate free sulphur in a finely-disseminated condition in the Weldon mud, may be employed as an oxygen-bearing substitute for sulphur or its compounds.—W. M.

Improvements relating to the Extraction of Nitroglycerin from the Waste Acid Formed in the Manufacture of Nitroglycerin. J. Lawrence, Paulsboro', New Jersey, U.S.A. Eng. Pat. 7981, April 27, 1892.

The inventor states that hitherto the waste acids have only been treated for the recovery of acids. He has discovered that by cooling the waste acids to a temperature lower than the freezing point of nitroglycerin and higher than that of the acids (about 40° F.), a reaction takes place between the residual, unacted on glycerin and the nitric acid, a certain amount of nitroglycerin being thereby produced.

The refrigeration has to be continued for three to four days with occasional agitation. Sulphuric acid may be added to the waste acids with good effect. By this process the ultimate yield of nitroglycerin from a given weight of glycerin may be increased from 6 to 9 per cent.—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

*On the Optical Measurement of High Temperatures.*H. Le Chatelier, *Compt. rend.* **114**, 1892, 214—216.

THE author has previously shown how high temperatures may be easily and exactly measured by means of thermocouples. This method is rapidly spreading in laboratories and has even done good service in factories, although delicate galvanometers are unsuitable apparatus for workmen.

At the high temperatures, however, now attained in metallurgical operations all bodies rapidly disintegrate, and it becomes necessary to make use of the differences in the radiations emitted at different temperatures. It is only necessary to assist the eye by the use of apparatus sufficiently precise and at the same time simple.

The author's method is to compare the radiations emitted with those of the flame of a small petroleum lamp, itself standardised by comparison with a standard amyl-acetate lamp. A red glass placed in front of the eye-piece ensures the practically monochromatic radiations necessary for exact photometric observations. The most appropriate photometer for the purpose is that of M. Cornu, modified so as to render it more manageable. The method is very sensitive, the intensity of the luminosity varying from 1 to 1,000,000 as the temperature varies from 600° to 1,800°, a graduation quite impracticable with thermo-electrical pyrometers.

Working under these conditions, the author has found the following values for the intensity of the most luminous regions of the given sources, expressed in terms of the corresponding intensity of the standard lamp.

Amyl-acetate.	Candle.	Careel Lamp.	Melting Platinum.
1	1.10	1.9	5

The principal difficulty met with is owing to the fact that the radiations emitted by the incandescent body do not depend only upon the temperature, but also upon the chemical nature, the physical state of the surface, and upon the temperature of the surrounding space. In the particular case where the temperature of the body is the same as that of the surrounding space, a condition practically obtaining in a reverberatory furnace, the brightness depends upon the temperature only, and in the case of black bodies the radiation is independent of the temperature of the surrounding space. Magnetic oxide of iron (formed on the surface of iron heated in air), and carbon fulfil this latter condition. A special graduation is necessary for all other bodies.

The author has made this graduation for a certain number of bodies heated in the flame of mixed air and gas. The results are expressed in terms of the intensity of the flame of amyl acetate. The scale of temperatures has been determined by taking as fixed points:—

Sulphur.	Gold.	Palladium.	Platinum.
448	1,045	1,509	1,775

It should be remarked that the ratio between the emissive power of magnetic oxide and that of platinum varies slightly with the temperature:—

Temperature.	Magnetic Oxide.	Platinum.
600	0.00003	0.00001
800	0.003	0.00125
1,000	0.08	0.03
1,200	0.65	0.26
1,400	3.40	1.41
1,600	12.6	5.62
1,800	39.00	17.00

The following bodies have, between 1,000° and 1,500°, for the red radiations adopted, the following approximate emissive powers:—

Magnetic Oxide of Iron, and Carbon.	Palladium.	Rough Platinum.	Polished Platinum and Kaolin.	Magnesia.
1	0.5	0.4	0.25	0.10

The value obtained for magnesia is very uncertain, owing to the inevitable roughness of the body.

The graduation given for magnetic oxide, of which the emissive power is unity, is applicable to all bodies heated in a region of uniform temperature.—D. E. J.

The Measurement of High Temperatures. H. Le Chatelier. *Compt. rend.* **114**, 1892, 340—343.

A REPLY to H. Becquerel's claim for priority on behalf of his father, E. Becquerel (this Journal, 1892, 709).

—H. T. P.

INORGANIC CHEMISTRY.—
QUALITATIVE.*A Sensitive Reagent for Carbon Monoxide.* J. Habermann. *Zeits. ang. Chem.* 1892, 324—325.

WHEN carbon monoxide or air containing it is passed through a solution of ammonio-nitrate of silver, a brown colouration is produced more or less rapidly, and in presence of appreciable quantities of carbon monoxide a black flocculent precipitate of metallic silver soon separates. Air containing only 0.1 per cent. of CO by volume still produces a distinct colouration, whilst air alone has no effect on the solution. The reagent is perfectly stable and is prepared by adding ammonia to a solution of silver nitrate until the precipitate at first formed is almost redissolved, and then filtering.—H. T. P.

Micrographic Analysis of Alloys. G. Guillemin. *Compt. rend.* **115**, 1892, 232—234.

THE researches of Messrs. Osmond and Werth (*Compt. rend.* **100**, 1885, 450; this Journal, 1885, 406) induced the author to undertake similar investigations on non-ferruginous alloys. The polished surfaces are attacked by dilute acids while under the influence of a feeble electric current (2 volts and $\frac{1}{10}$ th ampère). The corroded surfaces were examined microscopically. The images obtained are always the same for the same alloy, and they are preserved by photography. The corroded surfaces consist of furrows more or less twisted, separated by ridges, which represent material spared by the acid.

Doubtless at the moment of solidification the fluid metal had separated into many simple alloys of definite composition which are unequally attacked by acids as shown by M. Riche (*Ann. de Chim. et de Phys.* **30**, 1873).

By microscopic examination of the corroded surfaces they may at once be referred to a small number of classes. Thus, among bronzes and brasses we can distinguish those with a base of tin, the phosphor-bronzes, brasses containing less than 37 per cent. of zinc, Muntz metal and analogous alloys containing over 37 per cent. of zinc, aluminium bronzes, aluminium brass, delta metal, Roman brass, &c.

In white alloys with a base of tin, antimony, and copper known as *antifriction* alloys, the presence of lead can easily be recognised, and even with practice something near the proportions. In examining ingots of red copper from the same fusion, but of different pourings, those which are properly refined can be distinguished, whilst others in which the refining is not complete can be classed according to the degree of advancement. It is known that the mechanical qualities of brasses and bronzes are much modified by the addition of very small quantities of aluminium or of phosphorus. The presence of these bodies is at once recognised since the furrows have the forms of veins of marble, or of conglomerate when aluminium is present, whilst phosphorus produces, in bronze containing tin, a characteristic image resembling a fern-leaf which is seen more clearly near the outer margin than in the centre, and which no doubt indicates differences of composition due to different periods of cooling as shown by M. Riche (*loc. cit.*)

The presence of 4 per cent. of zinc in a zinc masks the micrographic action of phosphorus. Further, for a given alloy the "microgrammes" indicate not only the circumstances of casting, but also the nature of the operations to which it has been subsequently exposed; whether it has been poured too hot or too cold; if it has been stamped or rolled; and if rolled, in which direction the power has been applied.—J. H. C.

Changes in Chalybeate Waters during Storage. J. Riban.

See under XVIII., page 768.

INORGANIC CHEMISTRY.— QUANTITATIVE.

Von Schulz and Low's Method of Estimating Lead in Ores. J. E. Williams. Eng. and Min. J. 53, 641.

It is claimed that this method is superior to the fire assay. It consists essentially in forming lead sulphate, dissolving out with ammonium chloride solution, and precipitating the lead by means of sheet aluminium. The details are as follows:—

One gramme of ore is treated with 10 cc. pure strong nitric acid and 10 cc. pure strong sulphuric acid, and heated until all nitric acid is expelled and the sulphuric acid is boiling freely. The liquid is then allowed to cool and 10 cc. of dilute (1 in 10) sulphuric acid free from chlorine added. Next are added 2 grms. of Rochelle salt, and when that is dissolved 40 cc. of water free from chlorine. The solution is heated to boiling and allowed to stand and settle for two minutes, filtered and washed with dilute sulphuric acid. The $PbSO_4$ is then dissolved out of the insoluble residue by means of a saturated boiling solution of NH_4Cl , keeping the volume as small as possible, and the lead is precipitated by placing in the solution three strips of aluminium, each about $1\frac{1}{2}$ in. \times $\frac{3}{4}$ in. \times $\frac{1}{16}$ in. thick. The whole is boiled for five minutes, then diluted with cold water, poured into a basin, and the lead collected, dried and weighed. It is practically free from Ag, Au, Cu, Sb, Bi, &c. The aluminium used must be purer than the commercial article, which contains too much silicon.

Von Schulz and Low state that this assay is applicable to all ores, mattes, &c., which can be decomposed by nitric or sulphuric acid. If silver be insignificant in amount the reagents need not be perfectly free from chlorine. If antimony be absent, only 5 cc. of sulphuric acid, no Rochelle salt, and only half the dilution are required. The time is the same as for copper and zinc, and the cost less than for the fire assay, 1 lb. of aluminium sufficing for hundreds of assays. One, two, or three assays may be made in the same time as a similar number of fire assays, but as the "humid" scheme requires much more manipulation, in

making a large number the advantage would rest with the fire method. Assays by this humid method can be done in less than 40 minutes. The results have a tendency through oxidation of the lead to be slightly above the correct amount. If oxidation becomes visible, the assay should be rejected. The results are generally 3 per cent. higher than those by fire assay, and it is suggested that this amount should be deducted to meet the objections of the smelters who will not buy on the basis of any wet assay. The method is very valuable for assaying a matte or a speiss, and antimony, arsenic, &c., do not interfere with its accuracy.

—A. W.

The Separation and Estimation of Lead, Silver, and Zinc in Minerals composed of Galena and Blende.
E. Aubin. Bull. Soc. Chim. 7-8, 1892, 134-135.

The author recommends the following method as being rapid and easy of execution, and therefore suitable for prospecting work. 10 grms. of the powdered mineral are boiled in a conical beaker of 1 litre capacity with 50 cc. of fuming nitric acid and evaporated to dryness on a sand-bath. The residue is warmed with 20 cc. of nitric acid (36° B.), and when all the iron is dissolved, diluted to 400 cc. with distilled water and allowed to stand until the sulphate of lead has settled. The liquid and sediment are then transferred to a pair of balanced filter-papers placed one within the other, the sediment is thoroughly washed, dried, and weighed. This insoluble portion, consisting of gangue and sulphate of lead, is removed from the filter-paper and triturated in a mortar with a warm alkaline solution of sodium tartrate (20 per cent.) until all the sulphate of lead is dissolved, as shown by the disappearance of white specks. The residual gangue is retransferred to the original filter-papers, washed, dried, and weighed. The difference between the first and second weights gives that of the lead sulphate, and thence the percentage of lead in the sample.

The nitric acid solution containing the line and silver is diluted to 500 cc. and 50 cc. taken for the estimation of zinc in the ordinary way, *i.e.*, by precipitation as sulphide, after previous removal of the iron and aluminium, re-solution in hydrochloric acid, and reprecipitation as carbonate. The remaining 450 cc. are rapidly concentrated to 20-30 cc. and cooled. Any crystalline deposit is then decanted off, one grm. of sodium chloride is added to the liquid, and finally the precipitated silver chloride is collected on a tared filter-paper and weighed.—H. T. P.

Note on the Estimation of Potash. F. Jean and Trillat.
Bull. Soc. Chim. 7, 1892, 228.

For the rapid estimation of potash in manures the authors proceed as follows:—An aqueous extract of the manure is boiled with soda in order to expel ammonia, filtered if necessary, and evaporated to a syrupy condition with excess of platonic chloride. The residue is washed with alcohol and ether in the usual way, the remaining potassium platonic chloride dissolved in boiling water and treated with an alkaline solution of sodium formate. The platinum black which separates is washed with very dilute acid, collected, and weighed. From its weight the corresponding amount of potash is deduced. Formaldehyde may be employed as reducing agent instead of sodium formate, as it keeps much better and is more energetic, besides which there is no tendency for the precipitated platinum to adhere to the sides of the beaker.—H. T. P.

The Influence of Nitrogen Tetroxide on the Specific Gravity of Nitric Acid. G. Lange and L. Marchlewski.
Zeits. ang. Chem. 1892, 330-331.

This research was undertaken with the object of avoiding the direct estimation of total acid, which is very troublesome, especially in the case of fuming nitric acid. It was thought that the percentage of true HNO_3 present in a

sample might be deduced from its specific gravity, a correction being first applied to allow for the influence of dissolved N_2O_5 , the latter being estimated separately by potassium permanganate. It appears, however, that results thus obtained are not at all reliable, chiefly owing to the very varying influence exerted by N_2O_5 , HNO_2 , &c. on the density of nitric acid of different strengths. The estimation of total acid, therefore, remains indispensable; and the

authors recommend that the portion of acid taken for analysis be weighed in a tap-pipette and that methyl-orange be employed as an indicator. The bleaching of the indicator (by HNO_2 , &c.) may be avoided either by adding it only near the end of the titration, or by adding excess of alkali and titrating back with normal acid. Neutrality is attained when all the nitrous acid is exactly converted into nitrite. Some results are given in the table.

N_2O_5 per Cent.	Corresponding Amount of HNO_3	Total Acid per Cent.	HNO_3 alone.	Specific Gravity of Sample in vacuo at 15°	Specific Gravity due to HNO_3 alone.	Total Difference between the Specific Gravities.	Difference for 1 per Cent. N_2O_5
GRIESHEIM ACIDS.							
0.71	0.97	94.69	93.72	1.5061	1.4992	0.0069	0.00550
2.40	3.29	98.26	94.97	1.5180	1.5018	0.0162	0.00675
5.50	7.53	96.53	89.00	1.5255	1.4884	0.0371	0.00674
12.32	16.87	103.43	87.06	1.5694	1.4831	0.0863	0.00700

"GREEN ACIDS": SPECIFIC GRAVITY OF ORIGINAL ACID = 1.31466 at 15° IN VACUO.

N_2O_5 per Cent.	Corresponding Amount of HNO_3	Total Acid per Cent.	HNO_3 alone.	Specific Gravity of Sample in vacuo at 15°	Specific Gravity due to HNO_3 alone.	Total Difference between the Specific Gravities.	Difference for 1 per Cent. N_2O_5
0.64	0.88	65.32	64.47	1.33916	1.33676	0.00240	0.00375
1.21	1.65	65.77	64.12	1.40000	1.39476	0.00524	0.00433
2.65	3.63	66.69	63.06	1.40317	1.38944	0.01403	0.00529
4.07	5.57	67.42	61.85	1.40594	1.38294	0.02300	0.00564

—H. T. P.

Note on the Difference in Solubility of the Chromates of Strontium and Calcium in Dilute Alcohol, and the possibility of Separating the two Earths by this Means. W. Fresenius and F. Ruppert. Zeits. Anal. Chem. 30, 1891, 672—680.

THE ordinary calcium sulphate test for strontium is very unsatisfactory, especially in presence of much calcium chloride which may entirely prevent the precipitation of strontium sulphate. In this paper a more efficient means of detecting strontium in presence of calcium is described, based on the slight solubility of strontium chromate, as compared with calcium chromate in dilute spirit. The test is best carried out as follows:—Potassium chromate is added to a fairly dilute neutral solution of the two chlorides, the mixture is heated to 60° — 70° C., and shaken with one-third of its volume of absolute alcohol. In presence, even of small quantities of strontium, a yellow precipitate of strontium chromate is obtained, whilst under identical conditions, pure calcium chloride solutions remain perfectly clear or yield only after some standing, a trifling deposit, which can readily be distinguished from the strontium chromate precipitate. Acetic acid entirely prevents the separation of the strontium, whilst ammoniacal salts hinder it more or less. As regards the delicacy of the test, a solution containing in 5 cc. 0.002 grm. $SrCl_2$ and 0.013 grm. $CaCl_2$ yielded at once a distinct turbidity when tested as above. On the other hand, a liquid containing per 10 cc. 0.171 grm. $SrCl_2$ and 1.100 grms. $CaCl_2$ gave no precipitate with calcium sulphate, even after long standing.

Endeavours were made to apply the method quantitatively, and the results of a number of experiments are given; but they are not perfectly satisfactory, the strontium being in all cases found somewhat low, and the calcium high, chiefly owing to the slight solubility of strontium chromate in dilute spirit. The addition of a considerably larger quantity of alcohol fails to precipitate all the strontium, but throws down a large portion of the calcium chromate.

Possibly the difficulty might be overcome by applying a correction for the solubility of the strontium chromate.

The solubilities of the two chromates in alcohol were found to be as follows:—

50 cc. of alcohol (53 per cent. by volume) dissolve 0.044 grm. of calcium chromate, and 0.001 grm. of strontium chromate. 50 cc. of alcohol (29 per cent. by volume) dissolve 0.6080 grm. of calcium chromate and 0.0066 grm. of strontium chromate.—H. T. P.

Potassium Hydrogen-tartrate as a Starting Point for Acidimetry and Alkalimetry. A. Bornträger. Zeits. ang. Chem. 1892, 294—295.

POTASSIUM hydrogen-tartrate, which can easily be prepared in a state of purity, is recommended for standardising normal alkali solutions. For this purpose 3.7626 grms. of the tartrate are equivalent to 20 cc. of normal alkali.

—A. L. S.

On the Estimation of Small Quantities of Carbon Monoxide by Means of Cuprous Chloride. L. de Saint-Martin. Compt. rend. 114, 1892, 1006—1009.

THE absorption of carbon monoxide by a solution of cuprous chloride in hydrochloric acid has been utilised by F. Leblanc for the estimation of the gas. Berthelot subsequently obtained a crystallised product corresponding to the formula $3CO, 2CuCl_2 + 7H_2O$. This compound is destroyed by heat, and boiling (assisted by reduction of pressure) liberates the gas entirely. Starting from these known facts the author has endeavoured to estimate small quantities of carbonic oxide in gaseous mixtures by agitating a known large volume of the mixture with the acid solution of cuprous chloride, thus concentrating the poisonous gas, and afterwards extracting it by applying heat and exhaustion with a Sprengel pump. The method was analogous to that employed by Muntz and Aubin, for estimating carbonic acid in the atmosphere. But whereas a very small quantity of potash suffices to absorb all the carbonic acid from a large volume of gas, the same is by no means true for carbonic

oxide and copper solution. This practical difficulty seemed formidable at the outset; but after numerous trials the following procedure was found to be satisfactory.

In the first place the copper solution is made by digesting 40 grms. of copper turnings and 40 grms. of copper oxide with 450 grms. of hydrochloric acid in the cold. The colourless liquid can absorb about 25 times its volume of carbonic oxide, or 12 times its volume of oxygen. A glass flask provided with a stop-cock and having a capacity of 1,100 cc. to 1,200 cc. is emptied by first applying a water-pump and afterwards a Sprengel pump, and is then filled (by aspirating) with the air to be analysed. Fifty cc. of the copper solution are introduced and vigorously shaken up. The flask is now turned upside down and connected by thick rubber tubing with the apparatus for extracting the gas (which apparatus is pumped out beforehand). By simply turning the stop-cock the reagent (which has collected in the neck of the flask) is made to run into a distillation flask. This operation is repeated four times, 40 cc. of the copper solution being used the first time and 30 cc. afterwards. The gas has now to be extracted from the reagent by boiling in vacuo in the usual way; the apparatus used consisting of a distillation flask connected to a Sprengel pump by a long Liebig's condenser.

The gas collected is first freed from carbonic acid by means of potash. After measuring the residue, three times its volume of oxygen is added, and the mixture is exploded by an electric spark. After noting the contraction, the carbonic acid produced is estimated by absorption in potash. The eudiometric estimation of carbonic oxide is only accurate when the mixture which is exploded contains between 20 and 25 per cent. of the gas. If it contains more, compounds of nitrogen are formed (traces of this gas being unavoidably present); if it contains less the combustion may be incomplete.—D. E. J.

The Occurrence of Fluorine in different Varieties of Natural Phosphates. A. Carnot. *Compt. rend.* **114**, 1892, 1003.

See under XV., page 759.

Note on the Detection of Chlorine and Bromine in Presence of Iodine. D. S. Macnair. *Chem. News*, 1892, **66**, 5.

When freshly precipitated, moist silver iodide is heated with potassium bichromate and concentrated sulphuric acid the precipitate dissolves, silver iodate and bichromate being formed which are partially precipitated on diluting moderately and cooling the solution. Silver bromide and chloride when similarly treated evolve bromine and chlorine respectively and form silver sulphate. To carry out the test the solution is precipitated with silver nitrate and the resulting haloid treated as above, when a chloride or bromide is readily detected even in presence of a very large excess of iodide.—C. A. K.

A Method for the Quantitative Separation of Barium from Calcium by the Action of Amyl Alcohol on the Nitrates. P. E. Browning. *Amer. Journ. of Science*, 1892, **43**, April; also *Chem. News*, **66**, 3.

The method consists in converting the mixed salts of calcium and barium into nitrates, evaporating the solution to dryness and boiling the residue after taking it up with the least possible amount of water, with 30 cc. of amyl alcohol. The calcium nitrate is dissolved, whilst the barium salt remains behind and can be filtered off on to a perforated platinum crucible containing an asbestos lining. The precipitate is dried at 150° C. and weighed. The calcium in the filtrate is determined as sulphate, after evaporating off the alcohol. The author has previously shown (*Amer. Journ. of Science*, 1892, **43**, 50; and *Chem. News*, **65**, 271), that strontium and calcium can be similarly separated, a correction being made for the solubility of the strontium nitrate in boiling amyl alcohol (0.001 gm. SrO per 30 cc. of alcohol). Analytical data confirm the accuracy of the method.—C. A. K.

Determination of Phosphoric Acid in Presence of Iron and Aluminium. S. W. Johnson and T. B. Osborne. *Ann. Report of the Connecticut Agri. Exper. Stat.* 1890, 195—197.

The authors find that the rapid molybdic method now "official" in the United States, and by which the precipitation is effected from hot solutions, and the digestion is continued for one hour at 65°, gives irregular and higher results in the presence of iron and aluminium than the old Sonnenschein method, by which the cold solution of the substance in sulphuric or nitric acid is mixed with large excess of molybdic solution and kept for four to six hours at a temperature near but below 50°. The latter procedure ensures the precipitation of all the phosphoric acid with ammonia as the only base, whilst in the former course some iron oxide and alumina are precipitated with the yellow precipitate and carried forward during the subsequent operations into the magnesium phosphate.—D. A. L.

Pentasulphide of Antimony. Th. Willm. *J. Russ. Chem. Soc.* **24**, 1892, 371—388.

See under XIII., page 758.

ORGANIC CHEMISTRY.—QUALITATIVE.

Meta-dinitrobenzene. C. Willgerodt. *Ber.* **25**, 1892, 608—609.

CAUSTIC alkalis give a pink colouration with alcoholic solutions of *m*-dinitrobenzene only in presence of dinitrothiophen; the pink is turned to violet by warming with a little stannous chloride.

m-Dinitrobenzene freed from dinitrothiophen shows no pink colouration with caustic alkalis, and no violet with alkalis and reducing agents, but if it be dissolved in acetone a beautiful violet is given with caustic soda or caustic potash. As the author has previously shown (*Ber.* **14**, 1881, 2459), α -dinitro-chlorobenzene gives a similar reaction, and also the ethers of α -dinitrophenol.—T. L. B.

The Chemistry of Fermentation. E. Buchner. *Ber.* **25**, 1892, 1161—1163.

See under XVII., page 763.

Impurities of Chloroform. W. Ramsay. *Brit. Assoc.* 1892.

See under XX., page 772.

A Contribution to the Study of Deplastered Wines. H. Quantin. *Compt. rend.* **114**, 1892, 369.

See under XVII., page 764.

ORGANIC CHEMISTRY.—QUANTITATIVE.

Determination of Phosphoric Acid in Wine. M. M. Morgenstern and Pavlinoff. *J. Russ. Chem. Soc.* **24**, 1892, 341—346.

The authors have improved upon the citrate method of Mereker (*Landw. Vers. Stat.* **37**, 301), 200 cc. of the wine to be investigated are acidified and heated with 20 cc. of HNO_3 (sp. gr. 1.38), and then the liquid is neutralised with ammonia. When the liquid has cooled down, 50 cc. of a solution of citrate of ammonium are added, and then, after shaking, 25 cc. of magnesia mixture. The finally resulting precipitate, $\text{Mg}_2\text{P}_2\text{O}_7$, is quite white and crystalline.—P. D.

The Determination of Chlorine in Wine. W. Siefert.
Zeits. Anal. Chem. **31**, 1892, 186.

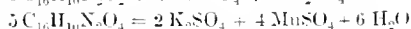
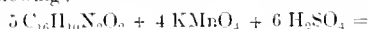
For the volumetric determination of chlorine according to Volhard's method, the wine is neutralised with sodium carbonate, evaporated, and the residue incinerated. The ash is dissolved in dilute nitric acid and the solution titrated.

—A. L. S.

Determination of the Quantity of Indigotine in Commercial Indigo. O. Müller. J. Russ. Chem. Soc. **24**, 1892, 275—299.

The author considerably improves Mohr's process, and has tested his improvement on more than 600 samples of Asiatic and American indigo. 0.5 gm. of indigo is treated with 10 grms. of monohydrated sulphuric acid, and the mixture is heated on the water-bath with stirring, for an hour. It is then mixed with water to make up 1 litre and left in a dark place from 6 to 12 hours. 50 cc. of the cold solution are now titrated with permanganate of potassium solution (1 cc = 0.0012861 gm. of indigotine).

The reaction of oxidation of indigotine is made according to the following:—



i.e., the proportion between indigotine and KMnO_4 is expressed numerically as 655 : 316.2.—P. D.

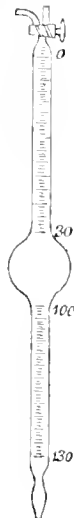
The Action of Acetic Anhydride on Dimethylaniline.
F. Reverdin and C. de la Harpe. Bull. Soc. Chim. **7**, 1892, 211—212.

In a mixture of acetic anhydride and dimethylaniline (employed for the volumetric determination of aniline and methylaniline) small quantities of tetramethyldiamidodiphenylmethane are formed after long standing. In well-stoppered bottles this decomposition is exceedingly slight, but when exposed to air, and more especially when air is passed through the mixture for a short time, a greenish-blue colour is developed, and after several days' standing as much as 10 per cent. of the dimethylaniline originally present may be converted into the new base.—H. T. P.

The Determination of Nitrogen in Nitrocellulose.

G. Lunge. Zeits. ang. Chem. 1892, 261—262.

The author draws attention to his nitrometer with separate decomposition vessel (this Journal, 1890, 547—549), by means of which the trouble of cleaning the measuring tube, and the annoyance caused by froth, &c., are avoided. Subsequently, a form of nitrometer is described in which either small or large volumes of gas may be measured, so that analyses of all kinds of materials, such as chamber-acid, nitrocellulose, manganese ore, &c., may be effected by its means. A cut representing the apparatus is given below.



It consists of a measuring tube which is widened out in the middle to a bulb of 70 cc. capacity. The portions of the tube above and below the bulb hold 30 cc. each and are divided into $\frac{1}{10}$ cc. as usual. It is obvious that the upper portion of the tube serves to measure small volumes, and the lower portion large volumes of gas.—H. T. P.

The Influence of Acetates of Lead on the Estimation of Invert-Sugar by the Fehling-Soxhlet Method.
A. Bornträger. Zeits. ang. Chem. 1892, 333—335.

The author has investigated the errors introduced in the volumetric estimation of invert-sugar by Fehling's solution, by the presence of varying amounts of acetate and basic acetate of lead, and the results obtained are embodied in two tables. As a general rule, the invert-sugar was found too low, and the error increased with the amount of lead solution employed, being already very considerable in the presence of such a quantity of acetate or basic acetate of lead, as would be ordinarily used for clarifying purposes. It is necessary, therefore, to get rid of any dissolved lead before titration, and for this purpose sodium sulphate is recommended in preference to sodium carbonate, since the latter salt distinctly influences the results obtained. In conclusion, the author states that a perfectly correct solution of invert-sugar for standardising purposes may be prepared by allowing a solution of cane-sugar to stand overnight in the cold with $\frac{1}{10}$ of its bulk of strong hydrochloric acid (1.188 sp. gr. at 15° C.), and finally neutralising and diluting to a suitable volume.—H. T. P.

The Effect of the Presence of Lead Acetate on the Titration of Lactose, according to Fehling-Soxhlet. A. Bornträger. Zeits. ang. Chem. 1892, 293—297.

In the presence of lead acetate, more lactose is required to reduce a certain volume of Fehling solution than would otherwise be the case, so that solutions of lactose containing lead acetate, when titrated with Fehling's solution, will appear to contain less sugar than they do in reality.

Experiments were made to test the extent of this difference. Fehling's solution was diluted with 4 volumes water and boiled for 6—7 minutes with a 1 per cent. lactose solution. Experiments were made with from 1 cc. down to 0.05 cc. of a basic lead acetate of a sp. gr. 1.250.

With 1 cc. lead acetate the per cent. of lactose indicated was 0.777	
„ 0.10 „ „ „ „	0.973
„ 0.05 „ „ „ „	0.987
No lead acetate.....	1.001

If it be necessary to employ any considerable quantity of lead acetate to prepare the solution, it is necessary to remove all the lead remaining in solution before titration. For this purpose sodium sulphate may be used, as it has been found that the presence of this salt has no influence on the reduction; the salt must, however, be free from carbonate, as this does affect the reduction.—A. L. S.

Precipitation of Raffinose by Ammoniacal Lead Acetate.
T. Koyd. Oesterr. z. Zucker. 1892, 92.

A SYRUP containing cane-sugar and raffinose in the proportion of 9.26 of the former to 1 of the latter, was precipitated with lead acetate, and the filtrate precipitated with an excess of ammonia. This washed precipitate was decomposed with carbonic acid and yielded a syrup in which the proportions of the two sugars were 2.01 to 1. The filtrate from the ammonia precipitate was precipitated with lead acetate, and this precipitate after decomposition with carbon dioxide yielded a syrup in which the proportions of the two sugars in the syrup were 3.47 to 1.—A. L. S.

Determination of Small Amounts of Sugar. M. Müller and F. Ohlmer. D. Zucker, 1892; Zeits. ang. Chem. 1892, 309—310.

ONE method, but not one to be recommended, is to evaporate the solution in a platinum dish and heat the

residue until the sugar is just caramelised. The blackened mass thus obtained is compared with others obtained in the same way from solutions containing a known quantity of sugar.

If concentrated sulphuric acid be added to a sugar solution and also a few drops of an alcoholic or alkaline solution of α -naphthol, a violet-red or light-red colouration is produced; with a solution containing only 0.01 per cent. sugar the colour is that of weak red wine, and even with a solution containing only 0.0005 per cent. sugar, the colouration is quite distinct. If nitric acid is present the delicacy of the reaction is destroyed; 0.6 mgrm. nitric acid is sufficient to destroy the reaction with 0.001 per cent. sugar; and 6 mgrms. nitric acid prevent the reaction with a 0.01 per cent. sugar solution.—A. L. S.

Notes on Analyses of Sugar, Molasses, Confections, and Honey. H. W. Wiley and others. U.S. Depart. of Agriculture Bull. **13**, 1892.

See under XVI., page 761.

Bibliography of Honey: arranged Chronologically. U.S. of Agriculture Bull. **13**, 1892, 871—874.

See under XVI., page 761.

The Determination of the Total Alkaloids in Cinchona Bark. W. Haubensack. Schweiz. Wochenschr. f. Pharm. 1891, 147; Pharm. Centralhalle, **32**, 291.

TWENTY grms. of the powdered bark are placed in a 500 cc. flask with 10 cc. of 10 per cent. ammonia solution, and 20 cc. of 94 per cent. alcohol added, and the whole well shaken. To this are added 170 cc. of ether, and after well shaking the whole is allowed to stand 2—3 hours; 100 cc. of the liquid are withdrawn, and about 50 cc. of dilute sulphuric acid are added, so that the solution is slightly acid. The aqueous solution is taken, warmed to expel the ether in solution, and extracted with 30 cc. of chloroform. The chloroform solution is collected in a weighed flask, and the chloroform distilled off; the residue is dried for some hours at 100° C. and weighed.

According to Wegmüller (loc. cit. 633), the above method gives too large a yield, and he recommends that the bark be extracted, mixed with lime, and the alkaloids be volumetrically determined in the chloroform solution by adding an excess of $\frac{N}{10}$ hydrochloric acid and titrating back with $\frac{N}{100}$ potash solution, using logwood as an indicator (1 cc. normal hydrochloric acid equals 0.0309 gm. of alkaloid).—A. L. S.

The Estimation of Mustard Oil. A. Schlicht. Zeits. Anal. Chem., **30**, 1891, 661—665.

CATTLE foods, in the composition of which the seeds of certain *Crucifera* enter, frequently contain mustard oil derived from the potassium myronate present in the seeds. The oil may be readily separated by steam distillation, and its amount most conveniently deduced from a determination of the sulphur in the distillate. Foerster's method for the purpose is based on the conversion of the mustard oil into thiosinamine by means of ammonia, and the subsequent decomposition of that body into sinamine and mercuric sulphide by treatment with mercuric oxide, the mercuric sulphide being finally weighed. In Duck's process the sulphur of the mustard oil is oxidised to sulphuric acid by alkaline potassium permanganate, the excess of the latter is destroyed by evaporation with hydrochloric acid, and the sulphuric acid afterwards precipitated and weighed as barium sulphate. According to the author both processes give low results. The following method is recommended instead. The mustard oil is thoroughly agitated and heated with an alkaline solution of potassium permanganate (20 parts of KMnO_4 , 5 parts of KOH to one part of oil). The

excess of KMnO_4 is then reduced by the addition of alcohol (25 cc. of alcohol to 5 grms. of KMnO_4), the liquid made up to a known volume and filtered. To an aliquot part of the filtrate, previously acidified with HCl , sufficient iodine is added to reoxidise any reduction product formed from the potassium sulphate by the action of aldehyde derived from the alcohol, and the sulphuric acid is then precipitated as barium sulphate in the usual way. Test analyses made with pure mustard oil yielded excellent results.—H. T. P.

Bibliography of Beeswax. U.S. Depart. of Agriculture Bull. **13**, 1892, 866.

See under XII., page 756.

Bibliography of Waxes used in Adulterating Beeswax. U.S. Depart. of Agriculture Bull. **13**, 1892, 869.

See under XII., page 757.

Chloroform. Tests of Purity. Traub. Pharm. Centralhalle, **33**, 245.

CHLOROFORM prepared with chloride of lime contains ethylidene chloride, and the action of sulphuric acid indicates that other impurities also occur in crude chloroform, giving rise to blue or violet colouration of the acid. Sometimes an odour of peppermint is developed. By treatment with sulphuric acid these impurities are removed completely, and a product is obtained in no wise inferior to the best kinds of chloroform. The following way of applying the sulphuric acid test is recommended:—The chloroform is mixed with an equal volume of sulphuric acid, and exposed for six or eight days to light, being meanwhile repeatedly agitated. Under such conditions there should be no colouration of the acid. The sulphuric acid is then separated, the chloroform dissolved in it, evaporated off, water added, and then 1 cc. of a solution of silver nitrate. No precipitate should be caused. However, it is only very pure chloroform that will stand this test. The author also recommends another test, based upon the action of sodium. Five cubic centimetres of the chloroform are shaken up during several days with 0.2 gm. of sodium, in a stoppered tube. In the case of pure chloroform free from alcohol, there is at most only a deposition of sodium chloride in small colourless crystals, and the odour remains pleasant. In the presence of alcohol the salt deposited has a yellow or brown colour.—W. S.

ANALYTICAL AND SCIENTIFIC NOTES.

The Action of Metals on Salts dissolved in Organic Liquids. R. Varet. Bull. Soc. Chim. 1892, 172—173.

CERTAIN metals which precipitate others from the aqueous solution of their salts, lose this property when certain organic solvents are substituted for water. In the experiments on the action of aluminium on cyanide of mercury dissolved in absolute alcoholic ammonia, an unstable cyanogen compound of aluminium was formed which is remarkable as being the only cyanogen compound of aluminium which does not contain a complete radicle similar to ferrocyanogen.—V. C.

The Allotropy of Amorphous Carbon. W. Luzzi. Ber. **25**, 1892, 1378—1385.

THE so-called graphite from Wunsiedel in the Fichtelgebirge, has always been looked upon as amorphous, and the author has made further examination as to whether this is really correct. The mineral he finds consists of pure carbon containing neither hydrogen nor nitrogen; microscopic

examination shows no signs whatever of the substance being of crystalline nature. The conclusion arrived at is that this form of carbon is amorphous, but that it differs considerably from wood charcoal, for ordinary amorphous charcoal has a sp. gr. 1.57—1.88 whilst the graphite in question has the sp. gr. 2.21—2.26 (Ceylon graphite according to Brodie has the sp. gr. 2.25—2.26); again, ordinary amorphous carbon is completely oxidised by potassium chlorate and red fuming nitric acid, without formation of the slightest trace of insoluble graphitic acid, whilst amorphous graphite gives an insoluble crystalline oxidation product perfectly analogous to or identical with that obtained from crystalline graphite. Sebungite occurring in Russia cannot well be compared with the above, since it contains 0.5 per cent. of hydrogen and 0.5 per cent. of nitrogen, but it agrees well with ordinary amorphous carbon in that it has about the same specific gravity and in that on oxidation it yields no graphitic acid.—T. L. B.

Ignition Temperature of Electrolytic Gas. F. Freyer and V. Meyer. Ber. 25, 1892, 622—635.

As a continuation of the experiments already carried out (this Journal, 1891, 752), electrolytic gas was passed at the ordinary pressure through a glass tube contained in a cylinder of sheet iron dipping into a bath of boiling zinc chloride. If the zinc chloride be set boiling and then the gas be passed, a very considerable explosion takes place at once; if the tube, however, be filled with electrolytic gas and then be introduced into the bath of boiling zinc chloride, water is formed without explosion. If the passing of the gas be stopped, then the bath heated to boiling point, a forcible explosion may be obtained by simply re-starting the gas current. Determinations of the temperature showed it to be 730° C. Next, zinc bromide was taken for the bath, but with this no explosion could be obtained; the temperature in this case was 650° C. Hence the temperature of ignition must lie somewhere between 650° C. and 730° C.

—T. L. B.

On a New Instance of Abnormal Solution. Saturated Solutions. E. Parmentier, Compt. Rend. 114, 1892, 1000—1002.

The author has already shown that if phospho- and silico-molybdic acids are dissolved in ether, the ether being in excess, they only dissolve in a certain definite proportion of ether. This proportion varies with the temperature, being less as the temperature is raised. He has found a new instance of such a phenomenon. Schützenberger has shown that if bromine be treated with ether, a crystalline body may be obtained which he calls brominated ether (ether bromuré), and which has the formula $(C_2H_5OBr)_2$. The author finds that this body is very soluble in ether, but if the ether is taken in increasing quantities there comes a time when the excess of ether separates from the liquid product, which is no longer homogeneous. The quantities of ether saturating a solution vary with the temperature, just as in the case of the phospho- and silico-molybdic acids, but, whereas in the case of those bodies the quantities of ether decrease as the temperature is raised, in the case of the brominated ether they increase as the temperature is raised.

In ordinary solutions, the solubility of the solid in the liquid is defined by the weight of the solid dissolved in a given weight of the liquid at a given temperature, the solid being in excess. In these abnormal solutions it is the weight of the liquid which limits the saturation and which therefore serves to define the solubility, the liquid being in excess. The author proposes the following definition of saturation, as being applicable to all cases:—

“Whenever bodies can, without combining, give a homogeneous liquid, the solution is said to be saturated when the body in excess separates from the solution.”—D. E. J.

Determination of the Freezing Point of Dilute Aqueous Solutions, and the Application thereof to Cane-Sugar. F. M. Raoult. Bull. Soc. Chim. 7—8, 1892, 130—134.

THE author has modified his method of determining the freezing point of solutions in a manner which greatly increases its accuracy. The principal improvements consist in the use of a cooling medium (40 per cent. glycerol) maintained at a constant temperature (about 3° C. below the freezing point of the liquid under examination) by suitable means; and of a more effective stirring apparatus in the shape of a platinum wire-gauze spiral surrounding the thermometer and rotated with it by means of gearing operated at a distance. The accuracy attainable is said to be $\frac{1}{500}$ th of 1° C. Applying this method to the determination of the depression of the freezing point exerted by cane-sugar in solutions of different strengths (0.683 to 39.04 grms. of sugar per 100 grms. of water), the author in general confirms his previous results, and finds that the molecular depression of cane-sugar, as in the case of other bodies, gradually increases when the strength of its solutions falls below a certain limit.—H. T. P.

The Compressibility of Saline Solutions. H. Gilbaut. Compt. Rend. 114, 1892, 209—211.

WHILE engaged in determining the variation with pressure of the electro-motive force of batteries, the author was led to investigate the compressibility of saline solutions.

The method pursued was that employed by Caillaud in an analogous investigation, special precautions being taken to rid the solutions of gas and to ensure that the temperature was everywhere uniform during the course of an experiment. All the experiments were carried out at about the same temperature, the differences being not more than 0.1° C., thus allowing a comparison of the results.

For certain solutions the author carried out several experiments with the same liquor, which enabled him to construct curves from which he deduced the following laws.

(1.) At a given temperature between 10° and 35° the compressibilities of solutions of a given salt vary with the concentration.

(2.) For dilute solutions the difference between the compressibility of water and that of the solution, which he calls the *saline compressibility*, is proportional to the concentration, and depends upon the salt and the solvent.

(3.) In general, starting with a given concentration, the saline compressibility increases less rapidly than the quantity of salt added, and if we represent the relative results for different salts by curves of which the abscissæ are percentages of salt and the ordinates the corresponding compressibilities, all these curves, if suitable scales are chosen, are superposable.

(4.) The compressibility of very dilute solutions diminishes with increase of temperature; on the other hand, the compressibility of a nearly saturated solution increases or diminishes less than that of a dilute solution of the same salt in consequence of a rise of temperature. In general, there is a point of mean concentration at which the compressibility is unaffected by change of temperature.

(5.) The curves showing the compressibility of different solutions of the same salt have the same form at all temperatures, provided that the temperature is not 0°.

(6.) The curves being constructed up to the point of saturation, the relation which subsists between the length of the curved and straight parts for each solution, is proportional to the contraction which takes place on solution.

(7.) If a given weight of a given salt is dissolved in a given volume of different solvents, solutions are obtained of which the saline compressibilities are proportional to the compressibilities of the solvent, and for a given salt, the quotient of the saline compressibility by the compressibility of the solvent is a constant.

(8.) The product of the saline compressibility of different solutions of a given acid and of given concentration into the equivalent of the metal of the dissolved salt is not constant.

(9.) The product of the saline compressibility of solutions of a given metal into the equivalent of the halogen is not constant when we take salts of different acids.

(10.) For any salts whatever, having a very small equivalent, the product of the saline compressibility into the equivalent of the metal and into that of the halogen is a constant.—D. E. J.

On the Mineralising Action of Sulphate of Ammonia.
T. Klobb. *Compt. Rend.* **115**, 1892, 230-232.

METALLIC oxides or sulphates are fused in a crucible or evaporating dish with an excess of sulphate of ammonia. The mixture is heated to 350° — 400° as long as vapours are disengaged, and then left to cool. If the residue has not been overheated it will consist of a neutral sulphate—a new example of crystallisation by volatilisation of the solvent.

Precipitated sulphate of lead when thus treated is converted into a grey micro-crystalline powder consisting of transparent prisms not more than 0.07 m. long, having their angles and edges distinctly replaced. Many of the crystals show the combinations $m-a$, which is one of the simplest forms of anglesite. Their specific gravity is 6.78 , and they contain 26.9 per cent. of SO_4 .

Generally, intermediate double sulphates are formed. Some of these have already been described by Messrs. Lachaud and Lepierre. With copper the action is particularly clear. According to the temperature at which the operation is stopped, we have successively—

- 1st, a double sulphate. $2 \text{ SO}_4\text{Cu}, \text{SO}_4(\text{NH}_4)_2$
- 2nd, the normal sulphate . . . SO_4Cu
- 3rd, the basic sulphate $2 \text{ CuO}, \text{SO}_3$
- 4th, cupric oxide. CuO

Under certain circumstances, in the absence of reducing gases, cuprous oxide is also obtained.

The first of these bodies may be obtained by heating over a sand-bath a mixture of one part of ordinary sulphate of copper and three parts of sulphate of ammonia. At first only water and ammonia are given off, then sulphuric and sulphurous anhydrides. The liquid is kept boiling at 360° — 380° until a crust forms on the sides of the dish, and even until this crust is a little decomposed by the heat, so as to avoid any excess of sulphate of ammonia.

The body thus obtained is represented by the formula (No. 1) given above. It consists of pale green transparent prisms about 1 mm. long, with a specific gravity of 2.85 . They are very soluble in water; in alcohol, at 90° , they slowly colour it, but do not dissolve. Exposed to air they rapidly become blue and opaque. At a temperature of 20° they absorb within 24 hours 42 per cent. of water. Left in vacuo, at the ordinary temperature, the loss of weight is only $\frac{1}{10000}$ in 24 hours, but there appears to be some dissociation at the surface. The crystals melt at about 200° , and at 350° are converted into the anhydrous sulphate of formula No. 2. This consists of minute grey prisms with sp. gr. 3.78 , which are not so hygroscopic as those of the double salt, but which are gradually changed by contact with air into the sulphate containing five equivalents of water.

Heated with care to a dull red, the neutral sulphate loses sulphuric anhydride, and leaves a yellowish brown powder of the basic salt having a specific gravity of 4.21 which consists of pseudomorphs of the crystals of the neutral sulphate.

Finally, the basic sulphate, when heated to a bright red, is changed into a crystalline powder of cupric oxide of sp. gr. 6.36 , which is not hygroscopic.—J. H. C.

ERRATUM.

Page 713, col. 1, line 28, from bottom, for "perman-gate" read "permanent."

New Books.

THE EXTRA PHARMACOPEIA. By WILLIAM MARTINDALE, F.C.S. Medical References and a Therapeutic Index of Diseases and Symptoms. By W. WYNN WESTCOTT, M.B. Seventh Edition. London: H. K. Lewis, 136, Gower Street, W.C. 1892. 7s. 6d.

This little work, of pocket-book size, and elegantly bound in morocco, and gilt, now appears in its Seventh Edition. It occupies 524 pages, including Prefaces to the sixth and seventh editions, Introduction, with list of Abbreviations, Additions made in 1890 to Brit. Pharm. of 1885, principal subject-matter covering 409 pages: there is also a Secondary list of Drugs, covering 9 pages, Appendix, containing—1. Antiseptic applications, &c. (4 pages). 2. Histological preparations for staining, hardening, and mounting microscopic objects, &c. (2 pages), and Index and Posological Table (78 pages). The work closes with a Therapeutic Index of Diseases and Symptoms.

It is pointed out that during the last two years methods of attempting to rid the animal organism of the infective bacilli by chemical antidotes have increased, and for this purpose the following preparations have been proposed, and a description of them is given in the volume, viz., Cantharidate of potassium, Chloride of zinc, Eucalyptol, Creosote, Guaiacol, and Benzozol. In this little work have been summarised the chemical researches on Salicylic acid and its new compounds, on the Aconite alkaloids and on Chloroform, as also on the Mydriatic alkaloids, especially Hyoscyne, Hyoscyamine, Scopolamine, Gelsemine, and Cocaine, as well as those on Mercurio-Zinc cyanide and Eucalyptus oils. It is stated that as general anaesthetics, Pental (Amylene) and Ethyl bromide are now competitors with Chloroform and Ether, whilst in local Anesthesia, Chloride of ethyl competes with Cocaine and Methyl chloride, especially for dental purposes. As new antipyretics and Analgesics since the Sixth Edition of the work have been introduced:—Salophene, Salicylamide, Analgene, Iso-pyrine, Salipyrine, Phenocoll, and Euphorine. In urinary diseases, Piperazine has been used as a solvent for urates, and Jambul against glycosuria. The use of Nitroglycerol has been extended to heart affections, and that of oxygen for pneumonia. The use of Cornutine is now applied for hæmorrhage, of Apocodine as an expectorant, and of the bromides of Ethylene and of Strontium for epilepsy. The compatibility of Nitrate of Cocaine with Nitrate of Silver is referred to, and, in a word, all new applications that have met with a fair measure of success receive due descriptive notice.

Attention may be particularly called to the useful "Therapeutic Index of Diseases and Symptoms," or as it might with even greater truth be styled, "Alphabetical Index of Diseases and Symptoms, with Selected Remedies." The usefulness of this Index is enhanced by the printing of the newer remedies added in the fifth, sixth, and seventh Editions of the *Extra Pharmacopeia* last in each list and by printing them in italics.

ADRESSEBUCH UND WAARENVERZEICHNISS DER CHEMISCHEN INDUSTRIE DES DEUTSCHEN REICHS. Herausgegeben von OTTO WENZEL. General Secretär des Vereins zur Wahrung der Interessen der Chemischen Industrie Deutschlands. 1892. III. Jahrgang. Berlin: Verlag von Rudolf Mückenberger, Dossauerstr. 13. London: H. Grevel & Co., 33, King Street, Covent Garden. M 25, or about 11. 5s.

This systematic work, first issued in 1888 (this Journal, 1888, 536), now appears in its third edition and year, greatly increased in size. It is a most complete Directory of the Manufacturers of Chemicals and Chemical Products of the German Empire, taking the form of a large 8vo. volume bound in cloth. An excellent feature of the work is that it is written in German, English, French, Italian, and Spanish. It now covers 1164 pages without the Appendix, which itself covers 152 pages additionally. The work commences with brief Prefaces, a Table of Contents, an Alphabetical Index of

Chemical Products referred to in the body of the work, first in German and then repeated in English, French, Italian, and Spanish. Next follows the Index to Advertisements, then a List of German Associations and Societies connected with Applied Chemistry, and then the List of the Chemical Manufacturers and Laboratories. In the latter are given:—1. Chemical Manufacturers; 2. Chemical Laboratories; and 3. List of Localities. The next division of the work is devoted to the List of Chemical Products and Raw Materials, subdivided as List of Chemicals with Names of the Manufacturers, and List of Raw Materials and Half-manufactured Goods for the Supply of the Chemical Industry, with names of the suppliers. Finally, the third division of the work gives publicity to the Agencies, Wholesale Houses, Export and Import Houses in Germany and other Countries.

The Appendix is an Index for Articles required in Chemical Works, and is subdivided as follows:—1. Index to Advertisements; and 2. Index to the Market for Supply.

LESSONS IN HEAT AND LIGHT. By D. E. JONES, B.Sc., (Lond.), Director of Technical Instruction to the Staffordshire County Council, Late Professor of Physics in the University College of Wales, Aberystwyth. London: Macmillan & Co., 1892, and New York. 3s. 6d.

OCTAVO volume bound in cloth, containing Title page, Preface, Table of Contents, Note on Metric System of Weights and Measures, and Text covering 309 pages. Answers to Examples set in the body of the work cover pages 310 and 311, and an Alphabetical Index concludes the treatise. With regard to the subject-matter, this is arranged in chapters of which there are in all nine, and the illustrations number 194. Examples to be worked out by the student are given at the end of each chapter.

DIE SULFOSÄUREN der Beiden Naphtylamine und der beiden Naphtole. Uebersichtlich Zusammen-gestellt von Dr. ERNST TÄUBER. Privatdozent an der Königl. Technischen Hochschule, Berlin. 1892. Berlin: R. Gaertner's Verlagsbuchhandlung (Hermann Heyfelder), S. W. Schönebergerstr. 26. London: H. Grevel & Co., 33, King Street, Covent Garden. M. 3.60 (about 3s. 7d.).

LARGE 8vo. volume in paper cover, containing Preface, Arrangement of Text, List of Abbreviations of Sources of Reference, and Table of Contents. The subject-matter covers 30 pages. Pages 1 to 10 are devoted to a description of the α -Naphthylamine sulphonic acids; 10 to 17, the β -Naphthylamine sulphonic acids; 18 to 24, the α -Naphthol sulphonic acids; 25 to 30, the β -Naphthol sulphonic acids. In the description of these acids, *first*, the methods of preparation are given briefly with original references; *secondly*, the properties, also with references; *thirdly*, the constitution, and modes of determination, with references. The descriptive matter is given in the left-hand and larger column, a smaller right-hand space being reserved for the references, which are printed in italics.

HANDWÖRTERBUCH DER PHARMACIE. Praktisches Handbuch für Apotheker, Aertzte, Medecinbeante und Drogisten. Herausgegeben von A. BRESTOWSKI. Zwei Bände, Wien und Leipzig. WILHELM BRAUMÜLLER, K. U. K. Hof- und Universitäts-Buchhändler. 1892. London: H. Grevel and Co., 33, King Street, Covent Garden. 2s. 5d. (2.4 M.).

This Dictionary of Pharmacy, issued in parts, large 8vo. size, now reaches the issue of part 4 (see this Journal, 1892, 641). Part IV. commences with a description of "*Bernsteinsäure*," succinic acid. Its formula and constitution are first expressed. The chief methods of preparation then follow: then the properties, the tests, and finally the uses, therapeutic and otherwise. This method of description is systematically carried out in the case of the other substances referred to. Part IV. closes on page 320, with a definition of the word "*Burtonisieren*," or Burtonising, which is defined as the treatment of water with sulphate of lime.

MODERN MATERIA MEDICA. For Pharmacists, Medical Men and Students, by H. HELBIG, F.C.S. Third enlarged Edition. New York, Lehn and Fink, 128, William Street. London: The British and Colonial Druggist, 42 Bishopsgate Without, E.C. 1892. 4s.

OCTAVO volume, bound in cloth, and containing Introduction to third edition and also to the second, Table of Contents and Text covering 182 pages. The work closes with Tables of Doses, Solubility, Melting and Boiling Points of New Remedies, and the Alphabetical Index. The method of treatment and description followed of the various substances, is well exemplified in the case of the first individual, viz. *Acetaminilide*, the Synonyms in Pharmacy and Chemical formula of which are first given. The *Method of Preparation* now follows, then the *Physical and Chemical Properties*, and next the *Medicinal Uses*. Lastly, the Derivatives and Allied Compounds of interest are described.

Trade Report.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

GREECE.

The Greek Drug Trade.

The Greek official statistics for 1891 have not yet been published. Those for 1890 which our Consul at Athens sends over show a considerable increase in the imports of medicines and perfumery over 1889, but a still larger falling off in the imports of heavy chemicals. The figures showing the imports of pharmaceutical goods into Greece from various countries are as follows:—

Country.	Quinine.		Other Drugs and Medicines.	
	1889.	1890.	1889.	1890.
	Oz.	Oz.	Lb.	Lb.
United Kingdom	23,888	11,080	51,000	112,000
France.....	24,364	720	94,000	119,000
Belgium	850	..	..	..
Germany	44,280	29,084	51,000	69,000
Austria-Hungary	13,614	25,080	123,000	141,000
Italy.....	13,867	7,363	41,000	43,000
	120,943	77,230	350,000	484,000
Country.	Soap and Perfumery.		Heavy Chemicals and Acids.	
	1889.	1890.	1889.	1890.
	Lb.	Lb.	Lb.	Lb.
United Kingdom	49,000	74,000	2,806,000	2,723,000
France.....	36,000	64,000	3,719,000	394,000
Belgium .....	..	..	203,000	117,000
Germany	2,000	2,000	155,000	83,000
Austria-Hungary .....	..	..	174,000	150,000
Italy.....	..	..	255,000	64,000
	87,000	140,000	7,312,000	3,531,000

Quinine.

I can obtain no explanation, says Consul Elliott, of the great decline in the importation of this drug, except that there must have been an over-importation in 1889. In view of the simultaneous increase under the heading "*Other Medicines and Drugs*," I surmise that its place may have been taken by antipyrine and similar preparations, but I can obtain no confirmation of this conjecture. It has been suggested to me that sanitation has improved, and this is no doubt true as regards the capital and some other towns; but the bulk of the quinine is consumed in the low-lying country districts. The greatest decline was in the quinine brought from France, the quantity having fallen from 24,364 oz. in 1889 to 720 oz. in 1890.

Chemicals.

Although including acids, which obtained a reduction of duty, chemicals show a diminution of 45 per cent., the decrease in British imports being, however, only 18 per cent.

Soap and Perfumery.

A small trade, shows an increase. The duty on high-class soaps is nearly prohibitive, even with the reduction stipulated by the French Convention.

JAMAICA.

Manufacture of Lime Juice.

The crude lime juice is obtained either by running the limes through an ordinary cone mill, or by placing them in a squeezer especially adapted to the purpose, which is the simpler and more usual plan.

The juice is then clarified by straining and filtration, when some foreign substance is added to prevent decomposition of the vegetable matter. In this state most of the juice is shipped from the island.

In order to concentrate the juice, it is strained from the seed and pulp, placed in a copper battery, and boiled on the same principle as sugar, taking care not to scorch or burn it, as that destroys the acid. The more densely the juice is concentrated the more valuable it is; but it is not advisable to go too far, as it burns easily without forming a crust on the copper. No iron vessel must be used, as the iron turns the acid black.

In the year which ended March 31st, 1891, the amount exported was 53,881 gallons, of which 44,492 gallons went to the United Kingdom, 110 to Canada, and 9,282 to the United States.

The average valuation in the export list is 20 cents per gallon, but the price for the raw juice ranges from 18 to 30 cents, according to the supply and the demand, while the concentrated juice sells according to the percentage of citric acid it contains.

Substantially the same process is adopted in the manufacture of sour-orange juice, which, when concentrated, is valued at from 45 to 50 cents per gallon. Of this 1,102 gallons, the entire amount manufactured during the period above stated, was exported to the United States.

RUSSIA.

The Napbtha Business.

The yield of petroleum from the Baku fields is larger this year than it has ever been before, and the existing works are scarcely able to cope with the supply. The house of Chibaïev are constructing near their factory in Baku an immense underground reservoir capable of containing 5,000,000 pounds of napbtha. This reservoir is not to be rectangular, but to take the form of a reversed cone or funnel shape. The firm of Nobel are constructing a still larger reservoir, which will have a capacity of 6,000,000 pounds. The walls will be lined with zinc, and the foundation will be a bed of water, to be obtained by boring.

Quicksilver.

The only quicksilver mine, situated in the south-western part of Russia, near Nikitofka station, on the Kursk-Kharkov-Azov line, Bakhmoet district, in the province of Ekaterinoslav, shows an output of 50,114 tons of ore, or a decrease of 8,404 tons of ore extracted, as compared with 1890. Of this quantity 45,517 tons were killed, producing 314 tons of quicksilver, 30 tons more than in 1890. At present 350 men are employed, of whom 226 work underground.

GENERAL TRADE NOTES.

NEW OIL-FIELD IN SUMATRA.

In a review of the kerosine oil trade in Singapore for the June quarter, forwarded from the office of the Colonial Secretary at Singapore, the following note with regard to the development of a recently discovered oil-field in Sumatra occurs:—

The most important feature now before the trade is the new oil-field, for some time known, but only recently become productive, in the northern part of the island of Sumatra, in the State of Langkat, with a sea-board on the Straits of Malacca. Concessions have been granted by the Dutch Government to both Dutch and English capitalists, but so far a Dutch company is the only one which has got to work, and, after a commencement within the last 12 months, it is now reported to be producing from 15,000 to 20,000 cases per month, with a steadily increasing output. Altogether concessions have been granted for some 320 square miles of what has been pronounced by experts to be a very rich oil-producing territory, and, being on the sea-coast, and not, like the American and Russian oil-fields, far inland, and having besides an excellent deep water, well-sheltered harbour, its position may be said to be unique. Also the kerosine produced at Langkat is proved by a skilled English engineer to be of first rate quality, being "water white" absolutely without "bloom," flashing by Abel's test at 83 to 86 degrees, and burning at 124 to 126, the percentage of kerosine yielded being fully equal to good American and quite double that of Russian petroleum. When it is borne in mind that the Russian output in 1891 was 834 million barrels, the bulk of which was obtained from an area of about seven square miles of the oil-field near Baku, the capabilities of the new oil-field in Sumatra may be judged, supposing it turns out all that is said about it.—*Board of Trade Journal*.

DISCOVERY OF A NEW DEPOSIT OF ONYX IN MEXICO.

The *Revista Financiera Mexicana* announces that a new deposit of onyx of considerable importance has just been discovered about 50 kilometres to the south of El Paso. This deposit, the working of which has been conceded for a term of five years, is not less than 86,000 acres in extent.

The onyx newly discovered is of superior quality, with fine grain and richly shaded with delicate and varied tints. It is situated at about 22 kilometres distant from the Central Mexican railway, with which it may be easily connected by a branch line.

The cost of extraction will be very small, and, in view of the exceptional importance of the deposit, the onyx delivered at El Paso will not cost much more than building stone. It should also be observed that blocks of onyx of considerable dimensions can easily be extracted.—*Ibid*.

SOUTH AMERICAN METALLURGICAL INDUSTRIES.

Mons. Ch. Vattier recently read a paper before the French Société des Ingénieurs Civils, entitled "The present state of metallurgy in South America in general and Chili in particular; its future, and its importance from the point of

view of French industry and commerce." The *South American Journal* for the 30th July says that Mons. Vattier has resided for many years in Chili, and has erected numerous manufacturing establishments in that country. The climate of Chili, the French technologist says, is healthy; the artisan is intelligent, and the soil is very rich in metalliferous deposits. The railway system is already an important one, and the construction of several new lines is now under consideration.

The exploitation of saltpetre is, of course, a staple industry. It yields to the Government an annual revenue of 25,000,000 piastres. The crude saltpetre, treated in the large works, is brought to a percentage of 95. Many other industries exist, amongst which may be mentioned iron-founding and briquette-making. The chemical industry is, Mons. Vattier thinks, capable of great development. Metallurgical establishments pure and simple are very numerous.

As fuel, wood is employed in the central and southern regions. Fairly good lignite is worked on a large scale, especially in the neighbourhood of the industrial town of Lota. Coke is imported from the United States. At several points in the Republic refractory material of medium quality is found, together with the substances used as fluxes.

Mons. Vattier enumerates the mines of copper, gold, and silver, and discourses on the special metallurgy of each metal. The auriferous ores have a very hard gangue, and are treated with difficulty. The production of copper has comparatively little expanded since 1847, when it was equivalent to one-third of the entire output of the world. Mons. Vattier draws attention to the methods employed of treating the ores. Some of the processes, he says, although excellent, are unknown in France. Such are the treatment of argentiferous ores by the wet method, and even by the dry process, in the special furnaces (semi-blast furnaces), and the copper ores by smelting and "Bessemeration."

Among other metals, manganese may especially be cited. The export of the ores containing this metal has reached in one year 13,000 tons. Up to the present this export has been confined to Great Britain and the United States.

With respect to the metallurgy of iron, this is an industry which has yet to be created in Chili. Mons. Vattier, who made, for the Chilean Government, a tour of inspection through the Republic, extending over three years, found very pure iron ores near the coast, and he expresses the hope that French concerns will obtain the privilege of conducting future mining and metallurgical operations in the country.

In any case, he desires that Frenchmen will no longer be content to see foreigners monopolise the principal products of South America. At present the metallic silver, argentiferous lead and copper, mattes, the ores of copper, lead, silver, tin, bismuth, and antimony from the Argentine Republic, Chili, Peru, and Bolivia are shipped largely to Havre; but, instead of remaining in France, they are despatched abroad, principally to Hamburg.—*Ibid.*

THE SULPHURIC ACID TRADE IN BRAZIL.

The Brussels *Bulletin du Musée Commercial* for the 23rd July publishes the following particulars of the trade in sulphuric acid in Brazil:—

There is in the country a sulphuric acid factory; it is established at Rio de Janeiro, and its products are considered to be of excellent quality. They are much used in Brazilian industries. Deliveries are made in earthenware demijohns, of a capacity of 30 kilos., and in cases containing two demijohns packed in wood.

A maker of printed calicoes at San Paulo, M. Frederico Kowarick, receives six cases per month, and the six mineral water factories about eight cases. Two mineral water factories at Santos are also supplied from the works at Rio de Janeiro.

The acid of the desired degree of concentration for these factories costs 199 reis per kilog., including package. It is

stated that the European product costs more, and it would appear that no industry of the State of San Paulo obtains it from abroad.

The *Companhia Formicida Paulista*, founded at San Paulo in 1890 with a capital of 500,000 milreis, is engaged specially in the manufacture of sulphur of carbon used in the destruction of ants, which are a plague in the country. It will probably make also sulphuric acid for native establishments.

For this trade, as for all others, the conditions of payment are very varied. Some consumers pay ready money; others obtain credits of three, six, and often nine months.

The new tariff does not modify the duty levied on sulphuric acid; pure or colourless, 89 reis per kilog.; impure, 10 reis, duties estimated for both at 15 per cent. *ad valorem*. Tare is fixed as follows: in earthenware jars, 30 per cent.; in cases, 10 per cent.—*Ibid.*

THE OIL TRADE OF SCOTLAND.

So peculiarly is the destructive distillation of oil shale a Scottish industry, that the condition of the mineral oil trade is a matter of national interest. Mineral oil, of course, is not a monopoly of ours; but the mineral oil of America, East Europe, and Asia comes to the hands of man in a liquid or semi-liquid form, whereas in Scotland it has to be mined from the bowels of the earth in the form of shale, and then put through an elaborate process of distillation in retorts of the most scientific construction. The Scottish oil industry is, from first to last, one calling for the exercise of the highest chemical and engineering knowledge and skill, whereas that of America calls for little more than the application of mechanical labour. The history of the Scotch industry has been a romance, and few departments of human effort have experienced so many vicissitudes within considerably less than a generation. At present the trade seems to have fallen upon evil days, and a perusal of the annual reports of the several companies is a depressing exercise. Looking at the net result of the operations of the financial year just closed, we find the following in the case of those companies who have published their accounts:—

	Profit.	Loss.
	£	£
Broxburn (after depreciation)	20,354	..
Burntisland (without depreciation) .....	..	9,607
Clippens " " .....	..	13,831
Holmes " "	1,113	..
Linlithgow " " .....	..	7,512
Oakbank " " .....	..	1,623
Pampherson (after depreciation)	15,087	..
Young's (without depreciation, but less interest) ..	49,938	..

Thus, four only out of eight companies are able to show a balance on the right side of profit and loss account, even by postponing allowances of depreciation of property, machinery, and plant. In some cases (it would be invidious to make individual references here) no depreciation has been written off for several years; in others the operation has only been suspended for a year or two, in the hope, no doubt, of better days to come.

Whether such a hope can be fairly entertained there is only too good reason to doubt; and that that vague, incorporate, yet shrewdly intelligent body called "the market" entertains but little, can be inferred from an inspection of the Stock Exchange list. We have been at pains to compile a comparison of the prices of oil shares as at the close of last account and at the corresponding period of last year. The effect of a year's depression is startling. The following

statement shows the prices of the shares on June 10, 1892 and 1891, respectively:—

	June 10,		Loss.
	1891.	1892.	
Broxburn.....	17	10	7
„ Preference.....	11	10½	5½
Burntisland.....	65s. 6d.	10s.	55s. 6d.
Clippens.....	60s.	21s.	39s.
„ Debentures.....	95	81½	13½
Dalmeny.....	12½	10	2½
Herrnand (A).....	7s. 6d.	3s.	4s. 6d.
„ (B).....	3s. 9d.	3s. 9d.	..
Holmes.....	65s. 6d.	25s.	40s. 6d.
„ 8l. paid.....	6½	65s.	60s.
Linlithgow.....	25s.	5s.	20s.
Oakbank.....	8½	6	2½
„ 5l. paid.....	88s. 9d.	75s.	13s. 9d.
Pumphreston.....	9½	7½	1½
Young's.....	64s.	29s. 3d.	34s. 9d.
West Lothian.....	60s.	Nil.	60s.

(The West Lothian Company have gone into liquidation during the year under review.)

Now, what do these declines in the market prices of these shares represent to the public? The question is more serious than may be generally supposed, for the oil shares are nearly all held in Scotland; and while they are distributed among all classes of the community, they are very largely held by the class of small investors—the industrial and trading class—who have put their savings freely into this national industry. The following table shows the depreciation in capital amount:—

	No. of Shares.	Fall.	Loss.
Broxburn.....	23,500	7d.	£164,500
„ Preference.....	10,000	½	3,124
Burntisland.....	16,700	55s. 6d.	£4,342
„ Call of 30s. per share.	..	39s.	£5,050
Clippens.....	25,800	39s.	50,197
„ Stock.....	1,400	13½	18,900
Dalmeny.....	2,700	2½	6,750
Herrnand.....	115,000	4s. 6d.	25,875
„ Call on.....	200,000	5s.	50,000
Holmes.....	5,000	40s. 6d.	10,124
„ ..	625	60s.	1,875
Linlithgow.....	20,000	20s.	20,000
„ Call of.....	..	2s.	20,000
Oakbank.....	4,473	2½	12,860
„ ..	1,500	13s. 9d.	3,094
Pumphreston.....	12,500	1½	23,438
Young's.....	77,011	34s. 9d.	133,806
Young's Converted Stock depreciated.	..	(?)	(?)
West Lothian.....	10,000	60s.	30,000
Capital loss in 12 months.....			£46,237

To this, however, must be added the loss by interest in these companies which have not paid any dividends, the depreciation on capital converted from debenture bonds into ordinary shares (Young's) and the depreciation on other mortgage and debenture bonds and deferred shares—items which are not easily ascertainable, but which will bring up the year's loss to, in round numbers, not less than three-quarters of a million sterling. Indeed, it would not be unfair to assume that the community is poorer by one million in respect of these investments than it was a year ago. How much poorer since the companies were formed one shrinks from inquiring.

This is a serious enough fact in itself, but, unfortunately, worse remains behind. The accounts of a considerable number of these companies show that they are in a condition from which financial recovery is hopeless without some phenomenal revival in some branch of the oil trade. Of such phenomenon there is not the slightest prospect. Last year good hopes were entertained of profit under the arrangement with the American competitors for sustaining the price of scale or paraffin wax. What was gained, however, in scale was more than lost in burning and machinery oils, and a heavy net depreciation occurred. This year a fierce competition between the Americans and the Russians has produced a still further reduction in the price of oil, and at the present moment there does not seem to be a redeeming feature in the trade. Indeed, the competition between the petroleum wells of the eastern and the western hemispheres may conceivably reduce the price of burning oil to farthings, instead of pence, per gallon, and with this product must also decline the heavier oils used for machinery purposes. With the Scotch companies burning oil is now very much in the nature of a by-product, their profit being derived from elements which formerly went to waste. This however, is a mere general statement, not to be received without qualification. Thus, the companies may not, as a rule, expect to make a profit on the average selling price of burning oil; but if by the competition of petroleum they are compelled to sell at a loss what they cannot avoid making, then their chance of profit upon the other products is *pro tanto* reduced. At the present moment the fortunes of the survivors seem to depend on the future course of scale and sulphate of ammonia, and the balance of probability does not appear to be in favour of an advance of either. On the other hand, the announcement of a heavy reduction in the price of petroleum in America conveys a serious menace; and it must be admitted that few, if any, of these Scotch incorporations are in a position to stand any further buffeting. Their balance-sheets are not models of perspicuity; indeed, some of them leave the general impression that they are skilful contrivances to hide the worst from the long-suffering proprietors. Sometimes one may be cruel only to be kind, and sometimes one may try to be kind and end by being cruel. If all the oil concerns had been properly debited with depreciations most of them would have been wiped out of existence by this time. But while there is life there is hope; and, at all events, as long as there is life there is employment for a large number of persons, who will, indeed, be in an evil case when the oil industry has to be numbered among the departed glories of Scotland.—*Chem. Trade Journal*.

THE PERFUMERY DRAWBACK.

The following is the text of the General Order authorising a drawback on perfumed spirits and spirituous flavouring essences when exported from the United Kingdom:—

General Order concerning the Drawback on Exported Flavouring Essences and Perfumed Spirits.

Inland Revenue, Somerset House.

London, W.C., August 30th, 1892.

THE LORDS COMMISSIONERS OF HER MAJESTY'S TREASURY having sanctioned the repayment of duty charged on the spirits used in the manufacture of flavouring essences and perfumed spirits exported by licensed rectifiers and compounders, when such essences are not made in bond:

It is ordered:—

1. That a rectifier, or compounder, intending to export flavouring essences or perfumed spirits on drawback, must comply with the following regulations:—

2. Twelve hours' notice must be given to the officer on Form No. III.—5, prepared for the purpose.

3. The officer will attend at the notice hour and check the contents of the bottles with a suitably graduated measure to be provided by the Revenue.

4. The total quantity of flavouring essences or perfumed spirits in any one consignment for exportation examined at any one attendance of the officer must be not less than two bulk gallons, except under the special sanction of the Board, and subject, if so ordered, to a special charge for the attendance of the officer.

5. One sample out of every ten, or fraction of ten kinds, whether of essences or perfumed spirits, is, as a rule, to be taken by the officer. A larger proportion of samples may, however, be taken, should the officer in his discretion think it necessary.

6. The samples of flavouring essences are in all cases to be sent to the laboratory; but, usually, the strength of the samples of perfumed spirits shall be tested by the officer and the samples returned at once to the exporter.

7. In cases of doubt, arising from any peculiarity of the perfumed spirits, suggesting that the hydrometer does not afford an accurate indication of the strength, a sample should be sent to the laboratory; and also in all cases where the strength found by the officer is less than that declared by the exporter by more than 2 per cent.

8. The quantity drawn for a sample to be sent to the laboratory is to be not less than 3 oz. of perfumed spirits and 1 gill of flavouring essences. The sample may be contained in, or taken from, separate bottles, but the contents of all the bottles must be of the same strength. These samples are to be labelled with the name of the flavouring essences or perfumed spirits, and the original notice to export (Form III.—5) should be forwarded by the first post to the laboratory.

9. The name of the particular flavouring essence or perfumed spirits must be stated on the label attached to each bottle, and every case must be branded or inscribed with a progressive number and distinguishing mark, the bulk gallons contained therein, the name of the person for whom the goods were bottled, or a special mark without a name, and the words "flavouring essences" or "perfumed spirits," as the case may be.

10. Every case after the bottles have been counted, the strengths ascertained by the hydrometer, or samples taken for the laboratory, and the contents compared with the specification, must be packed, closed, and securely fastened with tape or wire at the trader's expense, and sealed by the officer with the Revenue seal.

11. There is no objection to the refilling of the bottles sampled with flavouring essences or perfumed spirits of the same kind and strength should the exporter so desire, or to the substitution of bottles already filled, labelled, &c. for packing, of similar kind, size, and strength.

12. The full particulars of the several cases, and the total bulk gallons of each consignment, must be entered in an opening of the survey book according to the following precedent:—

Number of Cases.	Marks on Cases.	Progressive Numbers.	Description of	Content of Bottles to the Thousandth Part of a Gallon.	Number of Dozens of Bottles of each Size in each Case.	Quantity in Bulk Gallons.	Declared Strength in Terms of Proof.	Strength of Spirits as found at the Laboratory, or by the Officer.	Proof Gallons.
			Flavouring Essences.	Perfumed Spirits.					

13. The officer should certify, at foot of the notice (Form III.—5), that the contents of the cases agree with the specification.

14. If on testing the strength by the hydrometer, or on examination of the sample at the laboratory, the average strength is found to be less by not more than 2 degrees than that declared by the exporter, the declared strength will be regarded as correct, and drawback, &c. allowed accordingly.

15. If, however, the average strength found be less by more than 2 degrees than that declared, a deduction to the extent of the difference, and a further deduction of 1 degree is to be made, in calculating the proof quantities of all the flavouring essences and perfumed spirits in the consignment; but where the difference amounts to 5 degrees or more, the Board will specially determine the basis on which the calculation for drawback, &c. is to be made.

16. For example, two samples are taken, the strengths of which are declared to be 50 over proof and 8 under proof respectively, or an average of 21 over proof.

17. These are found by the hydrometer or by analysis to be 47 over proof and 9·3 under proof respectively, or an average of 18·6 over proof. The drawback would be payable on the basis of the declared strengths if the average found had been 19 over proof or more; but, since it is less than that declared by 2·4 degrees, a further deduction of 1 degree is to be made (in all 3·4 degrees) in calculating the proof quantities of all the flavouring essences or perfumed spirits in the consignment.

18. In arriving at the amount of drawback payable under these provisions, the bulk and proof gallons are to be calculated to centesimals, following the rule adopted as regards spirits bottled in warehouse.

19. An ordinary spirit certificate, showing the number of cases, the total bulk gallons, &c., must be sent with the goods to the ship's side, the original notice (Form III.—5) being in all cases sent at the same time to the collector of Customs at the port from which the goods are to be exported. The proper officer of Customs will certify thereon the shipment of the goods, and send it immediately to the Customs Statistical Office. It will then be returned without delay to the station whence the goods were removed.

20. When samples are sent to the laboratory, a copy of the notice (Form III.—5) must be sent thereto by first post.

21. This notice, with the analysis strength inserted therein, will be forwarded from the laboratory to the proper officer, or by the Board to the proper collector, as the case may be, in accordance with the instructions in the case of tinctures, in General Order of April 6th last.

22. The officer should note, on each notice, the address to which it should be returned.

23. An abstract of each consignment should be sent to the principal of the Statistical Department.

24. Bond, with surety, for the due exportation of the goods, must be given by the rectifier or compounder before removal. The bond may be a general one. A special form of bond (No. 294—1) has been provided for use under the regulations in this Order, and a supply can be obtained in the usual way.

25. On receipt of the Form III.—5, examined by the supervisor, the collector will take steps for payment of the drawback without delay.

26. When flavouring essences or perfumed spirits are exported to the Isle of Man, the following course is to be adopted:—

27. When the strength has to be ascertained at the laboratory the officer must prepare a copy of the original notice for transmission to the collector of Customs at Douglas, and forward the original notice to the principal of the laboratory, who, after inserting therein the ascertained strengths, will forward it to the collector at Douglas, in order to enable him to charge the insular duty. Both notices will then be returned to the proper collector of Inland Revenue, for payment of drawback, &c.

28. If the strength be determined by the officer and found correct, only the original notice need be sent to the collector at Douglas.

29. In cases of extreme variation of strengths, whether found by the officer or at the laboratory, the notice will be sent to the collector at Douglas by the Board, when the basis for calculation of drawback has been fixed.

Flavouring Essences.

30. With regard to these essences an allowance for waste of 4 per cent., is to be made upon those prepared by maceration or percolation, the same as in the case of tinctures; and upon those prepared chiefly by the addition of flavouring ingredients to the spirits, an allowance of 2 per cent.

31. The drawback of duty will be at the rate of 10s. 6d. per proof gallon, with the usual allowance of 4d. per gallon.

32. The sizes of the bottles will be restricted to $\frac{1}{2}$ oz., 1 oz., 2 oz., 4 oz., $\frac{1}{2}$ pint, 1 pint, 2 pints, and 4 pints.

33. A case may contain flavouring essences of different kinds, but all the bottles in the same case must be of the same size.

34. When the size of the bottles is not less than 5 oz., they must be packed in cases containing not less than two bulk gallons, and when the size of the bottles is not greater than 4 oz., they may be packed in cases containing not less than 1 gallon.

35. Schedule of flavouring essences in respect of which the special allowance of 4 per cent. for waste may be granted under the provisions of this General Order:—

Essence of celery.	Essence of tonquin.
„ chocolate.	„ vanilla.
„ coffee.	„ lemon, made with
„ ginger.	spirits and lemon-peel.
„ horehound.	Essence of orange, made with
„ orris.	spirits and orange-peel.
„ tamarind.	

Perfumed Spirits.

36. An allowance of 4 per cent. for waste is to be made on perfumed spirits as prepared for sale (except upon certain articles herein-after mentioned); but in order to become entitled to this allowance the exporter must make a declaration on Form III.—5, that the perfumed spirits have been made from pomade extracts, or from other macerated substances prepared in this country, and that they do not consist of and have not been manufactured from imported perfumed spirits.

37. The drawback of duty will be at the rate of 10s. 6d. per proof gallon, with the usual allowance of 4d. per gallon.

38. To meet the requirements of the trade the sizes may begin at $\frac{1}{2}$ oz., and increase by multiples of $\frac{1}{4}$ oz.; but the bottles in each internal package must be of uniform size and of the same strength, and must contain at least 3 oz.

39. The contents of the bottles are to be checked by taking not less than six of each size for ascertaining the average contents of the bottles of that size, and the total contents for drawback and allowance shall be calculated from such ascertained average, and not from the nominal capacities of the bottles.

40. No case is to weigh less than 42 lb., after the same has been packed and made ready for exportation.

41. The regulations concerning perfumed spirits shall apply also, as far as applicable, to the following preparations; but the sizes of the bottles, except in the case of Eau-de-Cologne, lavender-water, and Florida water, shall begin with 1 oz. and increase by multiples thereof:—

Eau-de-Cologne.	Dentifrices.
Lavender-water.	Hair-washes.
Florida water.	Brilliantines.
Toilet-vinegars and waters.	

42. The strength of these preparations must be ascertained by the hydrometer.

43. These preparations are not entitled to the allowance of 4 per cent. for waste; but the usual drawback of 10s. 6d., with the allowance of 4d. per proof gallon, will be paid.

By the Board,

ROBERT MICKS,

Secretary.

ARTICLES OF INTEREST TO TECHNOLOGISTS AND MANUFACTURERS.

The following, in the *Board of Trade Journal* for September, will repay perusal:—

“Manufacture of Tin and Terne Plates in the United States”	p. 256
“The Russian Salt Industry”	p. 263
“Customs Tariff of Greece”	p. 293
“Alterations in the Swiss Customs Tariff”	p. 311

THE HISTORY OF BORAX IN THE UNITED STATES.

Previous to the year 1864 the existence of borax in the United States was unknown, and the whole of the supplies came from abroad. In those days its application for commercial purposes was comparatively limited, and it was chiefly known as a drug and a blacksmith's flux. Now it is largely used in welding, as a preservative for animal food, and as an enamel, while its uses in metallurgical processes and in assaying have been enormously extended. Thirty years ago the imports of borax into the United States were 145,000 dols. to 220,000 dols. per annum, but in 1864, when the domestic product was first placed on the market, the imports fell to the yearly value of 9,000 dols. In the old days borax figured chiefly in drug stores, where it was retailed at 25 cents an ounce. In 1864, however, the price fell rapidly, until in 1872 it was sold by the producers at 10 cents a pound. Coming down to recent years we may note that the 7,589,000 lb. produced in 1888 realised on an average 6 cents a pound, and that the eleven million pounds produced in 1887 brought about 5 cents a pound. As yet the only States where borax is found are California and Nevada. It is found in several forms, which chiefly occur as efflorescences from ancient marshes and lake bottoms. In some cases it occurs as tinkal *z.e.*, crude crystals of sodium baborate; at other places it is accompanied by other chemicals, such as sodium chloride and carbonate of soda; another common form is borate of lime imbedded in clay and sand, and known as ulexite or cotton balls; and pure borate of lime in the forms of colemanite and pandermite is also found in great quantities. In the first two cases very little treatment except purification by solution is required, and with ulexite, colemanite, and pandermite, the borate of lime is changed into borate of soda by mixing the solution when hot with carbonate of soda.

The credit of discovering borax in the United States is due to Dr. Veatch, who noticed in 1856 that the water in a spring near Red Bluff, Tehama Co., Cal., contained a small amount of borax in solution. He followed up this discovery by searching through the country north of San Francisco, and in the course of a year or so he found a lake among the mountains called Clear Lake, whose mud contained great quantities of crystals of borax. This lake is entirely surrounded by a circle of hills and the water has no outlet. The scenery and features of the landscape present many indications that the bowl of the lake has at one time been the crater of a volcano. When Dr. Veatch first came across the lake it was in the summer season, and the area of the lake was only about 50 acres, and its depth not more than one foot; but the appearance of the banks showed that in winter the lake would cover at least 200 acres. The uncovered bottom at the time of discovery was a mass of slimy mud emitting a horrible smell, but studded all over with groups of crystals of the desired article. It was not, however, until 1864 that a company was formed to collect these crystals and place them on the market. The four succeeding years were bright times for the company, who grew rich fast, but an unexpected event put a stop to their undertaking, and suddenly made the district an unprofitable one. This was the sinking of an artesian well whose upward flow of water was so great that all attempts to plug

it failed, and the valley consequently became deluged in water. Shortly after this catastrophe another lake, the Hachinhama, was discovered in the same locality, and work was done there for some time. At this lake, however, the borax did not crystallise out of its own accord, and the mud had therefore to be washed and the chemicals in solution extracted by crystallisation. The borax thus produced was largely mixed with carbonate of soda, which had to be washed out afterwards. A few years afterwards, in 1872, borate of lime was found in Nevada, and this was brought to Hachinhama and mixed with the concentrated waters of the lake. The effect of this mixture was to transform the borate of lime into borate of soda, and to change the carbonate of soda into carbonate of lime.

Borax was first discovered in Nevada by Dr. Veatch in 1860, and Mr. William Troup found a marsh near Columbus, Nev., which contained common salt and ulexite or cotton balls. It was not, however, till the year 1871 that Mr. Troup rose to the consciousness that if the cotton balls were mixed with carbonate of soda, a commercially pure borax was formed. Even then very little was done, and the Hachinhama people were allowed to go on without any rivals, and this condition of affairs was unaltered until in 1872. The Teel's Marsh deposits of crude borax were discovered by Mr. F. M. Smith, who is at the present time the president of the Pacific Coast Borax Company. This borax was of an extremely rich character, and no time was lost in putting it on the market.

The effect of the competition that sprung up between Teel's Marsh and Hachinhama was most disastrous. Prices were cut ruthlessly, until they were insufficient even to pay for the wood used in the evaporating tanks. It was no wonder, therefore, that a financial crisis occurred which ruined the company that worked Teel's Marsh temporarily, and the Hachinhama people permanently. Only a short time elapsed before the Teel's Marsh works were in full swing again, and they have ever since then held on their course with the prosperity that attends on careful and energetic management. The Teel's Marsh deposit was at first a most remarkable sight. The ground was covered with a vast deposit which had an appearance not unlike dirty snow or chalk. On examining it closely it was found to be covered with a sandy crust which would break under the feet and reveal an understructure of clay and unfathomable slime. This and many other marshes subsequently discovered sometimes, in very wet seasons, assume the form of lakes, and in almost every case they are surrounded by hills which allow no outlet for the local mountain streams except the marsh itself. In all these cases, as in the case of Clear Lake, the first discovered, there is every reason for supposing that they are the location of ancient volcanoes. It is even supposed that these volcanoes are not yet entirely defunct, for as fast as the first crop of superficial crystals is removed they are replaced by further formations which crystallise out of the liquid that oozes upward through the mud and clay. At Teel's Marsh this ooze crystallises out in a hard crust composed of borax, carbonate of soda, and common salt, while at the San Bernardino Company's marshes in California, subsequently discovered and worked, the crust becomes so hard that the miners have to use their picks very forcibly. Since the time that Teel's Marsh was first worked many other deposits of crude borax, both in marshes and otherwise, have been worked with profit.

It has already been mentioned that cotton balls or ulexite were discovered at Columbus and Saltwells, Nev., in 1871. Though these deposits were neglected at first, they were afterward developed, along with many other marshes which were found to give excellent yields of this, so to speak, oil of borax. The balls vary in size from pin heads to water-melons, and they occur generally embedded in tough clay, though in some cases they are distributed among sand. They are easily broken at first, but exposure to the air causes them to become very hard.

In some localities the ulexite is not in the form of balls, but exists as a powder mixed with sandy loam. For some years the borax marshes and ulexite formed the only source of commercial borax, but in the course of a few years a new and valuable deposit of borate of lime was discovered by Mr. W. T. Coleman, a well-known borax man of San

Francisco. This discovery was made accidentally while prospecting for silver in the Calico Mountains in the neighbourhood of Death Valley, where a deposit of borax had already been found. The borate of lime was in the form of a stratum of snow-white colour, and at first its constitution was not understood. Mr. Coleman, however, had an analysis made of it, and to his and everybody's surprise it was announced to be very rich in borate of lime.

The new substance existed in stratum or ledge, cropping out at various points and of an average thickness of six feet. The Pacific Coast Borax Company took possession of the ledge and christened the material colemanite. Further deposits have been discovered more recently, and a variation of it called pandermite has also been found. The natural features of the country, however, have stood in the way of a really successful working of these magnificent deposits. It can be worked easily enough, but it is impossible to carry out the chemical processes on the spot, owing to the total absence of fuel and to the great scarcity of water. Consequently the Pacific Coast Borax Company are obliged to transport it to San Francisco for chemical treatment and preparation. Unfortunately, however, even this part of the business is surrounded with difficulties. There is no railroad near and there are absolutely no roads or highways. The colemanite has to be carried in waggons, and the waggons are drawn along over rough ground by a team of mules. At the present time the deposits of colemanite are comparatively untouched, owing to the absence of good roads.

As we have already stated, the colemanite is heated for the production of borax at San Francisco. The method pursued is the same as in the treatment of cotton balls. The colemanite is crushed to a fine powder and mixed with the requisite quantity of carbonate of soda, and then the mixture is dissolved in water in an iron boiler. The solution is stirred by an internal mechanical stirrer. The resulting solution of borax is allowed to stand for a short time in order that the carbonate of lime shall be precipitated, and then it is run into open tanks, where, on cooling, the borax crystallises out in dark coloured crystals. These crystals are redissolved and recrystallised in a pure and marketable form.

In the manufacture of borax from cotton balls the process is slightly different. The balls are ground and mixed with carbonate of soda and then dissolved in water contained in an open vat. Besides the resulting carbonate of lime there are impurities in the cotton balls to be precipitated, such as sand and clay. The heating is done by steam from a boiler, and the stirring is done by hand. When the chemical treatment and purification are carried on at the marshes and other sources of supply, where wood is too expensive to be used for heating, it is customary to burn sage brush directly under the vats.—*Engineering and Mining Journal*.

MANURE MARKET IN 1890.

Ann. Report of the Connecticut Agri. Exper. Stat. 1890, 73—76.

Nitrogenous.—The wholesale quotation for nitrogen in nitrate of soda and in dried blood fell from 16.1 cents per pound in 1889 to 11.9 in the early parts, and 11.2 in December 1890, the retail price in Connecticut being about 16 cents per pound. Ammoniacal nitrogen also fell at first, but during the latter part of 1890 was higher than in 1889, owing to the use of ammonia in ice-making. The wholesale price was 16½ cents, the retail figure, 18 cents per pound. Dried fish scrap fell from 22.50 dols. per ton in January 1889 to 19.25 dols. per ton during 1890. Nitrogen was retailed per pound at 15.5 cents in blood, from 15.6 to 16.8 in castor pomace, and from 11.7 to 13.8 in cotton-seed meal.

Phosphatic.—Refuse lime-black fell from 19.45 dols. per ton wholesale in the beginning of the year, to 18.50 dols. in September and afterwards. Rough and ground bone were quoted at 21.50 dols. and 26.50 dols. per ton wholesale throughout the year; ground Charleston rock per ton wholesale at 11.25 dols. in January, 10.65 dols. in July, and 9.75 in August and afterwards; acid phosphate with 14 per cent. available phosphoric acid was

quoted in January at $81\frac{1}{4}$ cents per unit, equivalent to 4.06 cents per pound of available phosphoric acid, but, in July and afterwards at $73\frac{3}{4}$, or 3.7 cents per pound of available phosphoric acid.

Potassic.—Chloride valued at 3.64 to 3.55 cents per pound wholesale, and 4.2 to 4.1 retail; potassium magnesium sulphate at 4.42—4.44 cents per pound for actual potash, falling to 4.27 cents in November, but rising again to 4.53 cents in December, and retailing at about 6 cents per pound throughout the year; high grade potassium sulphate, almost free from chloride, cost wholesale 4.77 cents per pound of actual potash, but under new tariff with free importation fell to 4.17 in October, and 4.06 in November, but rising in December to 4.31 cents; kainite, wholesale, rose from 10.70 dol. per ton in January 11 dol. in April, fell to $10.37\frac{1}{2}$ in July, and in December to 10 dol.—D. A. L.

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

	Month ending 31st August	
	1891.	1892.
Metals.....	£ 1,918,888	£ 1,871,897
Chemicals and dyestuffs.....	496,852	487,122
Oils.....	589,870	706,249
Raw materials for non-textile industries.	1,134,652	1,621,154
Total value of all imports....	3,279,659	3,484,365

SUMMARY OF EXPORTS.

	Month ending 31st August	
	1891.	1892.
Metals (other than machinery)	£ 2,791,352	£ 2,739,174
Chemicals and medicines	615,625	708,785
Miscellaneous articles.....	2,549,098	2,360,060
Total value of all exports.....	20,670,480	20,051,339

IMPORTS OF METALS FOR MONTH ENDING 31ST AUGUST.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Copper:—			£	£
Ore..... Tons	7,548	7,256	59,134	35,541
Regulus	5,590	10,739	161,169	251,656
Unwrought	6,358	3,234	331,549	151,450
Iron:—				
Ore.....	272,983	373,221	204,521	258,778
Bolt, bar, &c.	7,188	5,620	73,350	56,432
Steel, unwrought..	1,065	279	10,364	3,189
Lead, pig and sheet	14,390	14,381	181,491	156,514
Pyrites	59,699	49,804	110,284	88,393
Quicksilver	65,400	67,650	6,676	6,197
Tin	34,748	67,660	158,958	323,075
Zinc	4,712	4,500	111,432	90,057
Other articles ...Value £	..	..	531,060	451,105
Total value of metals	..	..	1,918,888	1,871,897

IMPORTS OF OILS FOR MONTH ENDING 31ST AUGUST.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Cocoa-nut..... Cwt.	19,864	17,684	£ 24,191	£ 19,876
Olive	1,219	1,857	48,396	66,690
Palm	88,265	93,673	101,063	95,261
Petroleum	8,358,372	13,560,606	172,394	261,556
Seed	1,530	1,406	41,882	34,138
Train, &c..... Tons	2,662	2,398	55,842	45,541
Turpentine	54,331	94,974	71,321	99,965
Other articles ..Value £	..	..	69,271	83,313
Total value of oils ...	..	..	589,870	706,249

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST AUGUST.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Bark, Peruvian... Cwt.	6,472	7,924	£ 11,586	£ 15,949
Bristles..... Lb.	331,091	469,855	46,029	81,358
Caoutchouc..... Cwt.	23,870	15,483	298,212	149,417
Gum:—				
Arabic.....	6,978	6,137	14,551	13,962
Lac, &c.....	8,906	7,117	32,576	26,595
Gutta-percha	1,339	3,668	50,864	44,860
Hides, raw:—				
Dry.....	36,470	24,898	103,071	64,142
Wet.....	51,394	52,059	115,292	108,173
Ivory.....	634	756	30,966	34,364
Manure:—				
Guano..... Tons	785	2,967	5,839	20,567
Bones.....	4,150	2,126	23,345	9,696
Paraffin..... Cwt.	56,378	33,081	51,645	50,708
Linon rags..... Tons	3,222	2,071	33,745	21,129
Eaparto.....	19,114	18,333	91,155	88,969
Palp of wood	15,455	16,101	78,017	80,714
Rosin..... Cwt.	139,894	151,090	35,042	37,958
Tallow and stearin	165,847	126,131	215,664	157,173
Tar	33,179	35,967	20,575	191,748
Wood:—				
Hewn	275,649	308,379	565,922	718,880
Sawn	733,372	794,077	1,561,491	1,719,279
Staves	15,497	13,850	57,839	55,735
Mahogany	3,539	6,334	34,049	56,583
Other articles....Value £	..	..	955,571	1,042,195
Total value .....	..	..	4,496,652	4,621,154

Besides the above, drugs to the value of 65,253*l.* were imported as against 57,001*l.* in August 1891.

IMPORTS OF CHEMICALS AND DYE-STUFFS FOR MONTH
ENDING 31ST AUGUST.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Alkali..... Cwt.	6,579	5,639	£ 4,120	£ 3,553
Bark (tanners, &c.) „	67,027	31,395	35,067	12,001
Brimstone..... „	49,377	38,382	14,045	10,458
Chemicals..... Value £	..	..	127,101	102,740
Cochineal..... Cwt.	723	278	4,209	1,674
Cutch and gambier Tons	2,791	1,876	55,746	39,472
Dyes:—				
Aniline..... Value £	..	..	10,765	14,397
Alizarine..... „	..	..	27,645	24,073
Other.....	..	..	1,335	469
Indigo..... Cwt.	654	2,316	9,105	35,485
Nitrate of soda.... „	37,989	111,306	16,358	47,200
Nitrate of potash. „	22,840	30,170	20,504	25,889
Valonia..... Tons	1,190	3,424	22,403	47,379
Other articles... Value £	..	..	142,419	121,492
Total value of chemicals	..	..	436,852	487,122

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH
ENDING 31ST AUGUST.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Gunpowder..... Lb.	815,300	754,090	£ 21,334	£ 16,719
Military stores.. Value £	..	..	91,027	81,005
Candles..... Lb.	1,362,990	1,726,100	26,674	31,488
Caoutchouc..... Value £	..	..	96,422	103,029
Cement..... Tons	52,766	43,032	104,194	77,569
Products of coal Value £	..	..	108,189	67,245
Earthenware... „	..	..	165,018	186,432
Stoneware..... „	..	..	10,778	10,314
Glass:—				
Plate..... Sq. Ft.	265,517	144,916	19,717	8,299
Flint..... Cwt.	9,553	8,538	19,629	20,265
Bottles..... „	61,578	66,614	29,847	33,073
Other kinds.... „	17,582	18,565	15,047	13,929
Leather:—				
Unwrought.... „	12,189	16,091	111,362	94,831
Wrought..... Value £	..	..	33,151	46,932
Seed oil..... Tons	4,999	4,679	108,208	91,292
Floorecloth..... Sq. Yds.	1,518,500	1,282,700	66,133	59,334
Painters' materials Val. £	..	..	129,508	115,648
Paper..... Cwt.	78,822	79,072	133,779	131,159
Rags..... Tons	3,799	4,051	26,689	26,636
Soap..... Cwt.	42,739	47,798	15,120	19,955
Total value.....	..	..	3,542,918	2,860,009

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR
MONTH ENDING 31ST AUGUST.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Brass..... Cwt.	10,282	7,854	£ 45,585	£ 33,640
Copper:—				
Unwrought..... „	43,899	68,936	121,309	166,608
Wrought..... „	27,363	26,780	89,650	79,379
Mixed metal.... „	28,530	29,197	80,672	59,056
Hardware..... Value £	..	..	193,817	185,329
Implements..... „	..	..	99,170	100,644
Iron and steel..... Tons	272,209	259,625	1,834,692	1,880,174
Lead..... „	3,071	4,306	42,698	48,368
Plated wares... Value £	..	..	31,635	27,739
Telegraph wires, &c. „	..	..	112,690	29,755
Tin..... Cwt.	8,295	9,237	39,655	45,369
Zinc..... „	11,334	17,362	12,297	15,726
Other articles... Value £	..	..	84,682	76,396
Total value.....	..	..	2,791,552	2,739,174

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING
31ST AUGUST.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Alkali..... Cwt.	428,053	500,228	£ 158,344	£ 176,474
Bleaching materials „	114,739	159,624	39,615	59,807
Chemical manures. Tons	35,162	40,959	141,747	169,191
Medicines..... Value £	..	..	86,842	86,911
Other articles... „	..	..	189,089	216,402
Total value.....	..	..	615,628	708,785

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

14,672. W. McGuffin Greaves. Improved methods for supplying air to furnaces, and the apparatus therefor. August 15.

14,675. A. G. Berry. Improvements in and relating to multiple effect evaporators for treating sugar and other liquids. August 15.

14,835. E. Ashworth. Improvements in the method of and in apparatus for evaporating spent liquors, and for recovering salts therefrom. August 17.

14,851. F. Windhausen. Process and apparatus for separating out the constituent parts of gaseous and liquid compounds. August 17.

14,926. J. U. Askham. Improvements in apparatus for separating substances of different sizes or specific gravities. August 18.

14,985. T. Blatcher. Improvements in apparatus for producing currents of inflammable gases and air. August 19.

15,122. W. H. Beck.—From B. de Lissa, Australia. See Class II.

15,124. G. H. Richmond. Improvements in apparatus for heating and cooling liquids. August 23.

15,181. C. M. King. An improved apparatus for extraction and lixiviation. August 23.

15,244. V. J. Kuess and C. H. J. D. Donnadieu. An improved construction of alembic. August 24.

15,270. G. Thomas.—From A. Stauber, Germany. An oil-testing apparatus for ascertaining the frictional coefficient of oils and fats. August 25.

15,286. J. Martin. Improvements in apparatus for automatically controlling the flow of pulp and other semi-liquid or liquid substances. August 25.

15,521. F. M. Robertson. Improvements in means or apparatus for evaporating or drying. August 30.

15,698. F. W. Golby.—From B. Jardin, France. Improvements in apparatus for heating air. Complete Specification. September 1.

15,786. C. Wegener and P. Baumert. Improvements in furnaces using coal-dust or the like as fuel. September 2.

15,880. A. Dauber. Improvements in calcining furnaces. September 5.

16,019. A. McNeill. Improvements in and relating to multiple effect evaporating apparatus. September 7.

16,031. G. H. Biddles and J. Hewes. A new or improved furnace for burning town or other refuse. September 7.

16,259. G. Mitchell. Improvements in presses for the expression of oils or other liquids from substances containing the same. September 10.

16,308. W. Maybach. Improvements in the methods of and apparatus for effecting a continuous circulation and cooling of cooling liquids employed in motors and compressors. Complete Specification. September 12.

16,403. C. W. Cooper. Improvements in methods of and apparatus for evaporating liquids. Complete Specification. September 13.

16,609. J. McPhail. Improvements in or connected with supporting or strengthening pipes containing liquid under pressure. September 17.

COMPLETE SPECIFICATIONS ACCEPTED.*

1891.

17,750. J. J. McDaniel. Method of and apparatus for securing a continuous time record of the rate of distillation and direction of flow of distilled fluids. August 24.

18,533. J. Wright. Construction of vertical stills for distillation of ammoniacal and other liquors or liquids. September 21.

21,072. G. Johnston. Apparatus for drying moist substances or materials. August 24.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

14,725. J. Mitchell. Improvements in machinery or apparatus for withdrawing coke from coke ovens and for like purposes. August 15.

14,862. C. R. Poulsen. New or improved apparatus for the production of ozone by means of phosphorus. August 17.

15,122. W. H. Beck.—From B. de Lissa, Australia. An improved method of and apparatus to be used in the manufacture and storage of inflammable gas for general purposes. Complete Specification. August 22.

15,217. F. G. Birchall. Improvements in carburetting coal-gas. August 24.

15,262. E. J. Rothwell. Consuming smoke and saving fuel. August 25.

15,639. H. Collet and M. Merichevski. An improved mixture intended for use in making or enriching combustible gas. August 31.

15,748. T. W. Lee. Improvements in the manufacture of blocks or briquettes of fuel. September 2.

15,777. W. H. Laird. A process for producing gas and apparatus for using the produced gas for heating purposes. Complete Specification. September 2.

15,802. W. Hawkins, T. Hawkins, H. Fuller, and W. H. Fuller. An improved apparatus for carburetting gas. September 2.

15,818. P. H. Dawe, T. Gill, A. Brown, and J. Robinson. Improvements in retort benches and ascension pipes for the manufacture of gas. September 3.

15,925. J. J. Hood and A. G. Salamon. Improvements in the purification of coal-gas. September 5.

16,258. V. B. Lewes. Improvements in the manufacture or production of illuminating gas from liquid hydrocarbons and apparatus therefor. Complete Specification. September 10.

16,273. J. F. Bell. Improvements in self-sealing gas retort mouthpieces. September 12.

16,320. H. S. Pringle. An improved combination of ingredients or plastic compound, suitable for heating purposes. September 12.

16,322. C. Winter. Improvements in artificial fuel. Complete Specification. September 12.

16,622. J. Bowing. Improvements in coking processes, and in the manufacture of coke, and in the recovery of products. September 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

14,440. W. Arrol and W. Foulis. Apparatus for charging gas and other retorts, and in part applicable for other purposes. August 24.

20,420. H. H. Lake.—From W. H. Harris. Manufacture of gas and apparatus therefor. September 7.

1892.

7379. A. G. Boulton.—From H. C. Rew. Gas generators. September 7.

8207. W. Hawkins, T. Hawkins, H. Fuller, and W. H. Fuller. Metallic block to be used in the production of hydrogen. September 7.

12,716. A. Noteman. Process and apparatus for making, heating and illuminating gas. September 7.

13,339. J. M. Bailey. Apparatus for the production of fuel-gas. August 31.

13,379. W. Hawkins, T. Hawkins, H. Fuller, and W. H. Fuller. Generators to be used in the production of hydrogen gas. September 21.

13,601. R. F. Strong and A. Gordon. Manufacture of artificial fuel. August 31.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

14,717. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in the production of alpha-nitro-alpha-amido and alpha-quinoline compounds of alizarine and the anthra- and flavo-purpurines. August 15.

14,728. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in or connected with the manufacture or production of colouring matters. August 15.

14,742. R. G. Williams. Improvements in the manufacture of new colour-producing bases and new colouring matters therefrom. August 16.

14,927. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new colouring matters. August 18.

14,993. G. Pitt.—From L. Cassella and Co., Germany. Production of new dyestuffs derived from amidonaphthol-sulphonic acids. August 19.

15,056. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of dyestuffs. August 20.

15,246. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture and production of greenish-blue mordant dyeing colouring matters. August 24.

15,311. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of novel alizarine colouring matters. August 25.

15,321. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The production of new sulpho-acids and salts thereof. August 25.

15,325. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture and production of new mordant dyeing colouring matters, and of new intermediate products relating thereto. August 25.

15,386. Read, Holliday and Sons, and K. B. Elbell. Improvements in the manufacture of azo colouring matters and of materials for the same. August 26.

15,438. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new colouring matters. August 27.

15,439. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the production of black azo colours upon fibres. August 27.

15,636. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new azo colouring matters suitable for dyeing and printing. August 31.

15,692. J. R. Geigy. Production of two isomeric disulpho-acids of para-amidophenol, and obtaining violet-black dyestuffs therefrom. September 1.

15,789. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Germany. Improvements in the production of azo-colouring matters. September 2.

16,569. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Germany. Manufacture of new colouring matters. September 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

16,377. H. H. Lake.—From F. Reverdin and C. de la Harpe. Manufacture of colouring matter. September 21.

18,606. H. H. Lake.—From Wirth and Co., agents for A. Leonhardt and Co. Manufacture of colouring matters. August 31.

18,783. O. Imray.—From The Farbwerke vormals Meister, Lucius, und Brüning. A new manufacture of colouring matter. September 7.

19,061. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture and production of new cotton or substantive dyestuffs. August 31.

19,062A. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of colouring matters. August 31.

19,847. O. Imray.—From The Farbwerke vormals Meister, Lucius, und Brüning. Manufacture of colouring matters from precatechuic acid and phenols. September 21.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

14,754. G. C. Kingsbury. Improvements in the treatment of textile fibres for manufacturing purposes. August 16.

16,043. J. Purchase. Improvements in the cultivation and treatment of certain plants to obtain fibres and other products therefrom. September 7.

16,515. T. W. Harding. Improvements in the method of and apparatus for reducing cotton-seed and removing fibre or fluff therefrom. September 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

17,081. R. Scott and W. J. Beard. Manufacture of floorcloth and like fabrics and machinery therefor. September 21.

17,562. C. Ideson. Apparatus for gassing silk and other yarns. August 24.

18,878. S. Fisher and H. Murgatroyd. Machinery or apparatus for cleaning and lustreing dyed or undyed yarns of silk, cotton, or other fibrous substances. September 7.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

14,943. C. A. Sahlström and E. Parr. Improvements in the bleaching of wool, hair, silk, cotton, flax and other animal and vegetable fabrics and fibres, paper, pulp, and the like. August 18.

15,000. J. O. Obermaier. Improvements in or relating to the mordanting, dyeing, washing, and otherwise treating of spun yarn or the like, and apparatus therefor. August 19.

15,082. F. Obermayer. An improved process of dyeing animal fibres and fabrics, horn, feathers, leather, and albuminous substances generally. August 20.

15,239. W. T. Lye. Improvements in the bleaching or dyeing of chip, chip-plait, straw, or straw-plait. August 24.

15,310. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in dyeing wool and woollen fabrics with sulphonic acids of alizarin colouring matters. August 25.

15,726. D. Stewart and T. Lambert. Improvements in cleansing, bleaching, and dyeing textile materials and fabrics, and in apparatus therefor. September 2.

15,933. C. I. Edmondson. Improvements in printing designs or patterns in two or more colours upon textile fabrics. September 6.

COMPLETE SPECIFICATION ACCEPTED.

1892.

14,101. S. Smithson. Means or apparatus for dyeing yarns, piece-goods, and the like. September 14.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

14,835. E. Ashworth. See Class I.

14,842. I. Levinstein and T. G. Webb. Improvements in the method of and apparatus for concentrating sulphuric acid and other liquids. August 17.

14,945. H. W. Wallis. Improvements in the manufacture of chlorine. August 18.

14,946. H. W. Wallis. Improvements in the manufacture of chlorine. August 18.

15,083. L. Grabau. Improvements relating to the manufacture of aluminium fluoride. August 20.

15,275. W. Stones and R. Bardsley. Improvements in the method of and in apparatus for the production of carbonic acid gas. Complete Specification. August 25.

15,346. F. Bale. Improvements in obtaining ammonia, hydrochloric acid, and chlorine from ammonium chloride, also in obtaining chlorine from hydrochloric acid, and in the apparatus used. August 26.

15,513. H. J. Haddan. — From Viscount Lambilly, France. New process for the production of the cyanides of the alkalis and alkaline earth by the simultaneous employment of a hydrocarbon and ammonia gases, with the addition, if desired, of free nitrogen. Complete Specification. August 29.

15,633. E. A. Deiss. Process and apparatus for the production of sulphocyanides. August 31.

15,809. T. D. Owen. Improvements in the manufacture of copper sulphate. September 3.

16,046. H. Y. Caster. An improved process of and apparatus for the electrolytic decomposition of alkaline salts. September 7.

16,297. H. C. Bull and J. Ramage. An improved process for making hydrochloric acid and obtaining pure silicates of soda and lime for use in glass-making from pure sodic chloride with pure calcic carbonate and refuse sand from grinding plate glass. September 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

12,522. E. Brochon. Process and apparatus for enriching or concentrating phosphates of lime. August 17.

17,659. P. de Wilde, A. Reyckler, and F. Hurter. Apparatus for the manufacture of chlorine. August 31.

17,796. G. F. Brindley. New solide compounds of sulphur trioxide, water, and the bisulphates or acid sulphates of sodium or potassium. September 21.

17,911. H. C. Særé and H. Grimshaw. The utilisation of the waste oxide of iron produced in the manufacture and purification of chloride of zinc. August 31.

18,700. C. W. Vincent. Preparation of mineral salts for bathing and drinking purposes. September 21.

22,481. E. Edwards. — From O. Guttman and L. Rohmann. Process for the preparation of pure nitric acid. September 21.

22,558. A. M. Clark. — From The Deutsche Gold und Silber-Scheideanstalt vormals Roessler. Production of salts of ferri-cyanogen. September 21.

1892.

13,208. W. Malster. Manufacture of sulphate of ammonia. August 31.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

14,830. F. Winkle and J. Winkle. An improved appliance or tool for use in forming or shaping the interior of vessels or utensils made of or from clay, or similar plastic material or compound. August 17.

15,162. W. L. Pilkington. Improvements in the production of corrugated or like roughened surface sheet glass. August 23.

15,453. I. Rozelaar. An improved manufacture of pottery ware. August 27.

15,454. I. Rozelaar. An improved manufacture of decorated pottery ware. August 27.

15,934. J. Bilton. A new method of decorating pottery, porcelain, tiles, bricks, &c. September 6.

16,143. S. Hughes. Improvements in the manufacture of glass bottles. September 9.

16,241. J. C. Dantze. An improved process for producing colours on glass surfaces. Complete Specification. September 10.

16,252. P. Sievert. Improvements in glass furnaces. September 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

18,559. T. Arnold. Utilisation of slag for the manufacture of blocks, slabs, drain-pipes, or other moulded articles. September 7.

21,542. A. R. Carter and H. C. Hughes. Manufacture of stained glass panels for windows and other transparencies and mural decoration. September 21.

1892.

13,220. H. H. Leigh.—From I. K. Rue. Enamelled bricks, and manufacture thereof. August 24.

13,227. W. P. Thompson.—From the Clay Glass Tile Co. Process of plating clay with glass and articles made in accordance therewith. August 24.

13,569. J. W. Bonta. Lears or annealing furnaces for sheet or plate glass. August 31.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

14,889. R. Kieffert and H. Thirion. Improvements in cements. Complete Specification. August 17.

15,147. J. E. Keseling and C. Fuchs, jun. An artificial stone composition. Complete Specification. August 23.

15,221. J. C. Sellars. Improvements in or connected with the manufacture of Portland or equivalent cement, monldings, castings, blocks, or the like. August 24.

15,468. G. J. Elwood and R. Elwood. An improved process of preparing wood for the reception and indelible preservation of characters or designs written, painted, printed, engraved, embossed, or otherwise. August 29.

15,531. S. M. Wilmot. Wilmot's fireproof lathing. August 30.

15,911. E. Edwards.—From K. Goetz, Austria. Improved process for producing liquid clay or slip for casting in moulds. Complete Specification. September 5.

16,040. W. Orr. Improvements in the construction of concrete roofs and floors for buildings. September 7.

16,354. J. E. Keseling and C. Fuchs, jun. An artificial stone composition. Complete Specification. September 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

15,139. F. Haines. Constructing cement or the like pavements, floors, platforms, or other surfaces or structures. August 31.

15,195. C. Tompkins and J. A. Kinder. Improvement in buildings, fireproof walls, partitions, and roofs. August 31.

15,281. W. F. Thomas. Decoration of artificial stone and pavements. September 14.

19,467. J. C. Bloomfield. Manufacture of plaster. September 14.

20,269. L. Haarmann. Means for securing asphalt mastic as a coating or stopping upon all descriptions of buildings and building materials. August 24.

20,740. J. H. Blakesley. Fireproof floors, roofs, girders, joists, and the like. August 31.

1892.

12,174. O. Terp. Manufacture of artificial stone and hard compositions applicable to building and paving purposes, to moulds for cement castings, to safes, and to other articles and purposes. August 24.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

14,739. N. Henzel. An improved method of converting pulverous metallic oxides into solid ores. August 15.

14,787. J. Mandt and H. Hubnholz. Improved method of soldering aluminium to aluminium and other metals and alloys. August 16.

14,920. E. Goll and C. Vateky. Improved aluminium solder, and method of manufacturing the same. August 18.

14,982. T. D. Rock. A new method of dealing with blast-furnace and other slag, and apparatus therefor. August 19.

15,058. E. Martin. Process for alloying the surfaces of metal wires, strips, plates, sheets, and the like. Complete Specification. August 20.

15,075. J. von Langer and L. Cooper. Improvements in or connected with furnaces for puddling, welding, annealing, smelting, and similar industrial operations. August 20.

15,152. W. P. Thompson. Improvements in or relating to the production of bright metallic deposits. August 23.

15,206. J. D. Gilmour. Improvements in the extraction of gold or other metals from ore. August 24.

15,248. J. W. Sutton. Improvements in the wet process for the extraction of gold or silver, or both, from pulverised ores or other finely-divided material, and in apparatus therefor. Complete Specification. August 24.

15,289. T. Ray. An improved furnace for heating malleable iron or steel. August 25.

15,444. H. H. Lake.—From G. F. Simonds, United States. Improvements relating to the manufacture of steel, and to furnaces therefor, said furnaces being applicable for other uses. August 27.

15,491. E. H. L. Sturzel. Improvements relating to the coating of articles with zinc. August 29.

15,584. J. W. Chenhall. Improvement connected with the extraction of metals from their ores. Complete Specification. August 30.

15,707. G. D. Simpson. Improvements in or connected with apparatus or appliances for condensing and depositing metallic fumes. September 1.

15,713. J. B. Alzagaray.—From J. B. Torres, France. Improvements in and connected with the reduction of antimony ores, alloys, and salts, and purification of the metal obtained therefrom. Sept. 1.

16,002. H. F. Taylor. Improvements in gas-fired furnaces for heating, re-heating, and annealing purposes. September 6.

16,168. K. Wittgenstein. Process for manufacturing thin steel or iron sheets direct from ingots or blooms. Complete Specification. September 9.

16,173. J. T. Wainwright. Improvements in the process of reducing unsmelted ore, including roasted ore, furnace cinders, and like material. Complete Specification. September 9.

16,234. G. Selve. Improvements in coating or plating aluminium with other metals or alloys. September 10.

16,246. B. Dukes.—From J. Rose, Germany. Improved process for obtaining aluminium. September 10.

16,292. O. Nicolai and C. Langenbach. Soldering aluminium. September 12.

16,312. O. C. Streeker. Improvements in the preparation and production of aluminium plates for printing purposes. September 12.

16,356. T. Lockerbie. Improvements in the treatment of slags, and apparatus for effecting the same. September 13.

16,408. G. F. Thomson. Improvements in or relating to the manufacture of iron and steel. September 13.

16,582. A. Kay. Improvements in the treatment of dust deposited in calcining furnace, flues or other material to obtain bismuth therefrom. September 16.

16,629. W. Mills. Improvements in the manufacture of aluminium, and apparatus therefor. September 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

9784. W. Noad, C. Minns, and P. H. Stephens. Process or means for extracting or recovering metals from their ores or other metal-bearing bodies. September 14.

15,567. E. B. Parnell. Furnaces for treating ores. August 24.

16,178. C. Walrand and E. Legéniel. Treatment of steel, and apparatus therefor. August 24.

17,315. J. H. Pratt. New or improved metallic alloys. September 7.

17,636. F. Webb. Means or apparatus for extracting precious metals from their ores. September 21.

17,755. J. B. Alzugaray. Basic furnace lining and basic material. September 21.

18,442. W. A. Sugden.—From W. R. Sugden. Manufacture of iron, and a fuel or compound suitable therefor. September 21.

18,559. T. Arnold. See Class VIII.

19,118. H. Le Neve Foster. Manufacture of iron. September 14.

19,389. S. H. Johnson and C. C. Hutchinson. Leaching ores, and apparatus therefor. September 21.

19,771. A. K. Huntington and J. T. Prestige, jun. Copper alloys. September 21.

20,003. H. Y. Castner. Manufacture of the oxides of alkaline metals. September 21.

1892.

4460. W. P. Thompson.—From W. J. Miles, jun., H. S. Deming, and A. Herz. Metallic alloys. August 24.

10,583. W. P. Thompson.—From B. Talbot. Treatment of iron and basic slag, and extracting silicon and phosphorus. September 14.

13,148. G. G. M. Hardingham.—From H. Wilisch. Hardening particles of steel or other metal, and apparatus therefor. August 31.

14,264. P. Hart. Method of desulphurising zinc ores. September 14.

14,586. J. L. Sebenius. Apparatus for removing, when casting, gases and impurities contained in the metal or alloy. September 21.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

14,719. T. Floyd. Improvements in and relating to electrical storage batteries. August 15.

14,720. A. J. Jarman. Improvements in and relating to electrical storage batteries. August 15.

14,813. E. P. Usher. Improvements in electric battery plates. Complete Specification. August 16.

14,814. E. P. Usher. Improvements in storage batteries. Complete Specification. August 16.

14,815. E. P. Usher. Improvements in storage batteries. Complete Specification. August 16.

14,816. E. P. Usher. Improvements in electric battery plates. Complete Specification. August 16.

14,947. A. J. Jarman. Improvements in the plates or electrodes of electric storage batteries. August 18.

15,113. J. P. Ronbertie, V. Lapeyse, and V. Grenier. Manufacture of caustic soda and potash, and hydrochloric acid, by electrolytic treatment of chloride of sodium and chloride of potassium, and apparatus for this purpose. August 22.

15,120. H. W. Headland. Improvements in or applicable to electrical accumulators or secondary or storage batteries. August 22.

15,197. H. M. E. Andreoli. Improvements in electrolytic apparatus. August 23.

15,296. H. C. Bull and J. Ramage. Improvements in and appertaining to electrical accumulators. August 25.

15,319. D. Federman. Improvements in and relating to electric batteries. August 25.

15,356. H. C. Bull. An improved electro-chemical process for treating iron pyrites, thereby recovering everything valuable contained therein and avoiding all noxious fumes. August 26.

15,372. W. Boggett. Improvements in the method and means of obtaining electricity. August 26.

15,477. A. F. W. Kreinsen. Improvements in the means for and method of melting metals and other materials by electricity. Complete Specification. August 29.

15,649. J. Stoerk. Apparatus for continuous decomposition of alkaline chlorides by electrolytic fusion. August 31.

15,793. C. G. P. de Laval. Method of smelting or overheating iron or other metals by means of electricity. Filed September 2. Date applied for March 8, 1892, being date of application in Sweden.

15,799. E. Nunan and J. W. Nelson. An improvement in galvanic batteries. Complete Specification. September 2.

15,887. H. H. Frei. Improvements in and apparatus for obtaining metals by electrolysis. September 5.

16,201. J. B. Faehris. Improvements in galvanic batteries. September 10.

16,262. C. A. Faure. Improvements in the electrolytical decomposition of alkaline chlorides for the production of chlorine and alkalis, and in apparatus therefor. September 10.

16,300. H. H. Frei. Improved method of and means for supplying electricity to the carbon electrodes employed in the electrolysis of fused electrolytes. September 12.

16,461. W. Main. Improvements in secondary batteries. Complete Specification. Filed September 14. Date applied for February 15, 1892, being date of application in United States.

16,545. A. E. J. Ball. Improvements in and relating to dry and other galvanic batteries. September 16.

16,588. P. Garuti. Production of oxygen and hydrogen by electrolysis of water. Filed September 16. Date applied for, April 25, being date of application in Italy.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

17,758. The Mining and General Electric Lamp Co. and J. T. Niblett. Elements for secondary batteries. September 7.

18,974. T. Parker. Electrical furnaces for the manufacture of phosphorus or other matters capable of being volatilised by heat. September 7.

1892.

14,044. J. C. Fell.—From W. Morrison. Electrodes for secondary batteries. September 21.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

14,726. G. Harper. Improved compound or composition for cleaning or removing paint and varnish or for cleansing wood, metal, and stone. August 15.

15,012. J. Trent and G. Henderson. A process of extracting, purifying, and saving the fat or grease from wool, and for cleaning the wool by the use of benzole (benzene) or any other spirituous liquid suitable for dissolving the fat or grease. Complete Specification. August 19.

15,270. G. Thomas.—From A. Stanber, Germany. *See* Class I.

15,482. W. Shepperson. Improvements in the treatment of animal fats. August 29.

15,696. W. C. Latham. An improved cleansing compound. September 1.

15,899. J. C. Decker. Improvements in oil for general painting. Complete Specification. September 5.

16,018. W. H. Horton and E. M. Taylor. An improvement in what is commonly called dry soap or soap-powder, and intended for use for certain purposes. Complete Specification. September 7.

16,314. J. G. Haller and I. Magnus.—From R. Giebertmann, United States. A process for recovery and treatment of glycerin. September 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

15,547. J. Alexander and Co., Limited, and H. de Laspée. Manufacture of soap and saponaceous compounds. September 7.

17,440. J. Templeman. Manufacture of soaps and saponaceous compounds. August 24.

18,632. F. G. Haigh and W. C. Haigh. Fluid soap. September 21.

19,297. J. Taylor. Manufacture of soaps. September 14.

20,445. H. E. Walter. Cleansing material. September 14.

1892.

12,974. G. D. Macdougald and J. Sturrock. Process or means for making soap cakes or bars with an indelible colour. August 24.

13,081. W. P. Thompson.—From F. Hawaty and A. Kanitz. Manufacture of washing soap. August 24.

14,114. R. Haddan.—From B. Jaffé and L. Darmstädter. Separation of wool-wax from wool-fat, and preparation of lanoline from the more fluid residue. September 14.

XIII.—PAINTS, PIGMENTS VARNISHES, AND RESINS.

APPLICATIONS.

14,726. G. Harper. *See* Class XII.

14,734. G. D. Coleman. An improved process and apparatus for the manufacture of white lead and other lead pigments. Complete Specification. August 16.

14,888. R. Kieffert and H. Thirion. Improvements in paints. Complete Specification. August 17.

14,896. B. Pitt. A chemical compound gelatin or liquid detergent for laundry, washing, or other purposes. August 18.

15,348. J. W. Longbottom and A. Sharman. An improved material or composition for coating boilers or iron work or steel work generally for the prevention of rust, &c. and the like. August 26.

15,426. J. W. Savage. Manufacture of an elastic compound for electrical insulation and other purposes. August 27.

15,452. J. M. Raymond. Improvements in the treatment of vulcanised india-rubber. August 27.

15,544. A. F. S. George. Manufacture of artificial caoutchouc. August 30.

15,614. J. McDonnell. Coir fibre and rubber composition. August 31.

16,184. P. Bronner. Process for the manufacture of oxide of lead and of white lead from crude sulphate of lead. September 9.

16,435. P. Bronner. Improvements in the production of white lead direct from galena. September 14.

16,536. M. Mackay. Improvements in treating copal, kauri, sandrac, and other gum resins. September 15.

16,573. H. McKenna. A new process for the manufacture of paints and varnishes and strong cements. September 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

16,229. F. J. Rowan and B. Dawson. Apparatus for oxidising lead sulphide and zinc to form white pigments. August 21.

19,545. E. V. Gardner. Manufacture of white lead. September 21.

1892.

4232. D. Rigole. Extraction of gutta-percha, and apparatus therefor. August 24.

12,175. O. Terp. Enamel paints for resisting damp, fire, and atmospheric influences, and imitation mosaic and other articles made therewith. August 24.

13,402. E. Biernath. A new or improved insulating and waterproof material. September 21.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

15,630. E. Brand. Improvements in the manufacture of animal glue. Complete Specification. August 31.

15,807. J. Westaway. Improvements in means and apparatus for rendering leather waterproof. September 3.

XV.—AGRICULTURE AND MANURES.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

12,522. E. Brochon. *See* Class VII.

1892.

12,432. J. T. Knowles.—From L. Bironi and P. Marchand. A composition for fixing ammoniacal nitrogen used in agriculture. September 21.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

14,675. A. G. Berry. *See* Class I.

15,571. G. J. Epstein. Improvements in the separation of gluten from flour. August 30.

15,816. C. M. Lafontaine. A new or improved process and apparatus for the treatment and purification of raw sugar, and its conversion into blocks or ingots. Complete Specification. September 3.

15,897. A. Rümpfer. Process and apparatus for the production of invert sugar and dextrose. Complete Specification. September 5.

16,409. G. J. Epstein. Improvements in the treatment of waste products from the manufacture of starch. September 13.

COMPLETE SPECIFICATION ACCEPTED.

1891.

20,119. J. Drummond. Apparatus for separating impurities from sugar. September 21.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

15,656. C. A. Sahlström and A. B. Cunningham. Improvements in the purification and maturing of spirits and in apparatus therefor. August 31.

16,048. G. Franke and O. E. Nyeander. Improvements relating to the production of dry yeast. September 7.

16,563. W. Rohowsky. A new or improved process or manufacture of non-injurious beverages from liquids containing alcohol. September 16.

16,666. W. R. Lake.—From C. Zimmer, Germany. An improved process of brewing and apparatus therefor. September 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

13,088. H. E. Newton.—From La Société Anonyme "La Levure." Production and preservation of pure yeast. September 7.

18,258. F. E. V. Bains. Process for treating grain to obtain a product suitable for use in brewing, distilling, vinegar making and for other purposes. August 24.

18,292. F. Scheibler. Apparatus for liquoring sugar. September 7.

18,538. R. H. Leaker. Pneumatic malting, and machinery or apparatus therefor. September 14.

18,833. E. Barlow. Drying and calcining brewers' refuse and grains, and other substances and materials. August 31.

18,997. R. H. Leaker. Kilning malt, and structures and apparatus therefor. August 31.

19,849. P. A. Roche. Manufacture of beer. September 21.

1892.

6531. J. F. Wittemann. Process of finishing beer. September 7.

12,214. J. Mosler, M. Schäffer, and A. Sachs. A process for the production of sugar-colour from brewery and distillery refuse. September 21.

12,413. B. J. B. Mills.—From the Universal Carbonating Co. Method and apparatus for carbonating beer. August 10.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

16,548. C. Blackmore. A new or improved process for incorporating malt, or the aroma therefrom, with coffee, tea, and similar substances used as beverages or food. Complete Specification. September 16.

B.—Sanitary Chemistry.

14,861. C. B. Lotherington. An improved method of consuming noxious gases or vapours in chemical manure and other works, also applicable for ventilating such works. August 17.

15,285. C. A. Burghardt. Improvements in the production of a ferric preparation for the purification of sewage or other foul water. August 25.

16,333. W. F. Goodhue and C. Paulus. Improvements in sewage-separating and purifying apparatus. Complete Specification. September 13.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1891.

17,363. P. Meyer. *See* Class XX.

19,859. E. R. Kobert. Blood-forming substance and method of producing the same. September 21.

21,391. D. Evans.—From A. A. Freeman and C. Evans. Process of preserving oysters and other bivalves in the shell. September 21.

1892.

13,615. S. T. Aehor. Soluble chocolate, and the process of preparing the same. August 31.

13,642. H. H. Lake.—From S. Crump. An improved food compound, and method of manufacturing the same. September 7.

B.—Sanitary Chemistry.

1891.

17,924. A. P. Hope. Process for oxygenating, deodorising, and disinfecting sewage or other fermentable or noxious matters. September 7.

18,286. G. C. Purvis. Method in sewage precipitation. September 7.

18,466. A. Lutschaunig. Manufacture of filtering, precipitating, deodorising, and purifying material. September 14.

19,120. J. P. Alliott. Apparatus for dealing with the refuse of towns. September 14.

19,803. H. P. Boulnois and J. A. Brodie. Refuse destructors. September 21.

1892.

9760. H. Stier. Process for the purification of waste or refuse water from sewers, mills, works, factories, and the like. September 14.

C.—Disinfectants.

1891.

14,788. H. H. Lake.—From A. G. Plummerer. Fluid insecticide. August 31.

18,466. A. Lutschaunig. *See* Class XVIII. B.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

15,720. A. Brin. An improved process of and apparatus for treating peat for the manufacture of paper pulp. September 1.

15,851. J. Craig and G. J. Wildridge. Improvements in the manufacture and production of blotting-paper or like absorbent paper, and apparatus to be employed therein. September 3.

16,239. S. Berbuto and E. Marguet. Improvements in paper pulp refining apparatus. September 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

19,560. H. de Chardonnet. Manufacture of pyroxylines. August 24.

1892.

14,335. E. Jerome. Toilet paper. September 14.

XX.—FINE CHEMICALS, ALKALOIDS ESSENCES, AND EXTRACTS.

APPLICATIONS.

14,715. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in the production of iodoso compounds. August 15.

14,716. O. Imray. — From the Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in the production of pyrazolone derivatives. August 15.

14,881. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new chemical compounds containing sulphur. August 17.

16,112. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture of iodine compounds. September 8.

16,279. J. Simpson. Improvements in the manufacture of iodine. September 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

14,430. A. Schmitz and E. Toenges. Process for the production of oxy-fatty glycerin ethers and oxy-sulpho-oxy-dioxy and sulpho-dioxy fatty acids. August 31.

17,137. O. Imray. — From La Société de Lait et Cie. Manufacture of vanilloyl carbonic acid and of vanilline by its transformation. August 24.

17,363. P. Meyer. Apparatus for the production of dry extract of coffee or tea. August 24.

1892.

12,664. C. Lowe. Manufacture of crude acetone. September 7.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

14,706. J. H. P. Gillard. Improvements in sensitised films, and in sensitive emulsions therefor. August 15.

15,901. W. H. Slader and L. Siedle. An improved process for the transfer of photographic images. September 5.

15,956. E. H. Hardy. New or improved process and apparatus for the tentative exposure and development of pictures obtained by photography. September 6.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

15,434. J. Hauff. The preparation and employment of aromatic amido-compounds as developing means in photography. September 7.

20,690. J. Hauff. The use of aromatic amido-compounds, and of derivatives of pyrogallol for the development of photographic images. September 21.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

15,416. M. Weis. Improvements in lucifer matches. August 27.

16,567. O. Imray. — From Chemische Fabrik Greisheim, Germany. Manufacture of explosives. September 16.

COMPLETE SPECIFICATION ACCEPTED.

1891.

18,439. C. Huelser. — From G. Gillischewsky. Process for producing a liquid substance for making fir star firework. August 31.

XXIII.—ANALYTICAL CHEMISTRY.

APPLICATION.

15,273. P. Willis. — From J. E. Lonnergan, United States. A new process of ascertaining the quantity of butter-fat in milk. August 25.

PATENT UNCLASSIFIABLE.

COMPLETE SPECIFICATION ACCEPTED.

1892.

13,817. L. S. Langville. Carbon product. September 7.

THE JOURNAL OF THE Society of Chemical Industry:

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Post Office Orders should be made payable at the General Post Office, London, to the Honorary Treasurer, E. Rider Cook, and should be forwarded to him at Bow, unless it be desired to notify a change of address.

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Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

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 Flintoff, Robt. J., Crumpsall Lane, Manchester, chemist.
 Hammond, Geo. W., Hotel Hamilton, Boston, Mass. U.S.A., fibre manufacturer.
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 Kirby, Jno. E., Moorland Villa, Swinton, Manchester, manufacturing engineer.
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 Naylor, Wm., 16, Walton's Parade, Preston, Chief Inspector Ribble Joint Committee.
 Passmore, Dr. Francis W., 27, Kennington Park Gardens, S.E., analytical chemist.
 Pears, Andrew, jun., Spring Grove, Isleworth, chemical student.
 Rudolf, Norman S., Sewan, Sarun, Bengal, India, analytical chemist.
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 Thorpe, Thos., Whitefield, Manchester, civil engineer.

Winstanley, Hy., Glengowan Print Works, Caldercruix, *vid* Airdrie, N.B., calico printers' chemist.

Witthaus, Professor Rudolph A., 118, West 55th Street, New York City, U.S.A., professor of chemistry.

CHANGES OF ADDRESS.

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 Banks, A. J., 10 West Ham; c/o F. W. Fellowes, 61, Chancery Lane, E.C.
 Bewick, T. Burrell, 10 Suffolk House: Broad St. House, Old Broad Street, E.C.
 Bolas, Thos., 10 Grove Terrace; 60, Grove Park Terrace, Chiswick, W.
 Bookman, S., 10 Mittelstrasse; Pestalozzi Strasse 28, I, r., Charlottenburg, Berlin.
 Boothby, Chas., 10 Stockport; c/o J. L. Wade & Co., Manor House Wharf, Vauxhall, S.W.
 Boyd, Wm., 10 Cardiff; Tharsis Co.'s Works, Hebburn-on-Tyne.
 Deans, J. A., 10 Morriston; 4, College Street, Swansea.
 Down, Thos., 10 Willington-on-Tyne; Tharsis Copper Works, Cardiff.
 England, R., 10 Dunster House; Broomhill Lodge, Woodford Green, E.
 Fletcher, A. E., 10 Chalfont St. Peter; 13, Christchurch Road, Crouch End, N.
 Gillman, G., 10 Lorca; Ferro-carril de Murcia á Granada, Aguilas, Prov. de Murcia, Spain.
 Hirsch, Dr. R., 10 Potsdamerstrasse; 25, Urban Strasse, Berlin, S.
 Hodges, H. B., 10 Boston; c/o B. & O. R. R., Mount Clare, Baltimore, Md., U.S.A.
 Holmes, F. G., 10 Silvertown; 76, Pepys Road, New Cross, S.E.
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 Scrutton, W. J., 10 New Mexico; 18, Billiter Street, London, E.C.
 Sharp, Henry, 10 Southampton; Brockenhurst, Hants.
 Sommer, Ad., 10 California; corner 1st and Binney Streets, East Cambridge, Boston, Mass., U.S.A.
 Sirk, Jos., 10 Burton; Ferneliffe, Elm Bank, Nottingham.
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 Van Gundy, C. P., 10 Pittsburg; Laboratory, Baltimore and Ohio R.R., Baltimore, Md., U.S.A.
 Wilson, Dr. W. H., 10 Bedford; Presidency College, Madras.

Deaths.

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Thompson, Chas., 15, Patshull Rd., N.W.

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London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

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Vice-Chairman: W. Crowder.

Committee:

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A. G. Green.

D. Howard.

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B. E. R. Newlands.

W. Ramsay.

F. G. Adair Roberts.

A. Gordon Salamon.

G. N. Stoker.

F. Napier Sutton.

T. E. Thorpe.

T. Tyrer.

Frank Wilson.

Hon. Local Secretary: John Heron,
Ellerdale, Cottenham Park, Wimbledon.

SESSION 1892-93.

Monday, November 7th:—Mr. Watson Smith. "1. The Preparation of Nitrous Oxide. 2. A Reaction between Cupric Acetate and Galena."

Liverpool Section.

UNIVERSITY COLLEGE, BROWNLOW STREET.

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Vice-Chairman: E. Carey.

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G. Schack-Sommer.

A. Watt.

Hon. Treasurer: W. P. Thompson.

Hon. Local Secretary:

Dr. Chas. A. Kohn, University College, Liverpool

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892-93.

Wednesday, November 2nd:—Mr. Henry Brunner. Chairman's Address—"Artificial Manures in Fruit Culture."

Further Meetings on the first Wednesday in each month.

Glasgow and Scottish Section.

Chairman: C. A. Fawsitt.

Vice-Chairman: E. J. Mills.

Committee:

G. Beilby.

W. J. Chrystal.

C. J. Ellis.

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R. A. Inglis.

R. Irvine.

J. Falconer King.

J. S. Macarthur.

T. P. Miller.

T. L. Patterson.

J. Pattison.

J. B. Readman.

E. C. C. Stanford.

R. R. Tatlock.

G. Watson.

Hon. Secretary and Treasurer:

J. Stanley Muir, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892-93.

Tuesday, November 1st:—Mr. D. R. Stewart. "The Flash-point and Heat of Burning of Mineral Oil."

Communication.

THE FLAMELESS COMBUSTION OF NATURAL GAS.

BY GODFREY L. CABOT.

REFERRING to the well-known phenomenon of the ignition of gas in contact with platinum as described on p. 669 of the Society's Journal for August, it may be of interest to know that this does not occur with natural gas such as found in Western Pennsylvania.

Natural gas always contains aqueous vapour. The pipelines through which it passes can be most economically laid and maintained at or near the surface of the ground, and usually are thus laid, except in the large cities. In winter frost is formed inside them, and it is necessary to have gas fires burning at intervals along the lines to prevent them from being plugged.

Such fires are often extinguished by accidental causes, and it occurred to me to put platinised asbestos in front of the escaping gas jets along my lines to re-ignite the gas. This very convenient form of finely-divided platinum can be readily obtained by dipping asbestos in platinic chloride, and heating in the flame of a Bunsen lamp. When heated to below redness and exposed to the mixture of natural gas and air escaping from a Bunsen burner, this platinised asbestos quickly attained a bright red heat but did not ignite the gas. To try the experiment to the best advantage, I took two sheets of very thin platinised asbestos board and let the inflammable mixture pass between and around them, but all in vain. The *radiant* heat emitted was greater than the gas-flame itself would have given but no flame was to be had.

An electric gas-lighter such as is used in our New England mills would not ignite natural gas. When natural gas is used in gas engines, it is found necessary to use artificial gas for the smaller flame from which the flash is obtained. The flash of natural gas is too slow.

In short, natural gas requires a much higher temperature for ignition than ordinary coal-gas. It has a greater specific gravity, about that of water-gas such as used in this city; and, as it contains chiefly the homologues of the paraffin series, we may suppose that its non-inflammability results from the comparatively small percentage of free hydrogen. Another characteristic that may have something to do with it is the absolute freedom from sulphur and from all aromatic hydrocarbons.

Obituary.

GEORGE DIXON LONGSTAFF, M.D.

ONE OF THE FOUNDERS, AND FORMERLY
A VICE-PRESIDENT OF THE SOCIETY OF CHEMICAL
INDUSTRY.

WHEN the first and inaugural meeting of the Society of Chemical Industry was held on June the 28th and 29th, 1881, and Sir H. E. Roscoe, then Professor Roscoe, gave the first Presidential Address, it was Dr. Longstaff, who, in a brief but very interesting speech, proposed a vote of thanks to the first President for his address.

The fact may have been somewhat overlooked then, though it will not be overlooked now, that no more appropriate selection could possibly have been made of one who should open the first of the many discussions which have since been carried on in our Society on subjects relating to the Chemical Industries of this

country, than the venerable octogenarian, who has recently passed away from us. Dr. Longstaff was one of the pioneers and founders of chemical industry in this country, and in referring, in the little speech mentioned, to "Those who have been (*i.e.*, in 1881) acquainted with chemical manufactures for the last half century," he would probably find very few in that room who could respond to so long an experience.

It may not be out of place on this occasion to accentuate the interesting fact, then so modestly referred to by Dr. Longstaff, which shows that he and his friend Dr. Dalston of Edinburgh, were the first in this, and probably in any country, to found and carry on a coal-tar distillery.

To quote his own words:—"It so happens that the first chemical manufacture with which I was connected, was in Birmingham, with coal-tar, in the year 1822, together with my friend Dr. Dalston of Edinburgh. We had a contract with a gas company by which we were allowed to take all the tar away on the condition that we removed it gratuitously. A small manufactory was erected near Leith, where we distilled the spirits from the tar, which we supplied to Mr. Mackintosh of Glasgow, for waterproofing his cloth, and after that the residue we consumed, and produced lamp-black, &c." "I mention that as a matter of history." (This Journal, 1881, Proc. of First Gen. Meeting, page 7.)

It may thus be a reflection of certain interest to our Scottish members and friends, that tar-products were first carried from Edinburgh to Glasgow.

To turn now to the early days when George Dixon Longstaff first saw the light, we are carried back through almost a century, to the 31st of March, 1799, and to the little town of Bishop Wearmouth, county Durham. He thus linked, as it were, in his own person, the two centuries, and could relate from personal experience to the present generation many facts, that would seem like the records of ancient history. He used to tell, for example, how the stage coach drove on one memorable occasion, into the market place of Dundee, and the guard fired his blunderbuss and both pistols in the air (the signal of great news), and when people ran together, how he cried out, "Wellington has beaten Bonaparte at Waterloo."

As a schoolboy young Longstaff became a cadet in the great volunteer movement at the commencement of the century. As a young man, he assisted his father for several years in his scientific lectures, and himself frequently lectured on a variety of subjects. After the usual scholastic course he graduated in 1828, as an M.D. of Edinburgh, at which University he was some time assistant to the late Dr. Hope, and in that capacity, was probably the first teacher of practical chemistry to medical students in this country. He was distinguished for readiness of speech, clearness in explanation, and the success of his experiments. His readiness of speech and powerful voice, it may be added, were never better used, than in the support of Wilberforce's anti-slavery movement, and on this subject he both could and did speak from experience, as he saw much of negro-slavery and inquired more into it, when in the United States in 1834—37.

His experience in America, moreover, taught him the serious results of leaving government, especially local government, in the hands of the ill-educated and inexperienced.

Among other works of a well-spent life—much of it devoted to the well-being of his fellow men—he took great interest and an active part in the formation of mechanics' institutes, and was a frequent lecturer at these useful associations. Dr. Longstaff was not only one of the founders of our comparatively infant Society, he was also one of the founders of its elder sister, the Chemical Society of London, and in this connection he started the Chemical Society Research Fund by a donation of 1,000*l.* It was he who seconded the adoption of the Report to the Council of the Cavendish Society in 1849, in which the translation and publication of

Gmelin's Handbook of Chemistry were proposed, and later on he founded the Longstaff Medal for the encouragement and promotion of scientific research. He has resided in the parish of Wandsworth for upwards of 50 years, and was one of the first members of the Wandsworth District Board of Works, chairman of the Free Public Library Commissioners, and in 1887 presented a reading room to the library.

Dr. Longstaff, in 1833, married the eldest daughter of the late Henry Blundell, J.P., of Hull, and he leaves two sons, Colonel Longstaff (Wimbledon), and Dr. G. B. Longstaff, of Putney Heath, the latter well known on the London County Council. After his marriage, Dr. Longstaff spent some years in America to apply his scientific knowledge to gold mining in North Carolina, after which he entered into business in association with his father-in-law as a manufacturer of oil, colours, and varnish, and was for many years chairman of the firm of Blundell, Spence, and Co., Limited, and a director of that company till his death.

He died on Friday, September 23rd, at his residence, "Butterknowle," Wandsworth, after a brief but painful illness.—W. S.

Journal and Patent* Literature.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

The Action of Salt Solutions on Metals. Eng. and Min. Jour. 1892.

In reduction works using the Patara hyposulphite process or the modern Russell process there has been much complaint of the annoyance and expense of the rapid destruction of the pipes, pumps, valves, and plungers, and, in fact, of all metal exposed to the action of the solution charged with various salts. Hyposulphite of soda solutions alone are sufficiently destructive, but when charged with

* Any of these specifications may be obtained by post by remitting 8*d.*—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

various sulphates the life of pipes and pumps is short. So, too, in copper mines containing sulphide ores. A portion of the copper sulphide is oxidised to sulphate, and is washed out by the mine-waters. When this solution is pumped, the copper in it is precipitated on the pump column, the iron going into solution and the pipe is eaten away. Various acid-resisting paints have been tried, but unsuccessfully, the coating is worn away by attrition from particles of rock brought up with the muddy waters.

One remedy for this destruction, both in reduction works and mines, lies in the use of an alloy containing a large percentage of copper, such as deoxidised bronze, the composition of which is—

Cu 82·6; Sn 12·4; Zn 3·23; Pb 2·14

Digesters for wood pulp works made of this alloy have been found to withstand admirably the action of hyposulphite of soda and of sulphurous acid. Copper would not be precipitated upon it, at least in any quantity, and pump columns, plungers, and pipes made of this metal should certainly stand the action of mine-waters or of the Russell solution. The first cost would not be a drawback, as the saving in a short time would more than equalise matters. It is a matter which should be investigated by both mining men and manufacturers of alloys.

PATENTS.

Improvements in Analysing Columns. A. Berly, London. Eng. Pat. 11,690, July 9, 1891.

This invention relates to the construction of portions or segments of distilling columns devised in such a manner that a stirring action takes place at the circumference, and the combination of such segments so as to produce a variety of apparatus for various purposes, such as the distillation of gas ammoniacal water, the rectification of hydrocarbons, alcohol &c.—J. C. C.

Improvements in or connected with Evaporating and Condensing Apparatus. J. Reed, North Shields. Eng. Pat. 13,523, August 11, 1891.

This invention consists in the arrangement of pipes or coils for the circulation of steam, and in certain devices for effecting an automatic feed-water entry and exit atmospheric valve. The feed-water entry is controlled by an automatic device consisting of a float working in a chamber connected with the interior of the shell. As the level of the water changes, the level of the float varies, and this motion is utilised to actuate by means of rods and levers a piston valve controlling the feed-water entry port. The steam finds outlet from the evaporators through a perforated pipe leading to an atmospheric valve connected with a condenser. The valve is balanced by means of double pistons so as to neutralise the variations of pressure in the condenser, and a screw-down handle enables it to be used as a stop valve when required, and should the pressure

in the evaporator fall below atmospheric pressure, then the valve closes due to its exposure to the atmosphere through a small hole in the valve casting.—J. C. C.

Improvements in or connected with Condensers. J. Reed, North Shields. Eng. Pat. 13,522, August 11, 1891.

The condenser described, consists of a shell of suitable form with a medial division plate, and a filtering chamber attached to lower part. On either side of the division plate a number of coils are arranged, connected at their upper ends with one another and attached to the division plate. The cooling water passes into the shell at one side of the division and out at the other. The steam having passed through a perforated copper plate called the "dirt arrester," enters at the lower ends of the coils on one side of the division from a steam chest placed inside the shell. Having passed up the coils on one side of the division it descends through the coils on the other, and the condensed water enters the filtering chamber, passes downwards through the filtering medium and up again through the exit pipe.—J. C. C.

Improvements in Refrigerating and Freezing Apparatus. S. Puplett, London. Eng. Pat. 21,103, December 3, 1891.

THESE improvements relate to freezing machines described in specifications 12,541 and 12,542 of 1884, in which refrigeration is effected by the vapourisation of a liquefied gas, the liquid to be cooled passing through cylindrical vessels traversed by tubes and immersed in freezing tanks. So constructed, the tubes are liable to be blocked upon the stoppage of the circulation of the liquid, by the formation of ice. In the improved arrangement the freezing cylinders are placed above the level of the freezing tanks, and the brine is pumped through them. They are also fitted with a device for automatically draining them in the event of the failure of the pumps or stoppage of the circulation, whereby the danger of freezing is avoided.—B.

Improvements in Apparatus for Drying Moist Substances or Materials. G. Johnston, Springburn, N.B. Eng. Pat. 21,072, December 3, 1891.

THE improved apparatus consists essentially of a rectangular brick tank with semicircular ends, with the interior divided longitudinally into lateral spaces by a wall which stops short of the ends, and horizontally by any suitable number of floors. The substances are moved along the floors by scrapers attached to endless wire ropes carried by a grooved pulley at each end, all pulleys being fixed on vertical shafts secured in the centre of the circular ends and rotated by suitable gearing. (See Figs. 1 and 2.)

The material to be dried is fed in at the top; the floors have suitable openings at their ends, which allow it to descend from floor to floor, after having in every case passed over the whole length of the floor. The hot air or gases for drying are allowed to pass through the apparatus in any convenient way. Suitable devices are indicated for jointing the ropes and for securing the scrapers.

Fig. 1.

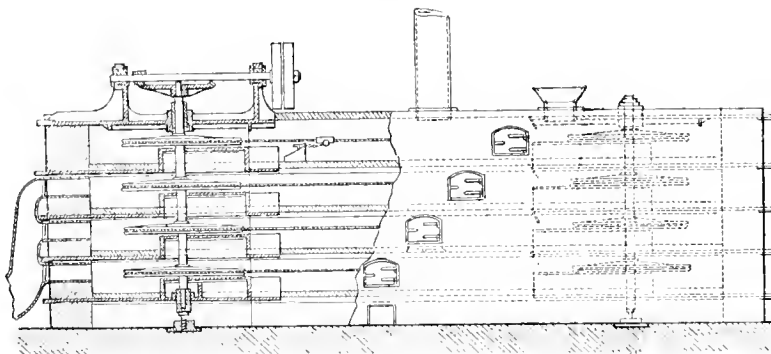
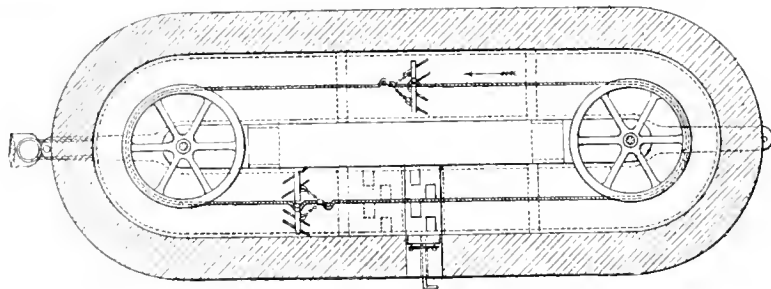


Fig. 2.



APPARATUS FOR DRYING MOIST SUBSTANCES.

—B.

Improvements in Displacement Pumps for Air or other Gases. J. H. Hargreaves and J. G. Hudson, Bolton. Eng. Pat. 12,588, July 8, 1892.

The accompanying illustrations show a pump constructed

Fig. 1.

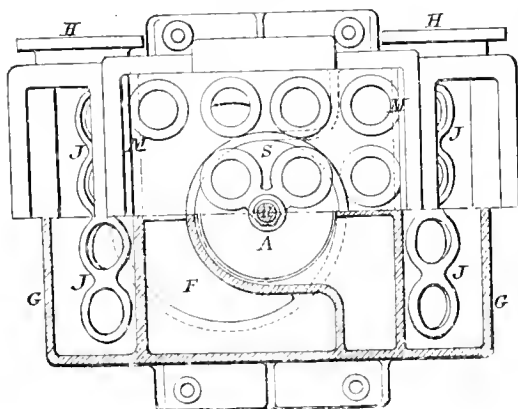
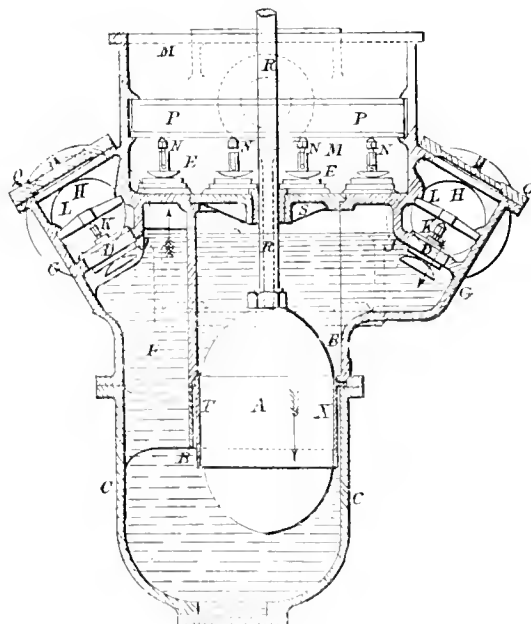


Fig. 2.

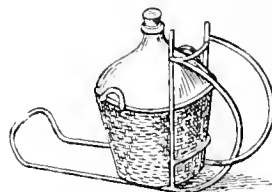


DISPLACEMENT PUMP.

in accordance with the specification. A piston or plunger A, which is of an elongated form with curved conoidal ends, works vertically in a cylindrical pump chamber B placed eccentrically in a larger cylindrical chamber C. The inlet valves D and discharge valves E are placed at the upper part of the apparatus, and the crescent-shaped space F, partly encircling the pump chamber, communicates directly with one set of the inlet valves and outlet valves. The inlet valves D are arranged in side chambers G, which are provided with flanged openings H, for the attachment of pipe or other connection. The piston A works through a brass sleeve, which is held by an external flange in the joint between the bottom and upper castings, forming the shell of the apparatus. If the pump is to be used for compressing air or gas, a cover must be fixed on the chamber M.—J. C. C.

An Improved Holder for Large Jars, Carboys, Demijohns, or the like. E. W. Holmgren-Holme, Toronto, Canada. Eng. Pat. 13,056, July 15, 1892.

THIS is a frame with rockers at the back for facilitating the tilting and emptying of large jars or carboys, as will be understood from the accompanying sketch.



IMPROVED HOLDER FOR CARBOYS, &c.

—B.

Improved Apparatus for the Desiccation of Solid Matters. E. Donard and G. Boulet, Rouen, France. Eng. Pat. 13,242, July 19, 1892.

THE improvement relates to the method of fastening the steam tubes in a rotary heating drum, for details of which the specification should be consulted.—B.

II.—FUEL, GAS, AND LIGHT.

The Use of the Producer. The Engineer, 74, 264.

THE principle on which the producer acts has long been applied in all methods of firing in which it is necessary to obtain a flame without using a fuel capable of yielding a considerable quantity of gas on mere destructive distillation. An example is afforded by a common reverberatory furnace, burning anthracite instead of bituminous coal, or yet more simply by any basket of live coke, topped with its lambent blue flame, serving to warm a night watchman. In cases such as these, and in the producer proper, which is nothing but a huge basket of fuel with a restricted inlet for air, and means of collecting and leading away the carbon monoxide in place of burning it on the spot—no difficulty is experienced in maintaining the combustion of the charge, and therefore the evolution of gas from it. This is at once explained by a consideration of the thermo-chemical reactions taking place under the given conditions. The union of carbon with oxygen to produce carbon monoxide is attended with the evolution of so much heat that the reaction can proceed without external impetus, and this heat is manifested and measured by the high temperature of the gaseous product; in one word, the reaction is exothermic. This is equivalent to saying that, of the whole quantity of energy which is present potentially in the coal and oxygen, a portion appears as sensible heat, while another part remains potential, although a step nearer utilisation in the shape of carbon monoxide, which, though an oxidised body, is not a saturated compound, and is capable under proper provocation of combining with another atom of oxygen before sinking to the dead level of complete satiety.

The economical aspect of this state of things is very easily elucidated. Since a large portion—something, indeed, approaching one-half—of the total quantity of energy is in the form of sensible heat, means must be adopted for its immediate absorption and application, as it is impracticable to retain it in storage or reservoir, to be drawn as required, at intervals short or long. Several methods of so doing are practicable. It remains to ascertain their several advantages and drawbacks.

When steam is substituted for air as the gas which is blown into a producer, a reaction wholly different from that which has already been described takes place. The oxygen of the steam combines with the heated carbon, and the hydrogen with which it was previously united is set free. But the decomposition of steam can only be effected by the expenditure of precisely the same amount of heat as is evolved by its formation from its elements, and when the energy bill is made out, it becomes evident that the balance is, from the user's point of view, on the wrong side. In short, the reaction in a producer evolving true water-gas is endothermic, and it is plain that if it is to go on evolving true water-gas, heat must be supplied it from without. This could be accomplished in several ways, but what is actually done in practical working is to keep up the temperature by burning, in a stream of air, a portion of the fuel which it is intended to convert into combustible gaseous products. This can be done in two ways. Either the working of the producer can be intermittent—that is to say, air can first be introduced until the contents of the producer are at a high temperature, and then steam blown in to react with the red-hot carbon until its temperature is reduced below the limit at which the reaction will take place; or steam and air are admitted simultaneously. In the first case the product during the admission of air only is producer-gas proper, theoretically consisting solely of carbon monoxide and nitrogen, and carries away with it a portion of the sensible heat of the reaction. In the second case the same result is arrived at, but the evolution of producer-gas and water-gas takes place simultaneously and continuously, the proportions being fixed by the amount of heat evolved by the production of the first, and that required for the formation of the second. Excess of air means waste, and excess of steam involves the extinction of the

producer. Possibly if these simple principles were a little more generally understood there would be fewer badly run producers.

Another method of utilising the sensible heat formed during the partial oxidation of carbon with air differs notably from that just described. It consists in introducing carbon dioxide into the producer, subsequently to, or simultaneously with, the air. The reaction that then takes place is the deoxidation of that gas by the heated carbon, and the production of double its volume of carbon monoxide, itself combustible. When the heat absorbed in the reduction of carbon dioxide is compared with that necessary for the decomposition of steam, it is found that a small advantage rests with the latter plan, as a somewhat greater fraction of the sensible heat is utilised; but the difference is not so great as to give the preference to the use of steam under all circumstances.

In addition to the methods detailed above, one has been devised for a special form of Siemens furnace, which does not depend upon the introduction of gases of extraneous origin. The products of combustion of producer-gas are nitrogen and carbon dioxide, part of the nitrogen being obtained from the air blown into the producer, and the remainder from the air by means of which the producer-gas is burned. If now these products of combustion be turned back into the producer, the carbon dioxide they contain will be reduced to carbon monoxide in the manner already explained, and the sensible heat of the primary reaction in the producer utilised. Obviously the whole of the waste gases cannot be so returned, as it would involve a constantly increasing quantity of gas in the producer. A fraction only of the products of combustion is therefore returned to the producer, the remainder passing away as waste gases. It will be seen that the main objection to this system arises from the large volume of nitrogen from the air used to burn the original producer-gas, that is returned from the producer, which is not only absolutely inert, but has to be raised to the same temperature as the burning gases, at the expense of a portion of their heat. This can, of course, be largely recovered by the use of the regenerator, but the objection to the dilution of the combustible material still holds good. All three methods have certain advantages, and the adoption of one rather than another can only be decided upon by consideration of the conditions governing each case; calculation of their theoretical merits is useful only as indicating the limits existing for each, and as a guide to the choice between them.

So far we have merely endeavoured to act as expositors of facts that are clearly, but not universally known, by showing their origin and correlation, but we cannot conclude without touching upon the possible extension that a recognition of their significance may bring about. Some time ago certain schemes were mooted for the conversion of coal at the pit's mouth into ordinary illuminating gas, and its conveyance to large centres of population. Although the feasibility, desirability, and utility of the scheme were sufficiently discussed at the time, little attention was paid to what is after all the main question of interest, namely, whether destructive distillation is the best means of gasifying coal. Seeing that at least half the coal remains in the retorts in the form of gas coke, which is already a drug in the market, there is little to be said for a plan that would enormously increase the amount of the output of that commodity, at places moreover where there is less demand than in the neighbourhood of London, where there are the cement makers to take a good deal of it. The way that obviates this fatal difficulty is, of course, to turn the whole of the combustible portion of the coal into producer-gas, enriched by the use of steam or carbon dioxide, and thus greatly increase the amount of gas, while simultaneously disposing of the coke. This process, patent enough, one would think, to anyone in the least conversant with the matter, seems to have been overlooked and was in danger of being completely ignored until Professor Emerson Reynolds, in his recent address to the Society of Chemical Industry, on the occasion of the expiration of his tenure of the presidency, emphasised the necessity of replacing the ineffective and wasteful process of destructive distillation by the more drastic dissolution that takes place in a producer.

The eminently practical gas manager has for some time produced a gas of comparatively low illuminating power, and enriched this in illuminating constituents by adding to it water-gas charged with heavy hydrocarbons formed by the judicious cracking of mineral oils. He has only to extend this system, to substitute producers for retorts, and to increase his enriching plant, to accomplish the object which we have here sketched. By this means all question of providing a separate system of mains for a heating, in addition to an illuminating, gas would be removed, and the difficulty of the odourless nature of a gas rich in the extremely poisonous carbon monoxide, which has so exercised our hygienists, overcome at a stroke.

So fruitful is the conception of the complete gasification of fuel by means of the producer, that it has sufficed to show a fairly promising plan for making the abundance of peat now lying idle in Ireland of some value to its inhabitants, and whatever the ultimate result the very fact that a method can be devised which puts peat on a level with coal as a possible competitor, is a powerful testimony to the alterations brought about by the study of the principles and reactions of the gas-producer.—B.

Report by A. Carnot and H. Le Chatelier on a Study of the Calorific Power of Combustibles used for Industrial Purposes, undertaken by P. Mahler. Bull. de la Soc. d'Encouragement pour l'Industrie Nat. **91**, 1892, 317—374.

See under XXIII., page 840.

Denitration of Pyrocylin. D. Woodman. J. Amer. Chem. Soc. 1892, **14**, 112.

See under XXII., page 839.

PATENTS.

Improvements in Apparatus for Producing Light. J. G. Hudson, London. Eng. Pat. 2226, February 6, 1891.

This is an apparatus for producing flash lights by blowing magnesium or other powder through a flame, and consists of two rubber balls, acting as air-pump and reservoir respectively, the latter communicating with a tube placed horizontally in a reservoir of magnesium powder. With each puff of air a cylinder of magnesium powder is driven forward, mixes with the air, and passes up a tube placed in the side of the reservoir to the exit tube. The entrance to the latter is smaller than the aperture communicating with the reservoir, so that the air takes up an eddying motion and the air and magnesium powder are more thoroughly mixed. The exit tube passes through an annular flame of naphtha or similar combustible, and must be protected by a non-conducting coating to prevent the magnesium from caking.—H. K. T.

Improvements in the Method of and Apparatus for Washing and Purifying Smoke. W. B. Hartridge, London. Eng. Pat. 4106, March 7, 1891.

THE gaseous products of combustion are subjected in their passage up the chimney to the action of water percolating down through layers of marbles or other rounded bodies.

—D. A. S.

Process and Appliances for Producing Peat Coke Cakes. E. Stauber, Hamburg, Germany. Eng. Pat. 7648, May 2, 1891.

THIS invention is intended to produce from peat a relatively pure carbon to serve as an advantageous fuel, and of a shape suitable for transport. The peat after being dried as much as possible by means of centrifugal apparatus, is finally dried by feeding it continuously through a drying furnace provided with endless bands and thick plates, which

are so arranged that the peat is passed several times through the furnace. The dried peat is carried by elevators to a briquette machine, and mixed with suitable binding material into a paste, which is then passed through a tapering spout compressed and divided into briquettes. The briquettes are lastly carried by an elevator to a specially constructed coking furnace, down which they slide automatically, and are removed, being finally withdrawn through a door at the bottom, and subsequently cooled.—D. A. S.

Improvements in Apparatus for Charging Inclined Gas Retorts. B. Gibbons and W. P. Gibbons, Lower Gornal, Stafford. Eng. Pat. 9366, June 3, 1891.

THIS invention consists in mechanical improvements in apparatus for charging inclined gas retorts, known as "through retorts." The inclined shoot or drive is used for holding the charge, and is set a little steeper than the angle of rest of the coal, and so made as to hold the charge of coal in an even stratum of about the same width and thickness as the charge when in the retort.—D. A. S.

Improvements connected with Ovens, Furnaces, Retorts, or other Structures used in the Making of Coke or Charcoal, or for Distilling or Roasting Carbonaceous Matter or otherwise subjecting Carbonaceous Matter to the Action of Heat. L. H. Armour, Gateshead-on-Tyne. Eng. Pat. 11,210, July 1, 1891.

THE ovens, furnaces, retorts, &c., are connected by pipes or passages with the chimney used in connexion with the oven, retort, or with any other chimney in proximity to the retort; the draft of the chimney being thus utilised to draw the gases, without the aid of mechanical exhausting devices or engine power.—D. A. S.

Improvements in Gas Producers. J. Bromilow, Ponty-mister, Monmouthshire. Eng. Pat. 11,416, July 4, 1891.

THIS is an improved producer, the bottom of which is divided into two parts by means of a brick wall, which is carried up a few inches above the door frames, thus forming two separate pockets at the bottom. The steam and air supply are so arranged that nearly pure water-gas can be produced in one of the pockets, while in the other the proper temperature is being maintained by the forcing in of a large volume of air. These conditions can be reversed by means of suitable reversing gear, thus rendering the producer continuous and regular in its working. The upper portion of the producer consists of a large rectangular chamber, which admits of free distillation of the solid fuel into gas. The inventor claims that by these means "the largest possible amount of steam can be decomposed in proportion to the amount of fuel used, thereby effecting considerable saving of fuel and labour."—D. A. S.

An Improved Device for Containing Volatile and Inflammable Liquids to be used for Illuminating Purposes. F. H. Diffetot, Paris, France. Eng. Pat. 12,721, July 27, 1891.

THIS device consists of two tubes fitting one inside the other, and having small holes, which can be arranged to coincide. The inner tube contains some absorbent material, which may be soaked with an inflammable liquid; this may then be used as a torch.—D. A. S.

Improvements in Inducing Combustion of Gases in Furnaces and in Apparatus therefor. J. Hargreaves, Widnes. Eng. Pat. 14,835, September 2, 1891.

Air is supplied through a nozzle fitted in an annular space, which is filled and fed with gas. Combustion is set up, and the joint currents of air and gas, whilst undergoing combustion (the air in the gas), are passed through a tube

or flue called the "mixing tube" into the furnace or space to be heated. The burning mixture may be directed downwards on to the charge on the bed of the furnace, or upwards on to the roof when heating by radiation is required. In the case of boilers the products of combustion are made to pass through the centre of the flue until the temperature of them is sufficiently reduced to allow them to impinge on the boiler plates without injury thereto.

—A. W.

A Simplified Form of Magnesium Lamp. P. Ellis, Wallington. Eng. Pat. 17,586, October 15, 1891.

It consists of a small spirit or other lamp in front of a reflector with a slit in its centre. The reflector is fitted at the back with a handle, so constructed that the whole can be lifted with one hand by placing three fingers below the handle and the first finger and thumb above, while the two latter are also used to push the ribbon through the slit and thus feed the lamp with magnesium without the use of any rollers or other appliances.—A. W.

Improvements in Coke Ovens. J. Johnson, Liverpool. From H. Kennedy, Sharpsburgh, Penn., U.S.A. Eng. Pat. 3959, March 1, 1892.

The proposed oven is of the bee-hive pattern, but instead of the parts being moveable, as has been suggested, the oven is constructed so that it can travel on wheels and carry the ignited charge with it from the hearth. After eoking, the oven is conducted laterally over an opening, down which the charge drops into water or into a waggon, as may be desired.

The oven itself is drawn back whilst still red hot, and is ready for the next charge. The hearth is made of extra strength and smoothness, as well as of considerable thickness, so as to retain the heat as much as possible. Sudden chilling of the ovens by water is thus avoided, and a saving in labour and working is effected.—D. A. S.

An Improved Method of Increasing the Illuminating Power of Flames. L. Chandor, St. Petersburg, Russia. Eng. Pat. 6188, March 30, 1892.

The invention is intended to be applied to lamps for burning vegetable or mineral oils. An incandescent body is arranged vertically in the burner, with a view of increasing the illuminating power, and the insuring of a more perfect combustion of the material employed. The composition used consists of asbestos, which has been treated with acetate of magnesia and gum tragacanth.

—D. A. S.

Improved Apparatus and Means for Increasing the Illuminating Power of Gas. J. Rudd, Atherton. Eng. Pat. 5994, March 28, 1892.

The inventor provides a suitable receptacle consisting of a simple three-necked vessel, charged with benzine or other liquid hydrocarbon, over the surface of which the gas travels on passing from the meter to the place of consumption.—D. A. S.

Improvements in Method of and Apparatus for Purifying Smoke and Precipitating the Products of Combustion thereof. C. Fink, St. Louis, Missouri, U.S.A. Eng. Pat. 7243, April 14, 1892.

This invention has for its object the purification of products of combustion from furnaces, and the like, by forcing them into a tank suitably provided with stationary and revolving sieves, or screens of different sized mesh, the latter being rotated by any suitable means in a reverse direction to the motion of the water, by which means all solid matter is precipitated.—D. A. S.

Improvements in the Manufacture of Artificial Fuel. R. F. Strong and A. Gordon, London. Eng. Pat. 13,601, July 26, 1892.

"COAL-DUST, coke, small coal, breeze, peat, lignite, charcoal, petroleum, sand, or other carbonaceous material or materials" are ground, intimately mixed together, and then mixed with water, to form a plastic mass, which is formed into briquettes with 6 to 10 per cent. of hydraulic lime and 1 per cent. of rock or other common salt, or sulphate of soda. If a non-flaming material is employed, 4 per cent. of cellulose is also mixed in, so as to supply a flame during combustion. The lime is stated not only to bind the ingredients, but to combine during the burning with the carbon dioxide, and so absorb "all or practically all the smoke-forming products of combustion." To restrict the ash to the lowest possible limit compatible with this object not more than 10 per cent. of lime should be used. The salt is used to cause the lime to set or harden more quickly.

—A. W.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Analysis of Coal Tar Preparations. H. Helbing and F. W. Passmore. Helbing's Pharm. Rec. July 1892.

See under XXIII., page 848.

A Method for Separating the Xylenes. J. M. Crafts. Compt. rend. 114, 1892, 1110.

See under XXIII., page 849.

PATENT.

Improvements in Column Stills for Distillation of Gas Liquor and other Liquids. A. Colson, Leicester. Eng. Pat. 13,417, August 8, 1891.

The inventor simplifies the jointing of the trays by casting them in one with the distance pieces, and joining them by bolts passing through ears cast on each tray, by means of which the packing rings placed between the grooved meeting faces are compressed. Through each tray pass short tubes standing above the bottom, and on each of these is placed a cap having its lower side perforated. Above the highest tray is placed a perforated plate to prevent priming of the liquid due to frothing.—J. C. C.

IV.—COLOURING MATTERS AND DYES.

The Relation between the Composition of Compounds and their Colour. M. Schutze. Zeits. physikal. Chem. 9, 1892, 109.

The following are the conclusions at which the author has arrived:—

(1.) A diminution of absorption from violet to red generally corresponds with the colour alterations green-yellow, yellow, orange, red, red-violet, blue-violet, blue, blue-green (deepening of the colour tone); a diminution from red to violet the converse changes (heightening of the colour tone).

(2.) Atoms and groups of atoms when introduced into a molecule, cause a characteristic deepening or heightening of the colour tone, for the same chromophore and solvent. Groups causing deepening are distinguished as "bathochrome," whilst those to which heightening of the colour is due are termed "hypsochrome."

(3.) Hydrocarbon radicals always act as bathochromes. In homologous series the shade increases with the molecular weight.

(4.) Similar alteration to that mentioned under (3.) occurs in the case of elements of the same periodic group.

(5.) The addition of hydrogen is always associated with a heightening of the colour.

(6.) The modification in colour from the causes enumerated above, is the greater the closer the alteration in chemical composition is to the chromophore. The distance of the atoms from each other as depicted in a structural formula seems generally to correspond with their actual condition: in the case of the di-derivatives of benzene, however, the substituted groups in the para-position appear to be nearer than in the meta-position.

(7.) The generalisation detailed in (6.) only applies to monochromophore compounds and symmetrical dichromophores. The colour of an unsymmetrical diazo-compound of the general formula $Y-A-X-A-Z$ approximates to that of a mixture of the two symmetrical bodies—

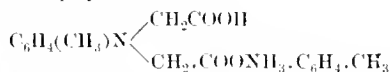


—B. B.

p-Tolylglycocine. C. A. Bischoff and A. Hausdörfer.

Ber. 25, 1892, 2280—2290.

The substance of melting point 166° — 168° , which was first prepared by J. P. Meyer (Ber. 8, 1158), and has since been generally regarded as *p*-tolylglycocine, is not this compound, but a polymeride—



The authors confirm the observation of Heumann (this Journal, 1890, 758) that the compound does not furnish an indigo derivative on fusion with potash. The true *p*-tolylglycocine has already been described by J. P. Meyer (Ber. 14, 1223), who regarded it as a polymeric compound: it has now been prepared by the authors by the hydrolysis of ethyl-*p*-toluid acetate. It forms colourless leaflets, melts at 118° — 119° , and gives an indigo-derivative on fusion with potash.—A. R. L.

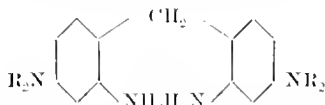
PATENTS.

Improvements in the Manufacture of Aniline Lakes suitable for the Manufacture of India-rubber Cloth and other Purposes. Isidor Frankenburg, Greengate Rubber Works, Salford, Lancaster. Eng. Pat. 16,582, September 30, 1891.

See under XXI., page 829.

Improvements in the Manufacture of Colouring Matters. H. H. Lake, London. From A. Leonhardt and Co., Mühlheim-on-the-Maine, Germany. Eng. Pat. 18,606, October 28, 1891.

In Eng. Pat. 13,217 of 1889 (this Journal, 1890, 934) certain oxides are described, which are obtained by condensing dialkylated *m*-amido-phenols with formaldehyde, and afterwards eliminating water by the action of a dehydrating agent. The present invention describes the formation of these oxides in a different way. Instead of treating tetra-alkyl-diamido-dihydroxy-diphenylmethane with dehydrating agents, tetra-alkyl-tetramido-diphenylmethane, which has the following formula—



is treated with two molecules of nitrous acid. A very unstable tetrazo compound is thus obtained which decomposes even at a low temperature, evolving nitrogen, and

forming oxy-compounds identical with the oxides described in the above-mentioned patent, and which can be oxidised in a similar manner to form pink colouring matters. A solution of 2.8 kilos. of tetramethyl-tetramido-diphenylmethane, 40 kilos. of concentrated sulphuric acid and 250 litres of water is treated with a solution containing 1.4 kilos. of sodium nitrite. When the decomposition of the diazo-compound, which may take place at any temperature up to 40° C., is complete, the solution contains the oxy-compound which may be precipitated by the addition of an excess of caustic soda-lye. In order to produce the colouring matter it is preferable to oxidise the acid solution directly by the addition of 14 kilos. of a 30 per cent. ferric chloride solution, and raise to the boil. After cooling, the dyestuff is precipitated by the addition of salt, and is purified by redissolving and precipitating with salt and zinc chloride. If the solution of the oxy-compound be first boiled down and then oxidised a similar colouring matter is obtained, but of a yellower shade.—T. A. L.

A New Manufacture of Colouring Matters. O. Imray, London. From "The Farbwerke vormals Meister, Lucius, und Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 18,783, October 31, 1891.

Up to the present, seven naphthylene diamines out of a possible ten have been obtained, but of these only the 1.5 compound has been employed in the manufacture of colouring matters. This body is converted into its tetrazo compound, and when combined with phenols and amines and their derivatives yields yellow, red and violet colouring matters (Ger. Pat. 39,954). More valuable colouring matters can be obtained from the 1.4 naphthylene diamine according to this invention, but as the direct conversion of the diamine into its amido-, diazo-, or tetrazo-compound is always incomplete, an indirect method has to be employed. The conditions necessary for obtaining colouring matters are that only one amido-group be diazotised and combined with an amine or phenol or derivative of the same, or that first one amido-group and then the second be diazotised and combined successively with two molecules of a phenol or amine, or their derivatives. In this way two different types of colouring matters are obtained having the general formulae—

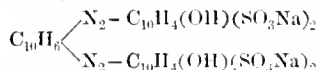


where x and y stand for the various components which may be used in each case. The colours formulated on type I. can be produced in two ways. 1. By nitrating α -acet-naphthalide the compound 1.4 nitro-acetnaphthalide is produced which on reduction yields 1.4 acetnaphthylene-diamine. This substance is diazotised, combined with any phenol or amine, and then saponified by heating with dilute mineral acids, strong solutions of caustic alkalis, or even by heating with water alone with or without pressure. 2. By diazotising 1.4 nitronaphthylamine, combining the diazo-compound and finally reducing the nitro-compound with an alkaline reducing agent. Colouring matters of type II. are obtained by diazotisation and combination with phenols and amines, of the bodies obtained as above. The following examples give the quantities to be employed in the various processes worked according to this invention. Twenty kilos. of 1.4 acet-naphthylene-diamine are suspended in about 300 litres of water and dissolved in the cold by slowly adding 27 kilos. of 30 per cent. hydrochloric acid. The solution is diazotised by the addition of 7 kilos. of sodium nitrite in about 24 litres of water, and the diazo solution is then added to 40 kilos. of sodium β -naphthol disulphonate R, and 100 kilos. of sodium acetate in about 500 litres of water and the whole kept agitated for 6—10 hours. Part of the colouring matter separates out and the rest may be precipitated by the addition of salt and purified in the usual manner. The shades given by these dyestuffs range from a bluish magenta to a claret red. The colouring matter thus produced may be saponified by dissolving in water to a 15—20 per cent. solution, adding 20 kilos. of caustic soda and heating under constant agitation to 120° — 125° C. either

with or without pressure until a sample no longer changes from violet to blue on acidifying with acetic acid. The melt is then acidified with acetic acid or dilute mineral acid, and the colouring matter precipitated with salt. The saponification can also be performed by heating with 30 per cent. sulphuric acid and also, but in a less efficient manner, by heating with water alone under pressure. The shades obtained are bluer than those from the acetylated compounds. The second method for producing these colouring matters is to suspend 188 kilos. of 1.4 nitro-naphthylamine in 250 litres of water and 400 kilos. of 30 per cent. hydrochloric acid. After diazotisation at about 15° C. with 69 kilos. of sodium nitrite in 200 litres of water, the solution is added to 370 kilos. of R salt dissolved in water and kept alkaline by the addition of sodium carbonate and sodium acetate. The colouring matter may be precipitated with salt or may be reduced by warming to 50°–60° C., and slowly adding about 2,500 kilos. of sodium sulphide solution containing 500 kilos. of crystallised sodium sulphide. The solution on completion of the reduction is acidulated and the colouring matter precipitated with salt. In place of sodium sulphide other alkaline reducing agents may be employed, such as glucose, stannous oxide, or zinc powder, but care must be taken not to use an excess of the reducing agent, as otherwise the azo group may be reduced. The colouring matters obtained according to the two preceding methods may, as already stated, be diazotised and combined with a variety of compounds. 517 kilos. of the colouring matter from R salt having the composition—



are dissolved in 8–10 times the quantity of water and mixed with 365 kilos. of 30 per cent. hydrochloric acid. A solution of 70 kilos. of sodium nitrite in 300 litres of water is then added below 5° C., and the whole left for several hours until a sample diluted with water forms a clear solution. This is then mixed with 385 kilos. of R salt, and 275 kilos. of sodium carbonate in 7,000 litres of water. Part of the colouring matter precipitates, and the remainder is thrown out with salt. It dyes a greenish to a black blue, according to the depth of shade, and has the formula—



By varying the components in these compounds a regularity in the change of shade is noticed, the lower molecular compounds of the benzene series giving colours at the red end of the spectrum, whilst the higher molecular compounds of the naphthalene series give blue shades. Moreover, in the example just quoted, it is observed that if other naphthalene derivatives are substituted for the second molecule of R salt the shades of the resulting colouring matters are a greenish blue when the compound contains a hydroxyl- or an amido-group in the β -position, but are reddish violet to violet red when these groups occupy the α -position.—T. A. L.

Improvements in the Manufacture of Colouring Matters.

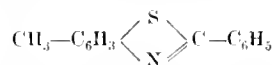
H. Wilcox, London. From "The Farbenfabriken vormals F. Bayer and Co." Elberfeld, Germany. Eng. Pat. 19,062A, November 4, 1891.

THE formation of leuco bases of the rosauiline series by condensing tetra-alkylated diamidobenzhydrols with primary, secondary and tertiary aromatic amines proceeds easily, but the oxidation to form colouring matters only takes place satisfactorily when the leuco products are obtained from tertiary amines. It has been discovered that if the leuco bases from the primary and secondary amines are converted into their nitrosamines before oxidation good results are obtained. The nitroso group is subsequently removed by heating the compounds in an aqueous solution with or without the addition of acids or alkalis, but in order to avoid oxidation by the nitrous acid disengaged it is advisable to perform the reaction in presence of an aromatic base, such as aniline or toluidine, or in presence of sulphurous acid. A product identical with Victoria Blue B can be obtained as follows, according to this process:—47.1 kilos.

of the leuco base, obtained by condensing tetra-methyl-diamidobenzhydrol with phenyl- α -naphthylamine in alcoholic solution and in presence of muriatic acid, are dissolved in 200 kilos. of 50 per cent. acetic acid, 40 kilos. of muriatic acid of sp. gr. 1.18 and 400 litres of water. After cooling, 69 litres of a 10 per cent. sodium nitrite solution are added, and the resulting nitrosamine leuco compound oxidised by the addition of 79.3 kilos. of a 30 per cent. lead dioxide paste. Diluted sulphuric acid from 10 kilos. of pure sulphuric acid, is then added to the deep green solution to precipitate the lead, and after the addition of 500 litres of a 6 per cent. sulphurous acid solution the whole is poured into an equal volume of strong hydrochloric acid, which eliminates the nitroso group. After standing some hours the solution is poured into water and the free acids neutralised with an alkali. The colouring matter then separates in a crystalline condition and may be purified by dissolving in acids and precipitating with alkalis. Tetra-ethyldiamidobenzhydrol may be employed in place of tetra-methyldiamidobenzhydrol and the following secondary amines may be substituted for the phenyl- α -naphthylamine: methyl-, ethyl-, and benzyl-aniline, diphenylamine, methyl-, ethyl-, benzyl-, *o*- and *p*-tolyl- α -naphthylamine and dinaphthylamine. All these colouring matters yield violet to blue or greenish blue shades on wool or on cotton mordanted with tannic acid.—T. A. L.

The Manufacture and Production of New Cotton or Substantive Dyestuffs. B. Wilcox, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 19,061, November 4, 1891.

IN the Fr. Pat. 209,519, November 14, 1890, Guinot, Picard and Jay describe a process for obtaining cotton colouring matters by the action of hypochlorites on primuline. Superior colouring matters are produced by acting with sodium hypochlorite on dehydrothio-*p*-toluidine sulphonic acid or its homologues obtained from *m*-xylylidine or ψ -cumidine and which are derivatives of benzenyl-*o*-amido-thio-*m*-cresol—

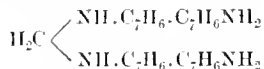


(Gattermann and Pfützing, Ber. 22, 1063; this Journal 1889, 698). The dehydrothio-*p*-toluidine, melting at 191° C., is sulphonated and 50 kilos. of the sulphonic acid are dissolved in 1,000 litres of water with 8 to 10 kilos. of sodium carbonate. The solution is mixed at a temperature of about 15° C. with a sodium hypochlorite solution obtained by adding the requisite quantity of sodium carbonate to 50 kilos. of chloride of lime. The solution, which is at first colourless, turns a deep reddish yellow and the reaction is complete in about 24 hours. The dyestuff is precipitated with salt, washed with brine, pressed and dried, and forms a brown powder readily soluble in water. It dyes unmordanted cotton a brilliant yellow, similar to Chrysamine R, and withstands alkalis, acids, chlorine, and light. The oxidation can also be effected by hypobromites or by potassium ferricyanide or lead dioxide in presence of an alkali. The new compounds probably belong to the class of azo- or azoxy-colouring matters produced from two molecules of dehydrothio-*p*-toluidine sulphonic acid by the simultaneous oxidation of the two amido groups, since nitrous acid no longer gives a diazo-compound. The shades produced by the higher homologues are redder than those from the toluidine derivative.—T. A. L.

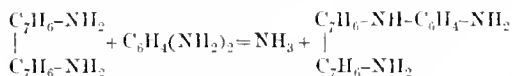
Manufacture of New Bases applicable for the Production of Substantive Cotton Dyes. C. D. Abel, London. From L. Durand, Huguenin, and Co., Bâle, Switzerland. Eng. Pat. 9360, May 17, 1892.

THESE bases are obtained by condensing toluidine, benzidine, or dianisidine with formaldehyde or with *m*-phenylenediamine. The condensation products obtained give diazo compounds which when combined with naphthylamine

sulphonic acids yield substantive cotton dyes. 21·2 kilos. of tolidine, 24·8 kilos. of basic tolidine hydrochloride, and 10 kilos. of alcohol are mixed to a thick paste and treated with 7·5 kilos. of a 40 per cent. formaldehyde solution. The melt is allowed to stand for 12 hours and is then heated for a further 12 hours on the water-bath. After cooling it is powdered, dissolved in hot dilute sulphuric acid filtered from unaltered tolidine, and the new base precipitated by sodium carbonate as a light green resinous mass which begins to liquefy at 60°–65° C. and is completely melted at 85°–90° C. The following constitution is given for the substance—



It is easily soluble in alcohol, slightly soluble in benzene, and almost insoluble in ether. The hydrochloride and sulphate are readily soluble in water. Similar compounds are obtained from benzidine and dianisidine. The condensation product from tolidine and *m*-phenylenediamine is produced as follows: 12 kilos. of *m*-phenylenediamine are heated to 180° C. and 10 kilos. of basic tolidine hydrochloride are slowly stirred in, the temperature being then raised to 280° C. and kept at this point for three hours, ammonia being evolved during the reaction. The melt, after being powdered, is washed with warm water to remove unaltered phenylenediamine and is then dissolved in hot dilute hydrochloric acid, any tolidine present being precipitated by the addition of sulphuric acid. After filtering, the base is precipitated by the addition of soda-lye, forming a yellowish-brown mass which melts from 100°–110° C. The following equation is given as representing the reaction—



The compound can be diazotised and the amount of nitrite used corresponds to the formula given. The diazotised base combines with naphthylamine sulphonic acids, giving substantive cotton dyestuffs. The solutions of the condensation products from *m*-phenylenediamine and more particularly those of the bases in alcohol possess a strong green fluorescence.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

PATENTS.

Improvements in the Treatment of Vegetable Textile Fibres for the Manufacture of Yarns and Fabrics. F. V. M. Raabe, London. Eng. Pat. 8776, May 23, 1891.

This invention, which is an improvement on Eng. Pat. 9811, of 1885, relates to the preparation for spinning and manufacturing of those bast fibres “which ordinarily are not employed in the production of superior goods.” The claims comprise:—the boiling of the fibres in a mixture of urine and alkali solution; rinsing the fibres so treated; hydro-extracting; drying by hot air; and opening, dividing, and cleaning.—E. B.

Improvements in Apparatus for Treating Vegetable Substances to obtain Fibres therefrom. D. Barnett, Glasgow. Eng. Pat. 10,252, June 17, 1891.

RUMEX and other vegetable fibres are submitted to a combined bruising, rubbing, and drawing action, for the purpose of removing the incrusting ligneous and cementitious matters “by a dry or almost dry mode of treatment.”

—E. B.

Improvements in Machinery for Washing and Treating Hosiery and other Fabrics. J. W. and G. Roberts, Bolton. Eng. Pat. 10,490, June 20, 1891.

A CAGE or dashwheel, formed by fixing wooden or metal lags with bevelled edges to two circular discs, is arranged to revolve inside a stationary washing cylinder. The cage is driven either continuously or with reversing gearing.—E. B.

Improvements in the Process of and Apparatus for Bleaching and Treating the Fibre of Peat or other Substances. G. A. Cannot, London. Eng. Pat. 13,102, August 1, 1891.

See under VI., page 813.

Improvements in the Method of and in Apparatus for Bleaching and Treating Textile Fabrics. C. F. Pike, Manchester. Eng. Pat. 13,509, August 11, 1891.

COTTON fabrics are continuously scoured by passing them in the rope-form through a series of tanks filled respectively with boiling milk of lime, hot water, and “hot caustic solution.” The cloth travels up and down through each tank, and is squeezed before passing into the succeeding tank. It is stated that the “entire bleaching operation might be carried out by putting a similar apparatus in line with the example illustrated (in the original specification), and carrying on the treatment until the goods are fully bleached.” Both the method and the apparatus employed are claimed.—E. B.

Improvements in the Process of Extracting Deleterious Matters from Wool and other Textile Materials. C. Hanson, Wakefield. Eng. Pat. 243, January 6, 1892.

THE process of extraction of the vegetable matters from wool, mungo, shoddy, &c. by immersion in cold, dilute mineral acid, as at present conducted, fails to thoroughly cleanse the wool and leaves it with a harsh feel. This, it is claimed, is obviated by heating the dilute acid to a temperature “varying from 100° to 400° F., or in some instances lower than 100° F.” Less acid is required in this way, and the wool is obtained of a better feel and colour, so that less soap, &c. for scouring is needed.—E. B.

Improvements in Machinery for Breaking or Scutching Flax and similar Fibrous Materials. E. G. A. Hatsehek, London. Eng. Pat. 5223, March 16, 1892.

THE flax-straw is passed downwards through a hopper to two feed-rollers and then between two fixed pairs of blunt knives placed horizontally beneath the feed-rollers. A frame provided with knives is arranged to move laterally to and fro between the two pairs of stationary knives, the lower pair of which is lightly pressed against the frame by springs. When the flax-stems pass through the apparatus the straw is broken and shaken out of the fibre.—E. B.

New or Improved Wood Fibre Ropes. O. Marwitz, Schierstein, Germany. Eng. Pat. 7482, April 20, 1892.

WOOD-ROPEs, to substitute straw-ropes for use in foundries, are manufactured by spinning together firmly-twisted strands of aspen or willow-wood fibre with loosely-twisted strands of pine or poplar-wood; or by covering a firmly-twisted inner core of aspen or willow fibres with loosely-twisted pine or poplar fibres, or with straw, hay, hemp, flax, manilla, cocoa-nut fibre, or other vegetable fibre.—E. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

The Discharge of Alizarin Dyes. Emil Schnabel.
Färben, Zeit. 1892, 395.

DISCHARGING a dye means the total or partial abstraction of it from the dyed fibre, although occasionally the same term is applied if a certain dye by means of some reagent is lightened in shade without any of the dye being removed from the fibre. If a brown dyed on chrome mordant with logwood, fustic and eamwood is treated in a boiling solution of tin crystals, no loss of dye occurs, but the shade becomes much lighter. Many of the alizarin dyes can be modified upon the fibre in the same manner, but in this case the solutions employed have to be much more concentrated than for the wood colours. The great stability of most of the alizarin colours calls frequently for the most energetic and destructive discharging agents.

Carbonisation with Sulphuric Acid at 5° B.

Does not modify.	Very slightly modifies.
Diamond black B. (Bayer, Elberfeld.)	Alizarin black S W. (B. A. and S. F.) (<i>Trifle more greenish.</i>)
Alizarin orange. (Hoechst.)	Alizarin black S R W. (B. A. and S. F.) (<i>Trifle more greenish.</i>)
Alizarin indigo blue S M W. (B. A. and S. F.)	Alizarin blue S W. (B. A. and S. F.) (<i>Trifle more greenish.</i>)
Alizarin green S W. (B. A. and S. F.)	

Does not modify.

Very slightly modifies.

Galloflavin.
(B. A. and S. F.)Alizarin blue W X.
(B. A. and S. F.)
(*Trifle more greenish.*)Alizarin blue D N W.
(Hoechst.)
(*Trifle more greenish.*)Alizarin brown.
(Hoechst.)
(*Slightly paler.*)Anthracene blue W R.
(B. A. and S. F.)
(*Trifle more greenish.*)Alizarin indigo blue S W.
(B. A. and S. F.)
(*Trifle more greenish.*)Alizarin yellow G G W.
(Hoechst.)
(*Slightly lighter and paler.*)Alizarin dark blue.
(B. A. and S. F.)
(*Slightly greenish, paler.*)

Considerably affected are:—Gallein (B. A. & S. F.), became a reddish purple; Alizarin grey G (Hoechst), grey green; Alizarin cyanine R R R (Bayer, Elberfeld), much paler and greener; Alizarin blue R R, pale green. Alizarin red appears after the acid treatment brighter and more yellowish in shade, but when the acid has been neutralised by an alkali, the shade is found to be considerably bluer.

Dyed with	After Treatment with			
	Sulphuric Acid.	Oxalic Acid.	Alum.	Tin Crystals and Hydrochloric Acid.
10 per cent. Gallein paste (B. A. & S. F.)	Pale violet, looks like shade dyed with 3 per cent. Alizarin Blue S W paste and 3½ per cent. Alizarin red W B.	Dull purple, like that obtained from 2 per cent. Alizarin blue S W paste, 1 to 1½ per cent. Alizarin red W B paste, and 1 per cent. yellow flavin paste.	Much fuller shade, purplish-violet. Almost as bright as similar shades obtained from methyl-violet.	Like alum, but brighter and redder shade.
10 per cent. Alizarin green S W paste. (B. A. & S. F.)	Purplish paler, not much lighter.	Like sulphuric acid.	Unaltered.	A dark grey, similar to that from 7 per cent. Alizarin black S W paste, and 1½ per cent. Alizarin blue S W paste.
10 per cent. Alizarin black S W paste. (B. A. & S. F.)	Turned red, like a shade obtained with 9½ per cent. Alizarin grey R paste (Hoechst).	Like sulphuric acid, red still more pronounced.	Turned slightly greenish.	Turned a shade of olive, such as is obtained from 5½ per cent. Alizarin brown paste, 3½ per cent. Cernlein paste, 1½ to 2½, 4 per cent. Alizarin blue S W paste.
10 per cent. Alizarin black S R W paste. (B. A. & S. F.)	Like Alizarin black S W.	Like Alizarin black S W.	Unaltered.	A shade more greenish.
2 per cent. Diamond black powder. (Bayer, Elberfeld.)	Like Alizarin black S W.	A little redder than sulphuric acid.	Unaltered.	Entirely destroyed into a pale buff, and like one obtained with 0.2 to 0.4 per cent. Alizarin brown paste, 0.2 to 0.4 per cent. Galloflavin paste.
10 per cent. Alizarin grey G paste. (Hoechst.)	Considerably greener, resembling shade from 2½ per cent. Alizarin green S W paste, 2½ per cent. Alizarin black S W paste, ¾ per cent. Alizarin brown paste.	Grey green.	Grey Green.	Exactly like shade from 5½ per cent. Alizarin brown paste, 4 per cent. Alizarin blue S W paste, 1½ per cent. Galloflavin paste.
10 per cent. Alizarin brown paste. (Hoechst.)	Intensity reduced to a shade obtained with 2½ per cent. Alizarin brown paste.	Yellowish orange, as from 1 per cent. Alizarin orange, 3 per cent. fustic extract paste.	Scarcely any paler, but somewhat more purple.	Gained a little in brightness and intensity.
10 per cent. Galloflavin paste. (B. A. & S. F.)	Lost about 6 per cent. of the dye, shade rather duller.	Like sulphuric acid, still paler.	Scarcely altered, a trifle lighter.	A little more reddish, no lighter.

After Treatment with

Dyed with	After Treatment with			
	Sulphuric Acid.	Oxalic Acid.	Alum.	Tin Crystals and Hydrochloric Acid.
10 per cent. Cerulein paste, (Hoechst.)	Dye not discharged, only a little paler, bluish red.	Like sulphuric acid, a little more affected.	Unaltered.	Not discharged, a little more dull and orange.
10 per cent. Alizarin yellow G G W paste, (Hoechst.)	Almost completely discharged, like a shade with 3 per cent. of the dye, but duller.	Like sulphuric acid.	Scarcely altered, only a trifle discharged.	Lost about 4 per cent. the dye, a little duller reddish.
10 per cent. Alizarin dark blue paste, (B. A. & S. F.)	Slightly lighter and duller.	Slightly lighter and duller.	A little fuller shade, bluish.	A dark purple, as obtained with 10 per cent. Alizarin grey R paste.
10 per cent. Alizarin blue R R paste, (Hoechst.)	Lost from 2 to 3 per cent. of dye, and is less red.	Not much lighter, but a little duller red.	A little more red.	A dark purple shade, a little redder than Alizarin dark blue.
2 per cent. Alizarin red S powder, (B. A. & S. F.)	Terra cotta shade, as obtainable from 4 per cent. Gallodavin paste, 6 per cent. Alizarin red S powder.	Light orange, as obtained from 15 per cent. Alizarin orange on alumina mordant, but rather duller.	Similar to ordinary Alizarin red, but more bluish and duller. A little discharged.	Similar as with oxalic acid, but duller.
10 per cent. Alizarin red W B paste, (B. A. & S. F.)	Slightly altered as Alizarin red S.	Like Alizarin red S.	Like Alizarin red S, a little discharged.	Like Alizarin red S.
10 per cent. Alizarin orange paste, (Hoechst.)	Lost about 4 per cent. of dye, yellower.	Like a shade with 15 per cent. Alizarin orange on alumina mordant.	Like oxalic acid, not so bright. A little discharged.	Much yellow, not much lighter.

The action of a hot bath of sulphuric acid is similar to that of the carbonisation bath, but acts much more energetic. The following table shows the alteration which the shades undergo, if submitted for 20 minutes to the action of a bath containing 10 grms. of sulphuric acid 66° B. in a litre of water at a temperature of 80° C. Of course these experiments only serve to illustrate the alterations of the various dyes, but cannot be generally employed for practical purposes. The experiments with oxalic acid were carried out with solutions containing 1·5 gm. of oxalic acid in a litre of water. In this bath the material was boiled for 15 minutes. The alum baths were of the same strength, but the boiling was continued for 25 minutes. The tin baths contained in a litre of water 1 gm. of tin crystals and 1 gm. commercial hydrochloric acid, and the material was boiled for 30 minutes in this bath.—C. O. W.

Red and White Discharge Prints on Dyed Indigo-Blue.
C. F. Brandt. Bull. Soc. Ind. Mulhouse, April—May 1892, 201—206.

In 1884, A. Scheurer directed attention to the decolorising influence on indigo-blue exercised by the alkaline hypobromites. This suggested the idea of applying the reaction to the production of red discharge effects on fabrics dyed indigo-blue, a problem at that time of considerable practical importance, the processes in use being very imperfect and most of them having the defect of strongly attacking the fibre. To effect the end desired, it is requisite to associate with a salt of alumina the reagents necessary for the disengagement on the fibre of bromine or hypobromous acid. Solutions of chlorate of alumina and ammonium or sodium bromide when mixed undergo no change, but on addition of bisulphite of soda a disengagement of bromine takes place after the lapse of some time in the cold and instantaneously and energetically on heating. A mixture of these three reagents thickened with British gum, printed on indigo-dyed cloth, and subjected to a steaming of 1½ minutes duration, effects a decolorisation of the tissue, and at the same time sufficient alumina is fixed on the fibre to produce a red when subsequently dyed up in alizarin. This process is, however, defective, as the colour only keeps for a short time, after which a decomposition sets in with liberation of bromine. If the bisulphite of soda be left out and in its place sulphide of copper substituted, the disengagement of bromine is also effected on heating, and such a mixture

gives excellent results. Here, however, a new difficulty presented itself. Although the new colour keeps much better than the one containing bisulphite, yet the insoluble sulphide of copper becomes slowly oxidised to soluble sulphate of copper, and when this transformation has reached a certain point a rapid decomposition of the printing colour takes place. An attempt to substitute the copper by vanadium was futile, the latter not inducing the necessary decomposition of the reagents. It became necessary to prevent the formation of a soluble salt of copper, and this was effected by the addition of iodide of potassium, which precipitates the soluble copper salt at the moment it is formed. This addition made the process complete and practical, and it has been used by the author from 1884 up to the present time without change. The working receipt is as follows:—

1 litre chlorate of alumina, 15° B. (thickened with British gum).

200 grms. bromide of potassium.

25 grms. iodide of potassium.

25 grms. sulphide of copper.

This is for a dark indigo shade; for medium and light shades the above colour is reduced by admixture with more of the thickened chlorate of alumina.

After printing, the fabric is steamed 1½ minutes in Mather and Platt's aniline ager; the discharge is complete and the tissue is not injured.

For the production of a white discharge simultaneously with the red, the attempt to substitute other chlorates in place of the chlorate of alumina was unsuccessful, the indigo being either unaffected or only partially discharged. The end was, however, gained by an addition of citric acid to the printing colour, this preventing the fixation of the alumina on the fibre. It was also found convenient in this latter case to partially substitute the chlorate of alumina by barium chlorate, in order to make the colour less acid, and to replace the bromide of potassium by bromide of ammonium. (Prints of red and white discharges on indigo-blue accompany the paper.)—W. E. K.

Process for the Discharge of Dyed Indigo-Blue. C. F. Brandt. Bull. Soc. Ind. Mulhouse, April—May, 1892, 210. (Sealed packet of 23rd February, 1885.)

This describes the process abstracted above in which bisulphate of soda is used. In order to obtain a good bright shade of indigo the white cloth is mercerised before dyeing

blue. The colour thus got is not injured by the subsequent processes of dyeing and brightening of the red. Anthrapurpurin is to be preferred as dyestuff.—W. E. K.

Process for the Production of a Discharge on Dyed Indigo. F. Binder. Bull Soc. Ind. Mulhouse, April—May 1892, 207—209. (Sealed packet of April 18, 1885.)

This process is based on the destruction of the indigo by nascent bromine, obtained by the action of a strong acid on—

- (1.) Bromide and bromate of sodium.
- (2.) Bromide and chlorate of sodium.
- (3.) Bromide of sodium and chlorate of alumina.

The acid is that disengaged from glycerosulphate of alumina, sulphate of alumina, alum, or chloride of aluminium, by steaming at 100° C. through the Mather and Platt ager.

The indigo is destroyed and alumina is simultaneously fixed on the fibre. It is sufficient after steaming to wash with off and then dyed up in alizarin.

Chloride, tartrate, or citrate of ammonium, admixed with the bromide and bromate of sodium, also destroy indigo on steaming.

An additional note of March 1892 gives the following details. The bromide-bromate mixture is prepared as follows:—600 grms. of bromine are added to 1,000 grms. of caustic soda at 38° B., boiled, and made up to 35° B. This gives 1,875 cc. of liquid containing per litre 343 grms. of bromide of sodium and 100 grms. of bromate of sodium. From this the printing colour is prepared:—

$\frac{3}{4}$ litre sulphate of alumina solution, 35° B.
115 grms. soda crystals.

Boil and add to—

$\frac{1}{2}$ litre gum tragacanth solution.

Cool and add—

625 cc. bromide-bromate 35° B. (above).—W. E. K.

Peroxide of Sodium. M. Prud'homme. Chem. Trade J. 11, 208.

See under VII., page 814.

The Chemical Examination of Handwriting. A. Robertson and J. Hofmann. Pharm. C. H. N. F. 1892, 13, 225.

See under XXIII., page 847.

PATENTS.

Improvements in the Manufacture or Production of Chlorine Compounds for Bleaching. Count T. de Dienheim-Brochocki, Paris. Eng. Pat. 9332, June 2, 1891.

CHLORINE gas, after being cooled, is passed through a vessel containing water in order to remove acid, and then after admixture with air, through a bed of coke moistened with sulphuric acid to dry it. The air and chlorine are then led through an apparatus where the mixed gases are subjected to a constant discharge of electric sparks which causes the formation of a certain amount of hypochlorous and chlorous acid. The gases are afterwards passed into a concentrated solution of caustic alkali. The product of the combination of the alkali and the chlorine so treated is designated by the patentee "chlorozone," and he claims that its bleaching capacity is superior to that of an ordinary alkaline hypochlorite.—H. S. P.

Improvements in the Process of, and Apparatus for Bleaching and Treating the Fibre of Peat, or other Fibrous Substances. G. A. Cannot, London. Eng. Pat. 13,102, August 1, 1891.

PEAT is rendered fit for manufacturing into thread or for conversion into paper-pulp by successively heating it with dilute alkali under slight pressure, washing with water and dilute acid, treating with dilute hypochlorous acid, washing and drying.

The inventor, further, claims a process of manufacturing "hypochlorous acid gas" by submitting a dry mixture of oxygen and chlorine gases at a low temperature (to avoid explosions) to the influence of a stream of electric sparks, the resulting gas being absorbed in a solution of caustic soda or potash.—E. B.

Improvements in Dyeing and Printing Textile Fibres with Aniline and its Homologues or Derivatives. W. J. S. Grawitz, Nogent-sur-Marne, France. Eng. Pat. 13,955, August 18, 1891. (Date claimed under International Convention, January 19, 1891.)

THE tendering of the fibre which takes place in the dyeing of aniline black by the process of drying and steam-ageing, is due to the action of the mineral acid which is liberated. This is obviated by adding to the aniline solution an acetate or tartrate of an alkali or alkaline earth, the mineral acid which becomes free interacting with such salt, and liberating acetic or tartaric acid. The best proportion of the alkaline salt to add is three-fourths of an equivalent to one equivalent of aniline hydrochloride. The cotton, after being impregnated with this solution, is dried and aged as usual.—E. B.

Improvements in Apparatus for Dyeing, Scouring, Bleaching, or otherwise Treating Yarn in Cop, or other similar Compact Form. A. and J. Graemiger, Bury. Eng. Pat. September 8, 1891.

IN order that large batches of yarn in cop may be dyed, and liquor of a high temperature used, the patentees propose to employ the following apparatus. The yarn is placed on hollow perforated spindles carried on suitable frames, which fit into a tank of convenient shape, which is capable of being hermetically closed. The frames are interchangeable, thus allowing of one lot being refilled, while the other is under treatment. During the process the yarn may be subjected to air exhaustion, or liquor, gases, or steam, may be forced or drawn through the tank. In cases where high temperatures are used, the action of the circulating pump may be assisted, and a more thorough impregnation of the yarn effected, by the introduction of steam, or air under pressure. A perforated bottom, and steam coil, permit of heating the dye or other liquor to the required temperature. The yarn may be finally dried after treatment, in the tank by means of superheated steam or air.—W. P. D.

An Improved Method of, and Apparatus for Effecting the Oxidation of Aniline Black in the Process of Dyeing Cotton, Thread, or Wool, on Bobbins and Cops. C. Schnürch, Alchemnitz, Germany. Eng. Pat. 7555, April 21, 1892.

THE cops or bobbins are fixed on pins projecting from bars which are carried through the drying and "damping" chambers by endless pitch-chains. The cops are placed upon the pins before passing into the drying apparatus and are removed from them outside the "damping" chamber, continuous working being thus achieved.—E. B.

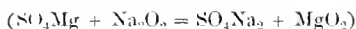
Improvements in Hawking Machines for Indigo Dyeing. W. H. Coulter, Batley, Yorkshire. Eng. Pat. 12,694, July 11, 1892.

IN this machine nipping rollers are made to rotate in the dye liquor, between which the fabric passes. In order to prevent the fabric sticking to the rollers, and thereby becoming damaged, it is proposed to use scrapers of strip copper, or other suitable material, which are fixed nearly at right angles to the rollers, and so prevent the return of the fabric. These scrapers are partly curved and attached to a longitudinal bar, and thumb-screws are employed to adjust the pressure of the scrapers upon the surface of the rollers.—W. P. D.

VII.—ACIDS, ALKALIS, AND SALTS.

Peroxide of Sodium. M. Prud'homme. Chem. Trade J. 11, 208.

SODIUM peroxide has lately been introduced into commerce at about 5 frs. per kilo., a price which may allow of its introduction as a bleaching agent. The commercial article contains about 20 per cent. of active oxygen, corresponding to the formula Na_2O_2 (barium peroxide only contains about 8 per cent., hydrogen peroxide 12 vol., only 1.5 per cent. oxygen). It dissolves without evolution of oxygen in dilute acids when kept cool, a solution of hydrogen peroxide being formed. A moderately concentrated solution of sodium peroxide attacks cellulose violently, disintegrating it and turning it yellow; when subsequently washed and treated with a weak acid, the cellulose takes a deep shade in a bath of Methylene blue. The peroxide is too alkaline to be used for bleaching wool and silk, therefore E. de Haen recommends the preparation of magnesium peroxide by means of the sodium peroxide from a solution of magnesium sulphate—



which is more stable than hydrogen peroxide.

Recipes are given for the use of sodium peroxide, for bleaching wool, tussur, and mixed silk tissues. As an example, the first method may be reproduced:—The wool is to be thoroughly freed from grease, and put into a bath at 30° C. containing 30 per cent. of the weight of the material in magnesium sulphate, free from chlorine. The material is turned several times, removed, and peroxide of sodium added (10 per cent. on the wool). It is again put in, and the temperature raised to 60°–70° C. After allowing to remain for $\frac{3}{4}$ to 1 hour, it is taken out, passed into dilute sulphuric acid to remove the magnesia, and then washed and dried.—J. L.

The Comparative Value of Brimstone and Pyrites in the Manufacture of Sulphuric Acid in the United States. J. H. Kelley. Eng. and Mining J. July 23, 1892, 72.

THE only advantage that pyrites possesses over brimstone is that the sulphur in this form costs from one-third to one-half less than in the form of brimstone, while the advantage possessed by brimstone over pyrites may be given as follows:—As pyrites contains an amount of iron requiring oxidation, more air is used in the burning process than with brimstone in producing the same amount of sulphuric acid; consequently the burner gas from pyrites contains a larger percentage of nitrogen and a smaller percentage of sulphurous acid and free oxygen than that from brimstone. In exact figures, the burner gas from pyrites should contain, with good working, from 8 to 10 per cent., and that from brimstone from 11 to 13 per cent. SO_2 . This increase in the amount of nitrogen and decrease in SO_2 and free oxygen requires an increase of from 2 to 3 per cent. of nitre in the amount of sulphur charged, and it also requires an increase of from one-fourth to one-third of the capacity of the chambers. The author finds that the average amount of nitre used with pyrites to be 6 per cent. and with brimstone 4 per cent. of sulphur charged.

He finds that 100 lb. of sulphur charged, in the form of pyrites, produces 430 lb. of chamber acid, and that 100 lb. of sulphur in the form of brimstone 490 lb. of chamber acid 50 B. (sp. gr. = 1.53), these figures being equivalent to 247 and 200 lb. of pure acid respectively. This difference is due to the amount of sulphur remaining in the cinder, averaging 3 per cent., and also to the sublimation of sulphur and the non-formation of sulphurous acid due to the high temperature of the furnace. This increase in temperature, combined with the greater amount of nitre used with pyrites, shortens the life of the chambers by at least one-half. On this account the wear and tear of the brimstone plant are calculated at 6 per cent. per annum, and in the pyrites plant at 10 per cent. per annum. The pyrites plant, which produced 9 nine tons 50 B. acid per

day, was valued at 30,000 dols.; and the brimstone plant, using the same chambers and producing 12½ tons per day, was valued at 27,000 dols. The difference in cost is due to the difference in the cost of the furnaces.

With pyrites the services of four men were required for charging (two during day, two night), besides the extra expense of breaking and preparing the ore for the furnace; while with brimstone two men were sufficient for all purposes.

In the following table are given the averages expenses for a day, first with pyrites, second with brimstone:—

COST OF PRODUCING NINE TONS CHAMBER ACID WITH PYRITES.

	Dols.	Dols.
5 tons pyrites, at 5 dols. to 8 dols., from.....	25 00	40 00
270 lb. nitrate, at 2.50 dols. per 100.....	6 75	6 75
*360 lb. acid, at 19 c. per 100.....	1 45	1 45
Breaking ore and loss, at 25 c. per ton.....	1 25	1 25
Four men, at 1.25 dols. per ton.....	5 00	5 00
Wear and tear.....	9 00	9 00
Office and other expenses.....	5 00	5 00
	53 45	68 45

Producing 50° B. acid (sp. gr. = 1.53), at from 594 dols. to 760 dols. per ton.

COST OF PRODUCING TWELVE TONS CHAMBER ACID WITH BRIMSTONE.

	Dols.	Dols.
2½ tons brimstone, at 21 dols. to 29 dols., from.....	52 50	72 50
200 lb. nitrate, at 2.50 dols. per 100.....	5 00	5 00
*200 lb. acid, at 19 c. per 100.....	0 80	0 80
Two men, at 1.25 dols.....	2 50	2 50
Wear and tear.....	6 00	6 00
Office and other expenses.....	5 00	5 00
	71 80	91 80

Producing 50° B. acid at from 598 dols. to 765 dols. per ton.

This table shows that if pyrites can be obtained at from 5 dols. to 8 dols. per ton delivered, brimstone should be bought at from 21 dols. to 29 dols. per ton delivered. At present pyrites can be bought at from 10 dols. to 11 dols. per ton, delivered, and brimstone at 28 dols. to 30 dols. per ton, delivered, so that the comparison is even more in favour of brimstone than appears from the table. This calculation does not take into consideration the value of the cinders in the case of pyrites, as we have never been able to make anything on them.

So far, the value of a ton of acid produced from pyrites has been taken to be the same as one produced from brimstone. This is true only where the presence of a small percentage of arsenic is of no consequence. There is always some arsenic in pyrites, and it is almost impossible to eliminate it.

In the manufacture of superphosphate or sulphate of soda to be used in alkali, or in glass-making, or in the purification of petroleum, there is no objection to arsenical sulphuric acid, but where the acid is to be used in the manufacture of food products, such as starch, sugar, and molasses, it is necessary that brimstone acid should be employed. Where a chemically pure article is required in pharmaceutical and analytical work, it is absolutely necessary to use the brimstone acid.

Brimstone possesses the advantage of producing an acid averaging from 5° to 10° stronger than that produced by pyrites. The pyrites burner-gas has a higher temperature, and in order to reduce this sufficiently for the chamber process it is necessary to introduce more steam than with brimstone. For some time Wm. H. Adams has been advocating the use of pyrites in place of brimstone for the manufacture of sulphuric acid, and gives the following estimates. The chief reason for the substitution is the

* This difference in the amount of acid used is caused by the difference in temperature, and by the fact that the nitrate pot in the pyrites furnace is stationary, so that the nitrate cake must be liquid enough to flow out.

greater cheapness of the sulphur contained in pyrites, and the second reason is that pyrites are comparatively abundant in the States, whereas brimstone has to be imported. He gives in his writings a comparative statement of the costs in producing sulphuric acid by the two processes. This may be put in the form of a table:—

COST OF SULPHURIC ACID MADE FROM PYRITES.

	Dols.
10 tons pyrites, all costs as above at 5 dols per ton	50'00
Nitrate of soda, 4½ per cent. on sulphur contents, or, say 100 lb, at 2'50 dols. per 100 lbs.	10'00
Coal, 2 tons daily, at 3 dols. per ton	6'00
Labour, five men for all purposes, at 1'25 dols. per day	6'25
Superintendent and office cost	6'00
Wear and tear as above	10'00
Total	88'25
(or 1'90 dols. per ton of chamber acid.)	

COST OF PRODUCING SULPHURIC ACID FROM BRIMSTONE.

	Dols.
Four tons brimstone, all cost including freight, losses in transit and burning, &c., at 21 dols. a ton, used in producing 18 tons daily	96'00
Nitrate of soda, 6 per cent. of brimstone used, or 538 lb, daily, at 2'50 dols. per 100 lb.	13'45
Labour, five men, all purposes, at 1'25 dols. per day	6'25
Coal, 2 tons daily, at 3 dols. per ton	6'00
Superintendent and office cost	6'00
Wear and tear per day, 10 per cent. per annum, on works, costing 35,000 dols.	10'00
Total	137'70
(or 7'65 dols. per ton of chamber acid.)	

It will be noticed that Kelley's and Adams' estimates vary considerably. Adams estimates that with brimstone costing 24 dols. a ton chamber acid will cost 7'65 dols. a ton, and that with pyrites at 5 dols. a ton chamber acid costs 4'90 dols., while Mr. Kelley estimates the cost of acid from brimstone at from 5'98 dols. to 7'65 dols., and from pyrites 5'84 dols. to 7'60 dols., taking pyrites as costing from 5 dols. to 8 dols. per ton and brimstone at 21 dols. to 29 dols. a ton.—W. S.

The Problems of Commercial Electrolysis. J. Swinburne.
Inst. Elect. Eng. July 1892.
See under XL, page 823.

PATENTS.

Improvements relating to the Manufacture of the Aluminates, Sulphates, and Carbonates of Soda and Potash, and to the Production or Recovery of Alumina and other By-products. C. F. Claus, London. Eng. Pat. 4311, March 10, 1891.

THE process may be considered in three stages:—1. Chloride of sodium or potassium is mixed with native hydrate of alumina (bauxite) or with the hydrate of alumina produced in the third stage, in the proportion of from 30 to 100 parts by weight of hydrate of alumina to 100 of the chloride. A sufficient quantity of water is added to make a stiff paste, and the mixed substances are moulded into bricks and dried. These bricks are then charged into chambers arranged in a series, the chambers being connected in such a way that a flow of gases can be led through the whole series, and by a system of valves, admitting of any one chamber being excluded from the series, as desired, for the purpose of charging or discharging it, and further so arranged that each chamber in turn becomes the first, the last, or an intermediate chamber in the series.

When the chambers are charged with the moulded material a gaseous mixture of hot sulphurous acid, steam (superheated or not), and hot or cold atmospheric air is then conducted through them. At the beginning of the

operation the chambers should be heated by gaseous fuel or hot air to a temperature of from 400° to 500° C., which is found to be the best temperature for the carrying out of the reaction that ensues. This reaction results in the decomposition of the alkaline chloride with the production of alkaline sulphate and hydrochloric acid gas. The reaction is energetic and runs its course quickly without any danger of the chlorides fusing, as in the analogous Hargreaves process, both of which facts are probably due to the admixture of aluminium hydrate, which is temporarily converted into sulphate and then transfers its sulphuric acid to the alkalis. The gaseous mixture used may contain a larger proportion of sulphurous acid, and the temperature of the air and steam may be higher than in the Hargreaves process. The sulphurous acid may be made by the combustion of sulphuretted hydrogen obtained in the second stage of the process or by the burning of pyrites or other sulphur ores. If the latter plan be adopted the sulphuretted hydrogen formed in the second stage may be burnt in a Claus kiln and solid sulphur recovered.

The hydrochloric acid evolved from this series of chambers is conveyed from the last chamber in the series to condensers. The finished product remaining in the first chamber of the series, consisting of sulphate of sodium (or potassium) and aluminium hydrate, is then withdrawn and charged preferably hot into one of another series of chambers.

II. In this second series the next stage of the process is carried out, and it consists in reducing the alkaline sulphate to sulphide by the action of reducing gases such as hot hydrogen, carbonic oxide, or water-gas. The gases should be nearly red hot, or at the temperature at which they leave the producers. If the heat be not sufficient a little air may be admitted so as to burn some of the gas and raise the temperature. The alkaline sulphide then reacts upon the aluminium hydrate, and the corresponding alkaline aluminate is formed, and sulphuretted hydrogen gas is evolved, which, as already stated, may either be burnt to sulphurous acid and used over again in the first stage, or may be used for the recovery of the sulphur it contains.

III. In this stage the alkaline aluminate is dissolved in boiling water, and after separation of the insoluble matters by subsidence or filtration carbonic acid gas is pumped through the clear liquor; or the carbonic acid may be forced through the mixture of water and alkaline aluminate and the insoluble residue separated afterwards. For this operation an apparatus such as that used in the Chance process for obtaining sulphuretted hydrogen from alkali waste may be used. The action of the carbonic acid on the alkaline aluminate results in the production of a solution of alkaline carbonate and a precipitate of aluminium hydrate which falls in a dense and easily filtered form. The alkaline carbonate liquor may be treated in the usual way, and the hydrate of aluminium may be used over again in the first stage of the process. Any undecomposed alkaline sulphide is likewise decomposed by the carbonic acid, and the sulphuretted hydrogen passes away with the residual gases and may be dealt with in the well-known manner.—H. S. P.

Using a Combination of Sulphuric Acid and Hydrochloric Acid for the Decomposition of Chlorides, Sulphides, Sulphates, and of Sulphuretted Hydrogen. J. Pedder, Widnes. Eng. Pat. 4712, March 17, 1891.

MIXED rock salt is placed in a Weldon still with a sufficient quantity of sulphuric acid mixed with one-third of its bulk of hydrochloric acid, and steam is applied until the salt is decomposed. The liquor is then run into a vat and crystallised. The residual liquor is used with sulphuric acid for the next treatment of salt. The crystals are roasted to drive off the adhering hydrochloric acid, and the still and roaster are connected with condensers. In applying the process to ordinary hand furnaces, these may be worked as at present with ground rock salt and sulphuric acid to which an addition of hydrochloric acid has been made, and the heat is kept lower than usual to prevent the formation of bisulphate.

In the application of the process to metallic sulphides, the ore is digested with a mixture of sulphuric and hydrochloric acids. Heat is applied to assist the decomposition

and expel the sulphurous acid. Air is admitted to oxidise the metals after desulphuration, and the gases are passed through cylinders to produce sulphate of soda. When applying the process to the treatment of salt in the Hargreaves cylinders, a certain quantity of sulphate of soda as a powder or in a liquid form is added to the salt before roasting to prevent too close packing. The sulphate of soda "decomposes the steam (which has been acidulated with hydrochloric acid and sulphuric acid) that passes with sulphurous acid or sulphuretted hydrogen into the cylinders of the Hargreaves type."—H. S. P.

Improvements in the Manufacture of Cyanogen Compounds, and the Treatment of Substances used therein. J. J. Hood, London, and A. G. Salamon, London. Eng. Pat. 5354, March 25, 1891.

ARZONIX and carbon bisulphide mixed with Weldon mud (washed free from calcium chloride) are heated together in closed vessels to the temperature of boiling water or somewhat higher, by steam. Sulphocyanide of manganese, sulphide of manganese, free sulphur and water are formed. A second base may be added such as an alkali, or caustic or slaked lime, sufficient in quantity to combine with the sulphocyanic acid. The resulting mass is washed, the sulphocyanide goes into solution and the sulphide of manganese and sulphur remain undissolved and may be revived by exposure to the air. The sulphocyanide of manganese or lime in the solution is recovered by crystallisation, or an alkaline sulphocyanide may be obtained by decomposing these with an alkaline salt (carbonate, sulphate or sulphide) and separating by crystallisation. Advantage is taken in order to separate the manganese and calcium from each other of the fact that carbonate of soda or potash first of all precipitates carbonate of manganese, which is removed and may be reconverted into the oxide by ignition, and then a further addition of the alkaline carbonate precipitates the calcium as carbonate.

From the alkaline sulphocyanide thus obtained, the aluminium sulphocyanide may be formed by addition of aluminium sulphate, or the yellow prussiate of potash or soda, may be made by evaporating the solution of the alkaline sulphocyanide and igniting with iron filings or borings.

Instead of Weldon mud, the peroxide of manganese artificially made from manganese carbonate by ignition, or the native ore called "wad" may be used.

Instead of manganese peroxide, hydrated ferric oxide artificially made or native may be used. Irish bog oxide is preferred. In this case sulphide of iron (which may be revived by exposure to air) and ammonium sulphocyanide are formed. If a second base such as caustic or slaked lime be added all the ammonia is converted into the cyanide radicle as sulphocyanide of lime, as in the case when peroxide of manganese is used.—H. S. P.

An Improved Method, Chiefly designed for Enriching Calcareous Phosphates, and for Manufacturing Superphosphates and various By-products. H. H. Lake, London. From A. Briart and P. Jacquemin, Belgium. Eng. Pat. 5357, March 25, 1891.

THE calcareous phosphates are treated in suitable vessels provided with agitators, with an aqueous solution of sulphurous acid. This acts upon the calcium carbonate in the phosphates forming calcium bisulphite, which goes into solution, together with a small quantity of the phosphate. The residual phosphate obtained contains a larger proportion of phosphoric acid than the crude phosphates used. The process may be facilitated by first calcining the crude phosphates. This increases the energy of the action of the sulphurous acid on the lime, and weakens the soluble action upon the tricalcium phosphate. The liquor containing the bisulphite of calcium in solution is then decanted and treated with sulphuric acid, which precipitates calcium sulphate in a state well adapted for making a high class plaster of Paris. The sulphurous acid evolved is again absorbed by water, and is used over again. The liquor drawn from the precipitated calcium sulphate, containing

sulphurous acid and phosphoric acid in solution, is used over again for treating fresh phosphate. There is therefore a gradual accumulation of phosphoric acid in this liquor, and it may be allowed to become so concentrated as to produce after further concentration by evaporation a marketable article, or it may be used alone for enriching the natural phosphates or in making superphosphates. The sulphurous acid may be generated in any known way, but when made from pyrites the gases from the burners must be cooled before passing to the absorbing towers where they are dissolved in water. Use is made of the heat contained in the gases to calcine the plaster of Paris and to dry the superphosphates and enriched phosphates made in carrying out the process. The patent also provides for utilising the escaping sulphurous acid evolved in the process for making sulphuric acid in leaden chambers.—H. S. P.

Improvements in the Manufacture of Caustic Soda and Caustic Potash. E. L. C. Martin, Ivry-Port, France. Eng. Pat. 8006, May 9, 1891.

SODIUM or potassium chloride is first decomposed by magnesium sulphate, magnesium chloride and sulphate of the alkali being formed. The magnesium chloride is then decomposed by heat whereby magnesium is deposited and hydrochloric acid liberated. The solution of alkaline sulphate is then treated with neutral or acid sulphite of barium or strontium, and the precipitated barium or strontium sulphate is removed and the solution of neutral or acid sulphite of sodium or potassium which remains is boiled. This causes a liberation of one-half of the sulphurous acid from the acid sulphite which is collected, and the solution of neutral sulphite remaining is then decomposed with lime mixed with a suitable proportion of caustic baryta, whereby a solution of caustic alkali is formed and calcium and barium sulphites are precipitated, and are afterwards separated by decantation from the solution. The calcium and barium sulphites are then converted into bisulphites by treatment with sulphurous acid, and these are used again for decomposing fresh quantities of alkaline sulphate.—H. S. P.

Improvements in Evaporating Pans for the Manufacture of Salt from Sea Water or Brine, and for other Purposes. T. Scott, Edinburgh. Eng. Pat. 17,185, October 9, 1891.

THE bottom of the pan is provided with a steam-chamber, which may be screw-studded to resist the pressure. Ordinary or superheated steam may be used. The water condensing in the chamber is passed through a coil, which heats the liquor before it is run into the pan, and is then pumped back into the boiler.—J. C. C.

An Improved Process for Preparing at the same Time Neutral Sulphate of Soda and Precipitated Phosphate of Lime. L. Brunner, Wetzlar, Germany, and A. Zanner, Laeken, Belgium. Eng. Pat. 2389, February 8, 1892.

BISULPHATE of soda is dissolved in water and treated with sulphuric acid solution of spent or refuse phosphates. The solution obtained by this treatment contains sulphate of soda and acid calcium phosphate, and the latter is then precipitated with milk of lime or calcium carbonate or by a weak alkali, and the precipitate of mixed calcium phosphates is filtered off from the solution containing sulphate of soda. The sulphate of soda may be then recovered by evaporation and crystallisation.—H. S. P.

An Improved Holder for Large Jars, Carboys, Demijohns, or the Like. E. W. Holmgren-Holmes, Toronto, Canada. Eng. Pat. 13,056, July 15, 1892.

See under I., page 804.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

The Expansion of Glass, and on "Compound" Glass.
Schott. Ber. d. Sitz v. April 1, 1892; d. Ver. z. Beförder d. Gewerbeff.

MOST of the determinations of the coefficient of expansion of glass that may be found in technical literature have been recorded without any reference being made to the composition of the samples used. The author, in conjunction with Winckmann, Straubel, and Pulverich has determined the cubical coefficient of expansion of 38 samples of accurately known composition. Several generalisations can be deduced from their results. In the first place the coefficient of expansion shows a relation with the content of alkali, in the case of silicate glasses. Sodium glasses give higher figures than those containing potassium, although the coefficient of expansion of the metal potassium (0.00008415) is higher than that of sodium (0.00007105). Lime, baryta, zinc oxide, alumina and lead oxide have no marked influence on ordinary silicate glasses. Phosphate glasses approximate to silicate glasses in their expansion; borate glasses, containing much boric acid are, on the contrary, distinguished by low coefficients of expansion; borosilicate glasses, which may be free from alkali on account of the fusibility imparted by boric acid, have low coefficients of expansion. A glass of this kind, of the composition BaO 25, ZnO 5, Al₂O₃ 4.5, B₂O₃ 14, Mn₂O₃ 0.08, SiO₂ 51.22, As₂O₃ 0.2 parts per cent. respectively, is noteworthy on account of its good insulating quality. This and its freedom from alkali will make it useful for many scientific purposes.

The coefficient of expansion is largely dependent upon the condition of tension in which the glass is, a fact that should never be lost sight of when glass is used for delicate measurements. The risk of alteration in length and volume is enhanced by great variations of temperature. This view is justified by the author's observations that slight permanent displacement of the thinnest parts of the glass may occur at a temperature considerably below its softening point, a fact bearing upon the alteration of the zero of thermometers. The belief hitherto held that the rise of the zero point is caused by a delayed contraction of the glass due to the high temperature at which it has been prepared appears scarcely tenable now. Alkali free glass does not show this phenomenon, and it is to be hoped that thermometers giving constant readings may be prepared from it. Other investigations of the authors have been directed to ascertain with what success glasses possessing different coefficients of expansion may be united, when they are taken upon the blow-pipe, in successive layers. When articles of glass of which the inner part has a lower coefficient of expansion than the outer are cooled in the air so that the outer layer exerts a compressive force, it is found that they resemble "hardened" glass. Such "compound" glass (*Verbundglas*) has been used for making flasks, upon which water could be sprayed when they were heated to the boiling point of aniline (184° C.) without risk of fracture. Dishes of this material could be heated directly over a Bunsen burner without cracking. An Argand chimney could be sprinkled with water on the inner surface with similar immunity. Gauge glasses of this "compound" glass withstood the corrosive action of water better than the ordinary specimens, and were so little affected by violent alterations of temperature that they could be plunged vertically into cold water after having been heated in oil to 200°—230° C.

The patented process for making compound glass consists in taking up a small portion with the blow-pipe of the glass with the lower coefficient of expansion, and then the rest from another pot containing the glass with the higher coefficient of expansion. The composition of the glass may vary within wide limits, as it is only the difference between the two coefficients of expansion that has to be regarded. The requisite difference can usually be obtained

by altering the percentage of alkali present. Spontaneous explosion, as sometimes occurs with Bastie's "hard glass," has not been observed.—B. B.

The Composition of Biscuit Porcelain. H. Seger. *Thonind. Zeit.* 16, 1892, 359.

BISCUIT porcelain for figures, &c., should be translucent, a circumstance which necessitates the addition of a considerable amount of fluxing constituents to the kaolin. If the limit of fusibility be overstepped a disagreeable waxy appearance occurs at the more prominent parts, such as the fingers, nose, hair, &c. A sample of biscuit porcelain, free from this defect, had the following composition:—Silica, 63.00; alumina, 24.74; ferric oxide, trace; lime, 0.77; magnesia, 0.64; alkalis calculated as potash, 10.86 parts per cent. respectively. The extraordinarily high content of alkali, and the low percentage of silica led to the conclusion that the material consists of a mixture of kaolin free from quartz, and felspar. Such a mixture having a composition corresponding with that given above, was made by mixing 32 parts by weight of kaolin and 68 of felspar. At the melting point of Seger's cone No. 8, it was thoroughly fused but retained its matt surface. For the production of biscuit porcelain of this quality the author recommends mixture of 54 parts by weight of Zettlitzer kaolin, 45 of felspar and 1 of marble, with the addition of 30 per cent. of the same mixture burnt and ground.—B. B.

Analyses of Glass used in the Manufacture of Incandescent Electric Lamps. D. Woodman, J. Amer. Chem. Soc. 14, 1892, 61—63.

IN the manufacture of incandescent lamps, apart from the breakages due to bad annealing and other causes, an excessive percentage of "spontaneous" breakages may often be traced to inequalities in the composition, and consequent variations in the coefficient of expansion of the glass of which the lamps are made. The author has analysed samples of glass employed in the manufacture of lamps which were peculiarly liable to spontaneous breakage, in spite of every care taken in annealing, &c. The results obtained fully explain the causes of the trouble.

ANALYSES OF GLASS ROD, TUBE AND LAMP BULB.

	Rod, 108.	Tube, 109.	Lamp Bulb, 112.
K ₂ O	1.38	4.20	2.32
Na ₂ O	15.06	9.65	14.50
CaO	2.15	..	6.10
MgO	0.70	..	0.93
MnO .....	..	Trace	Trace
Fe ₂ O ₃	1.02	1.65	1.45
Al ₂ O ₃	}		
PbO	16.81	19.83	1.39
SiO ₂	63.44	65.16	72.35
Cr ₂ O ₃	Trace	Trace	Trace
	100.56	99.89	99.34

The glass of an English lamp gave the following figures:—

ANALYSES OF BULB AND STEM OF ENGLISH INCANDESCENT LAMP.

	Bulb. 115.	Stem. 116.
K ₂ O	5.20	6.14
Na ₂ O	9.20	8.10
CaO	5.41	5.05
MgO .....	..	Trace
Fe ₂ O ₃ .....	..	1.10
Al ₂ O ₃	3.70	..
PbO	2.90	19.68
SiO ₂	75.10	68.24
	99.51	99.31

The above glass was very brilliant and clear. The percentage of breakages in the manufacture of these lamps was not known. Another lamp (of American manufacture) was found to be uniform in composition throughout, as shown below:—

	Bulb. 113.	Stem. 114.
K ₂ O	7.47	6.91
Na ₂ O	6.43	5.89
Al ₂ O ₃	6.39	1.98
PbO	18.70	17.14
SiO ₂	66.22	65.80
CaO	0.15	1.25
MnO	Traces	Traces
MgO		
Fe ₂ O ₃		
	96.36	98.37

—H. T. P.

PATENTS.

An Improved Process for Lining Metallic or other Vessels or Tubes with Glass. D. Rylands and A. Husselbee, Barnsley. Eng. Pat. 16,846, October 3, 1891.

THE metal vessel or tube is heated to the required temperature, molten glass is then gathered on a blow-pipe and blown out to nearly the size of the vessel. The glass is introduced into the metal vessel or tube, and is then blown out to the full size. The metal vessel being hot the glass adheres, and the vessel is properly lined. As soon as the glass has been blown out to the required extent a "burst-off" is formed round the top of the vessel, and thus the superfluous glass is blown, or burst, off. The glass-lined vessel is passed into the annealing arch or lehr, and is then annealed. The process is applicable to electric accumulator cells.—V. C.

Improvements in Treating China, Earthenware, and other like Surfaces for Various Useful and Ornamental Purposes. J. Slater, Burslem, and J. J. Royle, Manchester. Eng. Pat. 17,126, October 8, 1891.

THE purpose of the invention is the depositing of metals, such as copper and silver, on certain portions of china and earthenware articles with the double purpose of ornamentation, and of giving additional strength.

The surface of the articles to be treated is first coated with a paste containing the following ingredients:—

	Parts by Weight.
Nitrate of silver	120
Ammonia chloride of mercury	20
Bromide of sodium	30
Oxide of bismuth	10

and then fired. The article is afterwards placed in an electro-plating depositing bath, when the prepared surface is found to take a strongly adhering metallic coating. A very thick deposit (e.g., of copper) greatly strengthens handles, spouts, &c.—V. C.

New or Improved Process of Plating Clay with Glass, and in Articles made in accordance therewith. W. P. Thompson, Liverpool. From The Clay Glass Tile Co., Corning, U.S. Eng. Pat. 13,227, July 19, 1892.

HITHERTO various methods have been employed in applying transparent siliceous coatings to clay. Some such coatings come properly under the description of enamels, others are slags exuded from the body of the impure clay, and some, such as that formed on tiles by adding common salt, are glazes formed on the surface but in part out of the substance of the clay itself. It has long been known that molten glass will adhere with tenacity to burnt clay, e.g., at the sides of clay retorts. The structure of the surface in this case is, however, useless for ornamental purposes, unless the method be followed which is described in this invention. The purpose of the invention is to coat clay tiles or bricks with glass of any desired thickness, colour, and design. The method employed is as follows:—First, a clay is selected having about the same rate of shrinkage as the glass. The clay tile is heated to a high temperature and the molten glass is poured upon the surface. The clay is contained in a mould furnished with a plunger, by lowering which the glass is compressed against the sides of the mould. By employing a plunger with a figured face any required design may be impressed on the surface of the glass.—V. C.

Improvements in Leers or Annealing Furnaces for Sheet or Plate Glass. J. W. Bonta, Mayne, Delaware, U.S. Eng. Pat. 13,569, July 26, 1892.

THE object of this invention is to construct a leer or annealing furnace so that the furnace bottom or table shall not "heave" or "sag," that is to say, shall not expand irregularly. The table is simply a layer of soft bricks, which is supported by ventilated bricks constructed in any form (for instance, with ribs at the end) which will properly ventilate the table. During the operation of the furnace air is blown in from below, which keeps the table from being unduly heated. By these arrangements the table is properly ventilated without being unduly cooled. The object sought for and attained in this invention is to keep the plate of glass from being deformed, and thus save the waste of time and material involved in reproducing a true plane surface in the subsequent operation of grinding.—V. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Preparation of Concrete Blocks for Paving and Building Purposes. Trobach and Huppertsburg. D. Töpfer und Ziegler. Zeits. 23, 344.

MAGNESIUM chloride solution (30° B.) is mixed with powdered asphalt or other similar bituminous substances to a pasty consistence, and then magnesite equal in weight to the chloride used gradually stirred in. According to the quantities employed the mass sets, in from 5 to 30 hours, to a hard product insoluble in water, non-absorbent, and not

softened by the heat of the sun. The quantities found most suitable are 75 parts magnesia, 75 parts chloride of magnesium, and 50 parts asphalt by weight. The blocks are dried at first in the moulds and then alone at a temperature corresponding to the melting point of the original asphalt. For paving they are laid upon a cement basis, and cemented together.—F. W. P.

PATENTS.

Improvements in the Manufacture of Artificial Stone. O. Imray, London. From W. Schleuning, Heidelberg, Germany. Eng. Pat. 8567, May 19, 1891.

LEBLANC-SODA residues, after being exposed to the air and lixiviated to remove a great portion of their sulphur, or the residue from Chance's sulphur recovery process, are mixed with water and gypsum or any other hydraulic mortar or cement, and moulded into any desired shape by pressure and allowed to harden in the air. Or the residues from Chance's process may be mixed with powdered clay and slaked lime and the damp mixture moulded as desired. If it is not certain that the soda residues have been sufficiently decomposed or oxidised by the air, from one-twentieth to one-fifteenth of the entire mass may be added of finely-ground burnt pyrites.—H. S. P.

Improvements in the Utilisation of Slag for the Manufacture of Blocks, Slabs, Drain Pipes, or other Moulded Articles. T. Arnold, West Hartlepool. Eng. Pat. 18,559, October 28, 1891.

BLAST-FURNACE slag is crushed and ground and mixed with Portland cement, which may be added in the ordinary powdered state or in the form of clinker, in which case it is ground together with the slag. With slags which contain a high percentage of lime, such as Cleveland slags, a low percentage of cement, e.g., 10 per cent. for a slag with 45 per cent. of lime may be used, while slags from hematites and Spanish ores with 20 per cent. of lime, require as much as 30 per cent. of cement. The mixture is moulded dry into articles such as are mentioned in the title, and consolidated by pressure or the administration of a series of blows or shocks until its bulk is decreased by about 25 per cent. It can then either be exposed to the air to absorb moisture or immersed in water or "a silicate bath." An extra hard surface, which may be roughened for paving and the like if desired, may be given by covering the mixture with a layer of neat cement about $\frac{1}{4}$ in. in thickness before the pressure or shaking is applied.—B. B.

Means for Seaming Asphalt Mastic as a Coating or Stopping upon all Description of Buildings and Building Materials. L. Haarman, Eschershausen, Germany. Eng. Pat. 20,269, November 21, 1891.

ASPHALT mastic is caused to adhere firmly to sandstone, bricks, wood, concrete, and the like by painting the surface to be coated with a solution of a suitable bitumen dissolved in a volatile solvent such as "sulphide of carbon" or "benzine." The system of applying mastic can be utilised for protecting structures exposed to damp, including such as are exposed to weather, e.g., the wooden bearers of balconies.—B. B.

Improvements in the Manufacture of Artificial Stone and Hard Compositions applicable to Building and Paving Purposes, to Moulds for Cement Castings, to Safes, and to other Articles and Purposes. O. Terp, London. Eng. Pat. 12,174, June 30, 1892.

FIFTY per cent. of calcium chloride crystals are dissolved in 50 per cent. of water, and 66 per cent. of magnesium chloride crystals in 34 per cent. of water, and 77 per cent. of the resulting latter solution mixed with 23 per cent. of the former. "To this are added 2 per cent. of pure hydrochloric acid of full strength, and 1 per cent. of chlorated water being a pure saturated solution of chlorine while constantly

stirred." The resulting solution is mixed with "the bitter earth of commerce" (magnesia) and various compositions in imitation of sandstone and marble made therewith. The patented material may be also used for mosaic work, for moulds, and when mixed with peat, paper pulp, sawdust, &c., for panels and boards. A composition of 60 per cent. of emery, 20 per cent. of the chloride solution, and 20 per cent. of "bitter earth" may be cast in the walls of safes, and is said to be fireproof and to resist drilling.—B. B.

Improvements in Enamelled Bricks and in the Manufacture thereof. H. H. Leigh, London. From I. K. Rue, New Jersey, U.S.A. Eng. Pat. 13,220, July 19, 1892.

ENAMELLED bricks, made either by direct application of the enamel to the clay, or by the use of an intermediate layer of clay, sand, powdered flint, &c. made into a slip into which the brick is dipped previous to the application of the enamel, have the disadvantage that the enamel and the intermediate layer are apt to part from the body of the brick. This the patentee claims to obviate by forming the lining or intermediate layer of the usual materials in the form of a paste, so that it forms a coating of tangible thickness. The brick is then fired and enamelled in the usual way. In order that chipping of the enamel may be but little conspicuous, the lining may be coloured like the enamel.—B. B.

X.—METALLURGY.

The Manufacture of Iron in its Relations to Agriculture. Sir Lowthian Bell, Bart., F.R.S. Iron and Steel Institute Autumn Meeting, 1892.

THE author deals with the above subject from the chemical point of view. It is well known that any attempt to produce a crop from a purely mineral soil would fail, and the presence of organic matter appears to be necessary in order to enable the plant to assimilate the mineral matter, the soil contributing little or nothing else towards the substance of the plant. The ash of the plant is usually not more than $2\frac{1}{2}$ per cent. by weight, of which amount possibly only $\frac{1}{100}$ th is iron oxide. McKendrick's Physiology states the actual quantity of iron in an adult human body to be about $46\frac{1}{2}$ grains, and upon the proper changes in oxidation of this iron is animal life entirely dependent. The two ingredients entering into the composition of all animals and of the vegetables upon which they feed, and which are especially treated of in this paper, are nitrogen and phosphorus, the former being believed to be entirely derived from the ammonia and its compounds contained in the air which are present in so slight a proportion that if all this ammonia were collected in a layer at the sea level, under the ordinary pressure, it would form a stratum less than a quarter of an inch in depth.

Although fresh ammonia is continually generated by decaying animal and vegetable matter, in our country, under present conditions of population and sanitation, the waste of nitrogen is enormous, and has to be compensated for from other sources, a small quantity being found in nature, but much larger quantities being produced in gas manufacture. Coal burnt in the open fire yields little or no ammonia, that body being decomposed, but heated in closed vessels the nitrogen takes up hydrogen and is carried over in the form of ammoniacal compounds so much needed. The 7,000,000 tons of coal treated annually in our gas-works should yield about 60,000 tons of the sulphate, worth about 600,000*l*.

It is estimated that more than 15,000,000 tons of coal are annually coked for the use of our ironworks, and the attempts to obtain the ammonia from this coal have been abandoned, as the coke produced was less suitable for

blast-furnace work. The annual loss of ammonia from the coal thus incurred is estimated as considerably above a million sterling.

About a million tons of pig iron are annually produced in Great Britain by use of raw coal, and the extraction of ammonia in gasworks led the Scotch ironmasters to try the effect of applying condensers to the waste gases from the blast furnaces. In gasworks, from a ton of coal 9,000 to 10,000 cubic feet of gas are obtained, and about 5 lb. of ammonia converted into sulphate. In the blast furnace, however, not only have 10,000 cubic feet of gas to be produced, but all fixed carbon, except the small amount combining with the iron, escapes as oxides of carbon, and in addition there is the carbonic acid of the flux and the nitrogen of the blast, which more than doubles the volume of the gases, so that the ammonia seldom exceeds one volume in 800. It is generally estimated that each ton of coal burnt in the furnace generates about 90,000 cubic feet of gas and yields 4.38 lb. of ammonia-gas. The condensation is obviously much more difficult here than in the case of the gasworks.

The plant used in the Dempster mode of condensation at Carnbroe, with almost the completeness of a laboratory experiment, consists primarily of dust-boxes, condensers, exhausters, scrubbers, and separators, together with the tar and ammonia plants for working up those liquors. From the main gas-tube from close-top furnaces the gases pass through the dust-boxes, where the dust and about 80 per cent. of the tar are deposited, and thence enter the condensers, which, as with a gas plant, are in duplicate and fitted with valves by which any part in need of repairs or clearing can be shut off without interfering with the working. Each set of condensers consists of 144 wrought-iron tubes 20 in. in internal diameter and 55 ft. high, the whole being fitted on cast-iron boxes with partitions for giving the gas the full travel of the condenser. The total length of piping is five miles and the external area 48,000 sq. ft.; the temperature of gas on entering averages 130° F., and on leaving 60° F., the temperature of waste gases from furnaces burning coal being much lower than from those burning coke, as much of the heat is absorbed in vaporising the volatile portions of the coal. The tubes are cooled externally by water sprays. The tar and ammonia liquors overflow into the separators in the usual way.

The gas next passes to the exhausters, of reciprocating type, so arranged that the gas cylinders and all gas connections are outside the house to avoid risk from leakages. Each exhauster has two steam and four gas cylinders, passing 350 cubic feet of gas per revolution. The pistons work at one-quarter centre and draw off the gas very steadily. The engines are regulated by gas-governors, working by the pressure of the main gas tube. The gas is then forced into the washers, consisting of four cast-iron boxes sealed with the ammonia liquor from the scrubbers. The gas enters at the centre, passes through perforated plates, thus breaking up the stream of water into spray and washing itself, and reaches the outlets to the scrubbers. The overflow liquor or seal is regulated by patent slide valves, and passes to the separators directly opposite to those for dividing the tar and liquor from the condenser boxes, the tar being lighter than the liquor. The gas then passes into the three scrubbers, each 120 ft. high and 18 ft. in diameter. These towers are filled with thin boards, about 7 in. wide set on edge, each tier of boards being set at right angles to the next. The gas enters at the bottom and meets the liquor pumped from the tank to the distributor revolving inside the scrubber, thus equally wetting the whole area and presenting an enormous surface to the gas, which passes from the top to No. 2 scrubber, and thence to No. 3, in which the boards are still more closely packed, and fresh and clean water used. Water valves are attached to the scrubbers so that any one may be shut off while the others continue working. They have also relief valves, and man-holes for cleaning.

The washed gas then passes to the hot-air stoves and boilers of the works, and is used in the ordinary way. The yield of raw products has averaged 120 gallons of ammoniacal liquor of 2 (Tw.) and 25 gallons of tar

per ton of coal used in the furnaces. The ammoniacal liquor is worked up into sulphate by use of lime and steam in continuous ammonia stills, which may also be heated by the blast-furnace gas after it has passed the condenser. The tar is treated in eight vertical tar stills, each capable of holding 7,000 gallons. The oil is taken from the receivers into the store boilers and blown by compressed air to store tanks. The pitch is run into the coolers from the still. From the much lower temperature in the blast furnace the tar oil has a different composition from that of the gasworks and is unsuitable for the preparation of aniline and tar colours, but if passed over red-hot coke, benzene and anthracene, may be obtained, and future researches may give a higher value to this substance.

Figures are given showing the yield, prices, and profit obtained at one works in three weeks from three furnaces by the employment of this system. The coal used was 5,841 tons and the profit a little over 7187.

The author then turned to the element phosphorus, of which 3 to 4 lb. are needed for the building up and maintenance of the life of an adult human being. He believes that the absence of readily available phosphorus in the oldest geological formations may have had an influence in delaying the appearance of life upon the earth. By degrees these formations became disintegrated, the phosphates becoming more soluble, and as the amount of more soluble phosphates increased so vegetable life of a low type established itself and then higher types and richer vegetation flourished. When this process had arrived at a suitable stage, low types of animal life were brought into existence, followed by higher types until it has arrived at the present existing state.

The iron first dissolved from the soil by aid of carbonic or other acids is believed to have been deposited, as at the present day, under atmospheric influences as the peroxide, and as the concentration of phosphorus in vegetation progressed, the deposition of the organic matter must have caused an increase in the amount of phosphorus in the beds of iron ore then forming. It should also be remembered that the agents—carbonic and vegetable acids—which cause the solution of the iron are the same which effect the separation of the phosphates. In support of this view the author quoted a list of analyses from Percy's work on Iron and Steel, and from a report of the Labour Commissioner of the United States, which appear to establish that the iron ores from the older formations are very deficient in phosphorus as compared with those of later origin. That there are exceptions to this rule cannot be denied, but it would be remarkable if it were not so.

At the period of formation of the coal-bearing strata a great increase in the quantity of vegetable and animal remains occurred, and we find a corresponding increase in the proportion of phosphorus, but it is only in the more recent lias formations that we meet with the full measure of inconvenience caused by phosphorus, and in this manner the Cleveland ironstone from the deposition of the remains of marine organised beings has become so contaminated that the pig iron from it is totally unfit for the ordinary Bessemer process. With about 0.5 per cent. of phosphorus in it, however, the Cleveland ironstone would be impracticable for use in fertilising our land, but with this ore, when submitted to the action of the blast furnace the phosphorus becomes so concentrated in the metal that the amount which existed in 3½ tons of ore passes into one ton of pig iron. More than 20 years ago the author pointed out the loss to the country incurred by allowing the phosphorus of 20,000 tons of phosphoric acid to poison 2,000,000 tons of pig iron annually, while our ships were scouring the seas to obtain that substance from the remotest parts of the earth. This scandal is being removed gradually by the use of the basic process, and the slag formed is decomposed by natural processes when used as manure. The attempt to perform such a decomposition in the laboratory, although quicker, is much more costly.—A. W.

The Gold-bearing Veins of Pyrites on Monte Rosa.
Konrad Walter. Chem. Zeit. 16, 1892, 920—922.

THE veins are almost universally quartz, with pyrites, arsenical pyrites, with here and there potters' clay, and copper pyrites scattered through in varying quantities. The amount of gold and silver is very variable, as a rule gold is only found in the presence of much arsenic. The distribution of the gold is very irregular, and proper samples can be only obtained by examining at least 10 tons. The mineral, even in the same vein, differs greatly in its yield by the amalgamation process at spots only a few yards apart, and this has led to the failure of many small private undertakings worked by this method. As a rule it may be said that gold (and silver where it is present) is only found in the pyrites and not in the quartz. The ore can therefore easily be prepared, according to the amount of gold in the pyrites (from 45 to 90 grms. of gold per ton), so that it is worth carriage to a place suitable for the extraction of gold; and this all the more readily in that water-power is always available in the immediate proximity of the mines. As the result of experiments made on 2 kilos. of material, the veins above Alagna average 30 grms. of gold per ton of material; the deep mine in Pestarena yields ore containing 30 grms. per ton and an equal quantity of silver. Ore is found here and there, especially at the surface, which can be worked by the amalgamation process of extraction, but the method will not yield a profit on a large industrial scale. The future of the Monte Rosa Ore Works lies in the chemical gold extraction processes, but here also the method must be selected according to the ore to be treated. Extensive trials are now in progress for treating the raw ore, or even the residue, by an improved cyanide process. The roasting is omitted and is replaced by a very careful grinding. The ore thus prepared is treated with cyanide solution, filtered, and the gold deposited electrolytically, or with zinc. The addition of some other reagent to the cyanide solution is alleged, which is said to increase the efficiency of the cyanide.—G. H. R.

The Treatment of Argentiferous Zinc-Lead Sulphides.
C. Schnabel. Eng. and Mining J. 1892, 269 and 295.

THE ore under consideration is found in the district of Broken Hill and the Barrier Range, it consists mainly of a very intimate silver-bearing mixture of galena and zinc blende. The silver varies from 8 to 32 oz. to the ton, the lead from 15 to 40 per cent., and the zinc 15 to 30 per cent. Treatment by the ordinary metallurgical processes is unsuitable, as the separation of the silver and lead is impossible without material losses of these metals. It has been found impossible to make a complete separation of the zinc from the lead, and especially from the silver, by concentration, the zinc blende obtained not only being found to carry a high percentage of silver, but also a certain percentage of lead and garnets.

The Production of Metallic Zinc.

1. On account of the low percentage of zinc contained in the sulphides, and the proportionately high percentage of lead, the ores are unsuitable for distillation.

2. The direct decomposition of zinc blende by metallic iron or lime has never been carried out on a commercial scale.

3. The decomposition of the molten sulphides by electrolysis has never been attempted on a large scale. The electrolytic production of zinc from zinc sulphate can only be carried out economically when the power necessary can be produced at a very low cost, and when the sulphate of zinc is produced as a valueless by-product from other processes.

The Production of Oxide of Zinc.

1. Volatilisation. The treatment of the ore in the blast furnace is only possible after a preliminary roasting; further, the fumes resulting contain too much lead to be valuable as a zinc ore, or too much zinc to be valuable as a lead ore, and would be too impure to be used as a paint.

2. Reverberatory Furnace. The roasted ores mixed with coal were heated in a reverberatory furnace to the temperature necessary to reduce the zinc oxide. The volatilised zinc was re-oxidised and collected in chambers. Although the collected fumes were suitable for paint, the process was not a success on account of the losses of lead and silver, and the fume collected was not sufficient to pay for the cost of treatment.

3. Bartlett Process. The author considers that this process cannot be carried out with advantage under the existing circumstances, as the paint produced would hardly find a lucrative market in case much of the ore were treated by this process.

Wet Methods. The solution by means of carbonate of ammonia is not applicable for the roasted sulphides on account of the sulphate of lead and basic sulphate of zinc always present in the roasted ores, as the ammonia would be converted into sulphate, and thus cause loss of ammonia.

The zinc in the sulphides can be converted into chloride by roasting with common salt, and treated in solution with milk of lime, but the recovery of silver in this case would be a matter of considerable difficulty, there would also be a considerable loss of chloride of zinc by volatilisation.

During the process of roasting the ores at a low temperature, it is possible to convert as much as 50 per cent. of the zinc into sulphate. The balance may be converted into sulphate by treatment with sulphuric acid and the whole dissolved out. Zinc oxide may be obtained from the sulphate by precipitation with magnesia, or by heating the crystals directly. Both methods are practicable and leave a profit if the sulphate of zinc is considered as a valueless by-product. The author reviews the treatment of the ores by concentration, and comes to the conclusion that those methods having for their object the removal of the zinc previous to smelting, are those most suitable to be adopted in the treatment of these sulphides.—J. C. C.

The Problems of Commercial Electrolysis. J. Swinburne.
Inst. Elect. Eng. July 1892.

See under XI., page 823.

The Determination of Zinc in Ores. Eng. and Mining J.
August 20, 1892, 178.

See under XXIII., page 846.

The Action of Beer on Aluminium. R. Kobert. Chem.
Zeit. 16, 1892, 821.

See under XVII., page 830.

A Practical Slide-Rule for use in the Calculation of Furnace Charges. A. Wingham. Iron and Steel Institute Spring Meeting, 1892.

THE author describes a slide-rule of special construction for use in iron-smelting and other chemical operations. The principle is that of having a scale for each substance under consideration so arranged and divided that by measuring any given length on each the equivalent quantities of the various substances which chemically or metallurgically have the same power of displacement or combination are given.

In the present instance scales have been arranged for lime, limestone, magnesia, alumina, soda, potash, manganous or ferrous and ferric oxides, and lead, zinc, and cuprous oxides as bases, in accordance with their combining proportions with silica to produce silicates, and with sulphur to produce sulphides. The acids are restricted to silica, for which three scales are given, one each to represent the quantities of silica necessary to produce with each base a mono-, sesqui-, or bi-silicate.

By the special construction of the rule, and given an analysis, the amount of silica required by four or five bases conjointly in the same material to produce either of the three silicates can be read off without any calculation. The excess of acid or base in complicated slags can similarly be rapidly ascertained, and the amount, if necessary, of the material to be added to produce the correct proportions obtained. The main principle of the rule is recommended for adoption in many chemical operations requiring calculations, by the construction of special scales; and likewise in the laboratory for the conversion of figures obtained by analysis into end results.—A. W.

PATENTS.

An Improved Method of Condensing Lead and other Metallic Fumes arising from Furnaces. S. Elliott, Newbury, Berkshire. Eng. Pat. 20,944, December 23, 1890.

THIS is an improvement on a previous patent (Eng. Pat. 12,460, August 7, 1889; this Journal, 1890, 273), and consists in the use of a pipe made of fireclay, enamelled iron, or other non-corrosive material, jacketed, if necessary, leading from the furnace to the washing tank, the fumes or gases being made to pass along it by means of a fan or steam jet. The tube communicates with an enamelled perforated tube placed horizontally in the washing tank, the perforated tube being capable of rotation and provided with wings or beaters. Above the rotating tubes are horizontal perforated trays. The rotating beaters and the trays break up the water or chemical solutions contained in the tank into a fine spray, by which the fumes and gases are condensed and dissolved.—H. K. T.

Improvements in Furnaces for Treating Ores. E. B. Parnell, Sutton. Eng. Pat. 15,567, September 14, 1891.

THE furnace is tubular with a cross section not quite circular, and is fixed horizontally with the longer axis in the vertical plane. The tube is encased in an outer tubular shell with an annular space between them. The fire is at one end and by suitable dampers may be directed either into the annular space and so heat the inner tube as a muffle, or into the inner tube if it is to be heated after the reverberatory style. The ore is fed into one end of the inner tube from a hopper by a worm-feed and is carried along by a suitable screw running on a shaft through the length of the tube, to the exit at the other end. It is recommended to use these furnaces in series one above another with worm conveyors connecting them, so that the ore can be passed through more than one furnace and thus ensure perfect calcination. Steam pipes are provided for injecting steam when required. The tubes are made preferably of cast iron protected from the fire where necessary by a coating of suitable material.—A. W.

Improvements in the Treatment of Steel and in Apparatus therefor. C. Walrand and E. Legénis, Paris. Eng. Pat. 16,178, September 23, 1891.

THE steel is treated by additions in the converter with the object of obtaining greater heat and fluidity at the time of pouring. In acid conversion an alloy rich in silicon, in basic conversion an alloy rich in phosphorus, and in particular cases a combustible body other than silicon, or phosphorus, is added to the steel near the end of the blow.—J. H. C.

New or Improved Metallic Alloys. J. H. Pratt, Birmingham. Eng. Pat. 17,315, October 10, 1891.

THE alloys consist of nickel, copper, and zinc, in various proportions as tabulated, the nickel ranging from 4 up to 15 per cent., the copper from 55 down to 45 per cent., and the zinc from 40 to 15 per cent., the copper decreasing as the nickel and zinc increase. Some of the alloys are suitable

for use in place of German silver. In general the copper and nickel are melted together and the zinc is afterwards stirred in, but sometimes the nickel is melted by itself, then the copper and flux are added, and afterwards the zinc. Occasionally, when great ductility is required, small quantities of aluminium and manganese are added, together with a flux consisting of cyanide or ferrocyanide of potassium.

—J. H. C.

Improvements in Apparatus for Concentrating or Separating the Heavier Constituents of Pulverised Ores or the like. D. Ferguson, Barrhead, N.B. From P. Ferguson, Waiorongomai, N.Z. Eng. Pat. 18,211, October 23, 1891.

THIS is a combination and arrangement of parts for concentrating or separating the heavier and lighter constituents of pulverised ores and the like. They embrace a feeding hopper, into which the pulverised materials are charged, from the lower opening of which they are dropped in a regulated stream by means of a fluted roller, when they meet a strong blast of air directed against them in a horizontal or more or less inclined direction. The blast is directed through a number of inclined fixed blades which assist the separating action, whilst the space below the current forms a receptacle divided by partitions, into which the separated particles fall, arranged according to their sizes and weights.—B.

Improvements in the Manufacture of Alloys of Nickel and Copper, and of Alloys of Nickel and Iron, and of Alloys of Nickel, Copper, and Iron. F. W. Martins, Sheffield. Eng. Pat. 19,191, November 6, 1891.

THE alloys are made direct from the ores, or from crude mattes. Thus, to make an alloy of copper and nickel from Lake Superior matte, which contains copper, nickel, and iron in the state of sulphides, it is finely powdered and 100 parts are mixed with 60 parts of quartz sand and 134 parts of sulphate of baryta or sulphate of soda. The mixture is melted in a reverberatory furnace so as to remove the iron as slag and leave only the sulphides of nickel and copper. This double sulphide is again finely powdered and completely oxidised by careful roasting in a suitable furnace. The oxides so produced are then mixed with charcoal and moistened with coal tar and water, with which a little burnt lime and clay have been mixed so as to form a paste; this is made into briquettes, dried and strongly heated. The briquettes are melted in a "Siemens-Martin converter or in a reverberatory furnace," metallic copper being added if necessary to make up an alloy of definite composition. A similar alloy may be made, using New Caledonia ores in part, if they are first sulphuretted by fusion with such materials as soda-waste or gas-lime. In making an alloy of nickel with iron (known as ferro-nickel), New Caledonia ores are preferred. They are powdered, made up into briquettes and then smelted as above described, pig iron being added if necessary to make up an alloy of definite proportions. Alloys of the three metals may be prepared by similar methods. In some cases the dried briquettes are utilised as carbides without smelting. The gist of the claim is for manufacturing the alloys specified, directly from ores containing the metals of the said alloys, or some of the metals, &c., and afterwards melting them together, or alloying them, &c., &c.—J. H. C.

Improvements in Metallic Alloys. W. P. Thompson, Liverpool. From W. J. Miles, jun., H. S. Deming and A. Herz, Terre Haute, Indiana, U.S.A. Eng. Pat. 4460, March 7, 1892.

THE alloys consist of aluminium, iron (or steel), nickel, tungsten, and manganese combined in suitable proportions, with the addition of about one grain of osmium for each

24 oz. of alloy. For spoons and jewellery the following proportions are prepared:—

	Oz.
Aluminium.....	4
Nickel.....	8
Iron.....	8
Tungsten.....	1
Manganese.....	2 399 grains.
Osmium.....	1 grain.
Total.....	23 400 grains.

For table cutlery they recommend:—

	Oz.
Iron.....	3
Aluminium.....	6
Nickel.....	6
Tungsten.....	3
Manganese.....	5 399 grains.
Osmium.....	1 grain.
Total.....	23 400 grains.

In preparing the alloy all the metals except the aluminium are fused together; the aluminium is then added and the alloy is cast into ingots.—J. H. C.

An Improved Metallic Block to be used in the Production of Hydrogen. W. Hawkins, T. Hawkins, H. Fuller, and W. H. Fuller, Portsmouth. Eng. Pat. 8207, April 30, 1892.

The block consists of iron or steel scrap, preferably borings, shavings, or turnings, which are first cleaned and then galvanised with zinc. The scrap is then placed in a mould, heated to a suitable temperature, and molten zinc is poured over it. The scrap is sometimes consolidated by pressure before the molten zinc is applied, and a rust preventive coating is used in some instances.—J. H. C.

Improvements in Hardening Articles of Steel or other Metal, and in Apparatus therefor. G. G. M. Hardingham. From H. Wilsch, Homburg, Bavaria. Eng. Pat. 13,148, July 18, 1892.

A BATH of melted alloy is used for tempering, its composition varying with the temperature required. Thus, a bath composed of 10 parts of tin and 6 parts of lead solidifies at 358° F., and one composed of 2 parts of bismuth, 1 part of tin and 1 part of lead solidifies between 203° F. and 209° F.

The tank containing the alloy is provided with heating and cooling tubes for the purpose of controlling the temperature and keeping it uniform, and these may be brought into operation automatically by suitable means which are indicated.—J. H. C.

Improved Apparatus for Effecting the Casting of Metals in Vacuo. W. S. Simpson, London. Eng. Pat. 13,298, July 20, 1892.

THE apparatus consists of an upper vessel or chamber containing the ladle of molten metal, and a lower chamber in which the mould is placed, the two being connected by a channel which is closed by a fusible plate or diaphragm. Spy holes closed with glass are provided for both chambers. The mould is placed in position in the lower chamber, which is then securely closed. The molten metal is then run into the ladle through an aperture in the wall of the upper chamber, and this also is closed. The molten metal can be stirred by means of a rod passing through a stuffing-box. When all is ready the air is withdrawn from both chambers by a pump or other convenient means; the ladle in the chamber is then tilted so that the metal falls upon the fusible plate and melts it, and then flows into the mould where it sets in vacuo.—J. H. C.

Improvements in Centrifugal Ore Separators. O. B. Peck, Chicago, U.S.A. Eng. Pat. 13,990, August 2, 1892.

An Improved Process of Separating Powdered or Finely-Divided Particles containing Mineral-Bearing Substances of Different Degrees of Specific Gravity. O. B. Peck, Chicago, U.S.A. Eng. Pat. 13,991, August 2 1892.

THE method embraced in these two patents causes separation of particles to be effected through the action of centrifugal force exerted on the circumference of a belt whose direction is changed by guide pulleys.—B.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

The Problems of Commercial Electrolysis. J. Swinburne. Inst. of Elect. Eng. July, 1892.

THE object of the author is to take a bird's-eye view of the subject, and if possible to predict the directions in which others must seek for future developments. A very large number of the processes employed in chemical industry consist merely in oxidising and reducing, special conditions being arranged to suit the particular substance being operated upon. Once we take this broad view, all we have to consider is "Which of the oxidising and reducing processes in use in chemical works can we advantageously replace by electrical methods?"

Oxidation and Reduction.—Oxygen.—For the decomposition of water it would be best to use an alkaline solution with iron electrodes. Allowing 2 volts as the pressure required, the cost comes out at 5s. 7d. per 1,000 feet for the oxygen, taking the price of a kilowatt-hour as 0·25d. Taking 15s. per 1,000 cubic feet as the selling price, there is a large margin between this and the 2d. per cubic foot retail price of Brin's oxygen.

Alkali.—The Leblanc and Weldon process is exceedingly complicated and very costly; and as by simply electrolysing salt costing about 15s. per ton, chlorine and caustic soda can be produced, it seems at first sight at least, most strange that electrolytic processes have not replaced all others within the last few years. With suitable vats and a reasonable current density, we may take it that 3 volts is a liberal allowance. For the ton of 70 per cent. caustic soda we have—

	£.	s.	d.
Electrical energy.....	2	15	0
Salt.....	1	2	6
Lime.....	1	3	0

For 5*l.* we have thus obtained a ton of caustic and 1½ tons of bleaching powder. We have allowed nothing for the cost of vats, for labour at the vats and in handling, or for evaporation of causticised liquor. The ordinary caustic liquor, after causticising, is quite weak, but electrolytic caustic can be made into strong lye. Evaporation with a Varyan should not come to more than a shilling or two a ton extra, from which it appears that a ton of caustic and a ton and a half of bleach should be made for 6*l.* This allows an enormous margin for expenses and for profits, and therefore the author believes that the apparent non-success of electrolytic soda processes is due to the want of a really durable anode. Platinum is generally supposed not to be attacked by chlorine, and it is used extensively in the electrolysis of chlorides, but the author has found experimental anodes eaten away. In 1882 Bartoli and Papisogli pointed out that carbon was attacked when used in any solution which evolves oxygen. The author confirmed this in a series of independent experiments carried out in 1883, and suggests that corrosion is the cause of the failure of carbon anodes. The difficulty of making good contact and the expense of large carbon plates has been overcome by Greenwood

(Eng. Pat. 18,990, 1890; this Journal, 1891, 642) by electroplating one side of a number of comparatively small plates, and then soldering them to a plate of type metal. The electrolysis of sodium sulphate does not allow the same margin for profit as that of the chloride, and lead anodes are attacked. Magnesium chloride is generally employed in the Hermite process (Eng. Pat. 8177, 1889; this Journal, 1890, 733) but salt is now used. Messrs. Cross and Bevan (this Journal, 1890, 450—453, and 1890, 585) hold that the bleaching power of these products is not as determined by arsenious acid.

Potassium Chlorate.—A hot solution of the chloride is electrolysed. This process (Eng. Pat. 4686, 1887; this Journal, 1888, 327) is carried out on a large scale at Vallorbes in France, and it is stated that 24 h.p. hours yield 2·2 lb.

Aluminium.—It seems impossible to deposit aluminium from any of its solutions, so fused salts have to be employed. The electrolyte is cryolite, or a solution of alumina in cryolite. In the Minet process (A Minet, Compt. rend. 110, 342—343; this Journal, 1890, 753) a solution of the oxide is employed, aluminium is deposited, and the anodes are burned away by the oxygen. In the Hall process (Eng. Pats. 5669 and 5670, 1889; this Journal, 1889, 549) carried on at Pittsburgh, the electrolyte is practically the same.

Zinc.—Proposals have been made to deal with zinc ores electrolytically. Kiliani (this Journal, 1884, 260) proposed to use high current densities; Watt (this Journal, 1889, 287) prefers to use acetate of zinc as the electrolyte.

Lead.—Though the Keith process for desilvering lead electrolytically was brought out in America some ten years ago; it does not seem to have come into general use.

Gold and Silver.—Crookes (Eng. Pat. 3532, 1890; this Journal, 1891, 353) finds that the particles of gold become amalgamated, and get caught in the mercury, if the stamped quartz is worked in a weak solution of a mercury salt under the influence of an alternating current of small frequency.

Electro-Metallurgy of Copper.—Electrolysis may be employed either in connection with the extraction of copper from its ores, or in refining copper. The ore may be converted into matte, and subsequently cast into anodes which are treated in baths of copper sulphate, using copper cathodes. The circulation of the iron salts must be avoided, therefore some sort of diaphragm is necessary. The Marchese (this Journal, 1884, 260) and Siemens and Halske (Eng. Pat. 3533, 1889; this Journal, 1890, 396) are in commercial operation, and the electric extraction of copper is already a growing industry. The electro-motive force for this process is less than a volt; so that assuming coal to be used as in the estimate at the beginning of this paper, the electrical cost is 14s. 5d. per ton for the extraction of copper.

In the refining of copper the anodes are formed of crude copper, thin plates of fine copper are used as cathodes, and the electrolyte is sulphate of copper. At the Bridgeport Copper Works, where the arrangements are in accordance with the patents of E. S. Hayden (Eng. Pat. 2071, 1888; this Journal, 1888, 390), the anodes, instead of being thick cast copper, are sheets of thin rolled metal. Each vat contains a number of plates arranged vertically and across the vat, and at one end a thin plate is supplied as a cathode. The first plate is made the anode, and copper is eaten off one side of each plate, and deposited on the plate next to it. The process is carried on until the whole of the anodes are eaten, and their place is taken by pure deposited copper. The plates are syringed and removed, and the slime is treated to recover the silver and gold. The product is the highest grade of copper in the market, and fetches 6l. 10s. a ton above "tough cake," or 4l. 10s. above "best selected." Silver and gold are completely separated without loss, and as 35 oz. of silver and $\frac{1}{2}$ oz. of gold per ton are allowed as tare, any copper containing more than that yields 8l. per ton in bullion. Argentiferous copper thus yields at least 14l. 10s., leaving a gross profit of 12l. 10s. at present rates.

The author also deals briefly with electrolytic processes for producing magnesium; for the electrolysis of fused soda (Castner, Eng. Pat. 13,356, 1890; this Journal, 1891, 777); for treating antimony ores (Borchers, Chem. Zeit. 11., 1020—1022; this Journal, 1890, 673); for the recovery of tin from scrap tin; for the production of ozone (Siemens and Halske, Eng. Pat. 8929, 1891; this Journal, 1892, 585; and Fahrig, this Journal, 1890, 131). He describes the Cowles electric furnace (this Journal, 1889, 677—684); miscellaneous processes such as the Webster sewage process (Eng. Pat. 15,760 and 15,939, 1887; this Journal, 1888, 764); the Turrell and the Méritens (Eng. Pat. 14,162, 1889; this Journal, 1890, 758), processes for ageing wine and spirits, and the electrical tanning processes. Messrs. Rideal and Trotter (this Journal, 1891, 425—432) have shown that electricity has a beneficial effect; and Groth's process (Eng. Pat. 18,385, 1890; this Journal, 1891, 938) shown at the Crystal Palace Electrical Exhibition this year, also gives good results.—G. H. R.

Recent Developments in Electric Arc Welding.

P. I. Unwin. *The Electrician*, 29 (741), 335—336.

In the arc process of electric welding under the Benardos patents three separate and distinct methods are in daily use. Between these three there is a vital difference, and much difficulty and confusion have arisen from the want of distinction between them. The first method is welding proper, in which the wrought iron or steel to be united is raised only to the welding temperature, whereby a perfectly strong fibrous weld is obtained. No reinforcement of the weld is used in this case. In the second method, called a "built weld," small pieces of metal are melted into the joints and hammered in. The melting of course destroys the fibre of the metal, but this is partially restored by the work put upon it. A special grade of very mild low carbon steel has proved most suitable for reinforcing purposes. The third method, which is unsuitable for the welding of wrought iron and steel, is used chiefly in repairing castings. It consists in fusing pieces of metal into the weld, or defective place in the casting, until the metal is a molten mass locally. In the case of cast steel the hammer may be applied to produce a smooth surface, when the metal has partially cooled; but in the case of cast iron the whole casting must be kept black hot during this process of cooling. In welding wrought iron and steel it is of vital importance that the arc should be maintained at least 2 in. long or more, and should be kept continually moving over the surface of the metal to be heated. As an example the method of making a steel flanged "tee" for a marine steam-pipe line, 8 in. in diameter and having a 6 in. flanged outlet is given.—G. H. R.

Practical Notes on the Electrolytic Refining of Copper.

American Inst. Elect. Engineers. Eng. and Mining J. August 6, 1892, 126.

In this paper the author gives a partially complete list of the refineries in the United States where copper is treated electrolytically, and he also gives information as to the cost and the various processes and methods adopted at these refineries. The accompanying table is not complete, but it serves to show the extent to which this method of refining has been adopted.

From the table given, however, it appears that about 25,000 tons will be near the mark. As will be seen in the fourth column of the table, there are four different processes in vogue, viz.: the Multiple, Smith's, Hayden's, and Stalmann's. In all these processes the black copper is used as the anode and the electrolyte is a solution of sulphate of copper.

In the "multiple" process the anodes of black copper and cathodes of pure copper of each cell are arranged in a row alternately, but connected in multiple, and there is generally one more cathode than anode. The electrodes are suspended in a vertical position in wooden vats lined

with lead, and the vats are either in series, multiple, or multiple series, the best arrangement, however, being single series.

In Smith's process there are no cathodes at all. The anodes of black copper are arranged horizontally, and the current causes the solution of copper from the under sides of each plate and a deposition of it on the upper side of the plate next below. A cotton cloth screen is placed between each plate to intercept impurities or foreign matter, such as gold and silver. The anodes and the vats are all in series.

Hayden's process differs from Smith's only in the fact that his plates of black copper are arranged vertically

instead of horizontally and that there are no screens between.

In Stalman's process the anodes of black copper and cathodes of refined copper are arranged in ordinary series, but each pair of anodes and cathodes, except the initial and terminal ones, is riveted together to form a solid block without any electrolyte between.

Theoretically it is possible to refine any quantity of copper per horse power by increasing the size and number of the vats and the amount of copper under treatment indefinitely. Such an arrangement would of course be uneconomical, and a medium has to be found where both the vats and the power are the smallest consistently with

PARTIAL LIST OF ELECTROLYTIC COPPER REFINERIES IN THE UNITED STATES.

Name of Company.	Generators.	Number of Vats.	Process (Arrangement of Vats).	Estimated Capacity in Electrolytic Copper per Month.	Remarks.
1. Anaconda Mining Company, Anaconda, Mont.	5 Edison—40 volts, 1,100 amperes.	320	Partly multiple, partly Stalman.	Tons. 350	Plant being extended for ultimate capacity of 900 tons per month.
2. American Nickel Works (Jos. Wearlen), Camden, N.J.	1 Excelsior—6 volts, 1,000 amperes.	48 in series.	Multiple	30	By-product.
3. Balbach Smelting and Refining Company, Newark, N.J.	7 Excelsior—15 volts, 2,000 amperes. 1 Excelsior—30 volts, 3,000 amperes.	7 series of 48. 1 series of 96.	Multiple (18 anodes, 81 cathodes).	650	They refine the product of the Oxford Copper Co., whose smelters are in New Jersey, and who are general purchasers of copper ores, matte, and bullion.
4. Baltimore Copper Smelting and Rolling Company, Baltimore, Md.	6 Edison—150 volts, 400 amperes.	...	Hayden	800	Generators are sectional fields which can be plugged for different voltages.
5. Baltimore Refining Company, Baltimore, Md.	2 Edison—80 volts, 700 amperes.	...	Hayden	300	.. .. .
6. Boston and Montana Consolidated Copper and Silver Mining Company, Great Falls, Mont.	3 Thomson-Houston, multipolar separately excited, 165 volts, 1,000 amperes.	288	Multiple (19 anodes, 19 cathodes).	550	Plant in construction. Dynamo capacity in excess of present requirements.
7. Bridgeport Copper Company, Bridgeport, Conn.	1 Thomson-Houston, 1 Mather, 1 Edison—150 volts, 400 amperes.	3 series of 10	Hayden (100 electrodes in each vat).	400	They refine the entire product (black copper) of the Parrott Silver and Copper Company, Butte, Mont.
8. Chicago Copper Refining Company, Blue Island, Ill.	2 Edison—80 volts, 800 amperes.	165	Multiple	150	.. .. .
9. Electrolytic Copper Company, Ansonia, Conn.	3 Mather—100 volts, 300 amperes.	75	Smith	100	.. .. .
10. Lewissohn Bros., Pawtucket, R.I.	1 Excelsior—15 volts, 2,200 amperes.	60 in series.	Multiple (19 anodes, 19 cathodes).	110	.. .. .
11. Omaha and Grant Smelting Works, Omaha, Neb.	1 Excelsior—6 volts, 1,000 amperes.	48 in series.	Multiple	30	.. .. .
12. Pennsylvania Salt Manufacturing Company, Philadelphia, Pa.	.. .. .	...	Smith	30	By-product.
13. St. Louis Smelting and Refining Company, Cheltenham, St. Louis, Mo.	1 Excelsior—16 volts, 2,400 amperes.	48 in series.	Multiple	60	This plant is operated in connexion with an electrolytic silver refinery, using the Moebius process.
14. Washburn, Moen, and Co., Worcester, Mass.	.. .. .	...	.. .. .	90	Plant burned, being erected.

each other. The density of the current is also an important point to be considered in producing absolutely pure copper. It is usual in the States to use a current of 10 amperes per square foot of active cathode surface as a maximum. Though in some cases in the series processes the figure is as high as 15 amperes; by this arrangement the output per vat is higher, though the quality of the copper is not so good. Theoretically 1 lb. of copper will be deposited per hour by a current of 386 amperes out of a solution of sulphate of copper.

It is necessary to keep up a constant circulation in the electrolyte in order that its resistance shall be constant. Sometimes this is effected by arranging each vat a little lower than the other and by allowing the liquid to pass down the row in series. Another and better way is to supply all the vats from a common trough and to collect the overflow in a common reservoir and pump it back to the trough by means of lead pumps or injectors. However, the lead pumps are always getting out of order and the injectors add too much moisture to the electrolyte. The writer proposes as an improvement the adoption of two collecting tanks, which can be used alternately; as soon as

the one is full it will be made air-tight and a small air compressor will force the solution up to the tank again. In Smith's process it is claimed that no circulation of the electrolyte is needed.

The majority of these plants are by no means models of electrical engineering. There are many faults and defects in their design which shows that the advances made during the last 10 years in electrical discovery have not been taken advantage of in the plants for electro-deposition. In most of them there is no measuring of the voltage made, and in the exceptional cases it is made in a very clumsy manner. The writer in designing a new plant introduced a great improvement by placing a potential board in the manager's office, which indicated the pressure of any vat immediately by the turning of a switch handle. It is very necessary also to guard against the short-circuiting of anodes and cathodes, which in the multiple system means the short-circuiting of a whole vat. If such an occurrence is not detected immediately the whole contents of the vat are spoiled. Until recently, however, no automatic indicator was used in any of the plants.

Some of the electrolytic refineries in the United States buy copper matte of from 45 to 54 per cent. of copper from the mining companies: they resmelt the copper matte and produce black copper of from 97 to 98 per cent. of copper. This black copper is then cast into anodes and subjected to the electrolytic process. Other refineries buy the black copper from the smelters owned by the mining companies.

Each copper refinery ought to have an installation of its own for the manufacture of the necessary sulphate of copper, which can be effected at a small fraction of what there is to pay for it. The same holds good in relation to the refining of the slime or mud which collects at the bottom of the vats, and contains the precious metals. Each copper refinery should have its own plant for the refining of this mud.

The approximate cost of a refinery with a capacity of 1,000,000 lb. of electrolytic copper per month is as follows:—

	Dols.
Building	30,000
Pavement (asphalt)	2,000
Pipes for steam heating	1,000
Vats	6,000
Lead for lining vats, collecting tanks or troughs ...	28,000
Lead burning	1,500
Copper conductors	11,000
Rails for overhead blocks for handling plates	2,000
Sulphate of copper	3,500
Sulphuric acid	1,000
Steam injectors, or pumps, or air compressors	1,000
Electric generators, switchboard, and instruments	30,000
Shafting and belting	3,000
Total	123,000

To this sum must be added the copper under treatment, which will amount to at least 80,000 dols.; and if a steam plant is required another 20,000 dols. must be added, so that 223,000 dols. is the total cost of the plant. In the items in the table, the cost of labour is included, but not that of freights. As will be seen, a plant for the electrolytic treatment of black copper is a costly affair and the erection of one should not be commenced until the very best metallurgical and electrical advice has been obtained.

A few words may be said on the subject of electric generators. The writer prefers to use separately excited machines, for the reason that they cannot be reversed, and also because it is easier to regulate the current when the load varies. It is fairly easy to regulate a high-class steam engine, but with a turbine it is well-nigh impossible. By running the exciters from a separate source, the strength of the field can be kept uniform through all variations in the working circuit. There are two other processes coming into note, viz., Siemens' and Hoepfner's. Hoepfner uses in his process carried on in Schwarzenberg a cuprous chloride solution, out of which a current of one ampere will deposit 2.35 grms. of copper per hour, an amount nearly double that produced from cupric sulphate.—W. S.

A Modified Method for the Electrolytic Determination of Copper. G. P. Dröschbach. Chem. Zeit. 16, 1892, 818.

See under XXIII., page 845.

The Purification of Sulphuric Acid for Accumulators. The Electrician, 29, 135.

METALLIC impurities in the electrolyte are considered by Dr. Kugel to play a very important part in diminishing the capacity of secondary cells. Now these deleterious metals are completely precipitated in a dilute sulphuric solution by sulphuretted hydrogen, and Dr. Kugel utilises this fact to purify acid intended for accumulators. A current of the gas is passed through the electrolyte, which is then filtered after 24 hours' rest. When this process of purification is

carried out alone, it is preferable to generate the sulphuretted hydrogen within the acid itself, by treating it with barium sulphide. This method has been employed by Herr Lucas at Hagen.—W. S.

PATENTS.

Improvements in Apparatus for Use in Obtaining Copper.

The Rovello Syndicate, Limited, and J. C. Howell, London. Eng. Pat. 8837, May 25, 1891.

This patent describes the mechanical arrangements of the cells used in the copper-obtaining process known as the Rovello process. The chief feature consists in the use of a band of parchmentised paper or other porous material as a diaphragm, the band being passed backwards and forwards round upright posts fixed in the vat, and the joint between the band and the bottom of the vat rendered water-tight by means of a layer of plaster of Paris, or by means of rubber tubing which is fitted into a groove and then inflated. Or V-shaped grooves may be made in the sides of the vat, and pieces of parchment fitted into these grooves and rendered water-tight by means of flexible tubing as above. The apparatus also includes a system of pipes for the circulation of the fluid, which may also be produced by jets of air or by means of a centrifugal pump or a screw similar to a ship's screw rotating in the fluid. Or the liquid in the vat may communicate with an apparatus similar to a feed-water heater, which when heated causes the liquid to circulate. Other means of supporting the diaphragm consist in placing it in grooves into which wedges are driven either with or without flexible material. It may also be fixed in a similar manner to frames which slide in grooves in the sides of the vat, or the diaphragm may be fixed to perforated sheets of metal, ebonite, celluloid, or glass which slide in grooves and are made to fit water-tight as above.—H. K. T.

Improvements in or connected with Electric Batteries.

H. C. Bull, London. Eng. Pat. 11,712, July 9, 1891.

The object of the invention is to produce electricity direct from carbon, either in the form of coke, anthracite, coal, or wood charcoal. The battery is on the lines of Jablockhoff's coke battery (Eng. Pat. 492, 1877), the exciting liquid being nitrate of potash, nitrate of soda, or any other nitrate which may be found to work satisfactorily, maintained in a liquid state by the application of heat. The arrangement preferred is as follows:—Two iron troughs of convenient dimensions with chambers at each end connected by a passage underneath are arranged side by side, and between the passages an ordinary Bunsen or other suitable burner is placed to keep the nitrate liquid. The carbons are placed in the centre chamber, and an outlet is provided for the carbonic acid generated in the working of the battery. The nitrate produced is re-converted into nitrate by means of air, and nitric acid vapour introduced into the passages under the troughs by means of a steam jet. A small accumulator is necessary to start the battery working, and when the main circuit is broken, the battery is employed in re-charging the accumulator to prevent the oxidation of the iron by the nitrate which occurs when the battery is standing idle.

—G. H. R.

Improvements in Elements for Secondary Batteries. The Mining and General Electric Lamp Co., and J. T. Niblett, London. Eng. Pat. 17,758, October 17, 1891.

SUPPORTS have been formed of woven copper wire, which are protected from electrolytic action by a coating of lead or lead alloy, but owing to the dissolving effect of the electrolyte, a difficulty has been experienced in obtaining a perfect coating of the lead which is used for the purpose of protecting the copper from electrolytic action. According to this invention the support consists of a network or woven mesh of lead, or lead and antimony. To give the mesh the requisite strength it is surrounded by a rim of metal or other rigid substance, or the mesh may be mounted on any suitable support. To make better contact, and to prevent the

formation of sulphate or other inert salts between the active material and the network, the latter may be coated by any suitable means with gold, platinum, or other suitable metal which is not easily affected by electrolysis.—G. H. R.

Improvements in Electrical Furnaces for the Manufacture of Phosphorus or other Matters capable of being Volatilised by Heat. T. Parker, Wolverhampton. Eng. Pat. 18,974, November 3, 1891.

THE object of this invention is to overcome the objections arising from the condensation of phosphorus or other volatile matter in the upper part of the charge of the electrical furnace. According to this invention the furnace is provided at its upper part with a portion or addition which constitutes a retort, which is heated to retain the upper portion of the charge at such a temperature as to prevent condensation of the phosphorus or other volatile matter, and by applying heat to the charge at this part, economising electrical heat in the arc of the furnace. When the charge is fed through a hopper or the like by which the furnace is sealed, there may be at the upper part of the furnace a hollow chamber formed by a wall outside the retort-like part leading from the hopper to the furnace, and in this hollow chamber a flame or other means of heating may be used to retain the retort-like part at a necessary temperature.—G. H. R.

Improvements in the Construction of Secondary Batteries for Electrical Storage Purposes. J. B. Lee, London. Eng. Pat. 12,306, July 2, 1892.

THE elements are composite structures built up of cored rods of lead. Each cored rod consists of an outer tubular portion of lead with an axis of enamelled iron or steel, or other suitable material, to give internal support to the leaden tubes which completely encase the cores. The outer leaden portion may be cut or grooved either longitudinally, or spirally, or circularly, and the grooves must not be carried quite through the whole thickness of the lead.

—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Adulteration of Linsed Oil. Industries, 13, 1892, 212.

See under XXIII., page 848.

Testing Olive Oil for Adulterants. L. Paparelli. Chem. Trade J. 11, 207–208.

See under XXIII., page 848.

PATENTS.

Process for the Production of Oxy-fatty Glycerin Ethers, and Oxy-, Sulpho-oxy-, Dioxy-, and Sulpho-dioxy-Fatty Acids. A. Schmitz and E. Toenges, Cleves, Germany. Eng. Pat. 14,130, August 26, 1891.

ON mixing fatty acids or their glycerides with concentrated sulphuric acid in stoichiometric quantities, mono-sulphonated fatty acids or their sulphonated glycerides are obtained, which, on being heated to 105°–120° C., are transformed into hydroxy fatty acids or their glycerides with loss of sulphurous acid. The hydroxy fatty acids in their turn may be subjected to the same operations when sulphonated hydroxy fatty acids (or their glycerides) and, subsequently, dihydroxy fatty acids (or their glycerides)

result. Another repetition of the sulphonating process yields sulpho-dihydroxy fatty acids (respecting their glycerides). The products thus obtained are recommended by the patentees as mordants in dyeing and printing with alizarin dyes, for the preparation of Turkey-red oils, of finishing oils for cotton, silk, linen, and leather, and of paint-oils and varnishes by mixing them with linseed oil.

—J. L.

Improvement in the Manufacture of Soap and other Toilet Preparations. J. Alexander & Co., Ltd., and H. de Laspée. Eng. Pat. 15,547, September 14, 1891.

THE incorporation of an extract of the wych hazel (*Hamamelis virginica*) with soaps or toilet preparations is claimed by this specification.—J. L.

Improvements in and relating to the Manufacture of Soaps and Saponaceous Compounds. J. Templeman, Greenock. Eng. Pat. 17,440, October 13, 1891.

ANY free caustic soda of soaps is neutralised according to this "invention" by oleic acid or resin. Amongst others there is the following claim:—Making soap by combining, in a finely-ground state, anhydrous caustic alkali with oils, and preferably heating this combination to such high temperatures as exceed that of boiling water and under the boiling point of the oils.—J. L.

A New or Improved Process and Apparatus for Removing Fatty Matters from Wool-Washing and other Waters. F. Hughes, London. From A. Motte and Co., Roubaix, France. Eng. Pat. 2320, April 9, 1892.

THE object of this patent is to recover the fat from the wool-washing waters in four fractions, the purest being obtained in the first instance. This is done by subjecting the wash-waters to a heating operation by means of suitable beaters, when 30 per cent. of the total fat separate out as a froth on the top of the water. On adding the sulphuric acid required to neutralise the wash-water in two fractions, twice 30 per cent. of the fat are recovered. The remaining 10 per cent. are extracted directly by means of a filter-press.

—J. L.

Improvements in or Relating to the Manufacture of Washing Soap. F. Hlawaty and A. Kanitz, Vienna, Austria. Eng. Pat. 13,081, July 16, 1892.

THE patent is claimed for a resin soap to which 20 per cent. of borax is added. Instead of using soda-ash, the patentees pass carbonic acid into the mixture of resin and caustic soda.—J. L.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Production of India-rubber in Nicaragua. J. Soc. Arts, 11, 1892, 896.

INDIA-RUBBER is obtained in Nicaragua from the *Siphonia elastica*, a tree from 50 to 60 feet in height, and no india-rubber has as yet, it is said, been obtained from any other source. Some authorities in the country consider that the rubber tree of Nicaragua is not the *Siphonia elastica*, but the *Castilloa elastica*. There are several methods of obtaining the rubber employed by the hunters, but the principal are those described below. The large rubber trees are generally felled, and incisions about 2 inches deep and $2\frac{1}{2}$ inches wide at the top are made round the tree at

distances of about a foot apart, and the rapidly flowing milk collected, through funnels formed of leaves, into calabashes, each capable of holding from three to five pints, or in holes made in the ground and well lined with leaves. Another method employed is to cut into the tree near the top, and down to its base, one, two, or three vertical channels, according to the size of the tree, through the exterior bark into the lactiferous vessels, and frequently through these vessels into the woody fibres; then cutting numerous oblique channels on each side of, and connecting with, the vertical ones. This work requires ladders, which the rubber-hunters improvise either by using the vines on the trees which they intend to scarify, or cut from the numerous meshes of vines found handy in the forests; by these the hunters ascend the trees and commence their work near the top, and continue cutting one or two vertical, and numerous oblique connecting channels uninterruptedly, until they have completed them. They work rapidly in order to keep in advance of the fast flowing milk. The milk is conducted from these channels by the means referred to above. A third method used by the rubber-hunters is to scrape off the outer bark of the trees with a *machete*, commencing eight or ten feet above and extending down to within one or two feet of the ground. Clay alone, or a vine and clay, are placed around the tree, inclined so as to form a ridge about two inches high on the lower edge of the scraped or bark-removed part of the tree. This guard is sufficient to direct the rapidly flowing milk or emulsion into the receivers at the foot of the tree. In order to make the milk coagulate rapidly, the Indians or rubber-gatherers make a decoction from the vine which they find twined around the trees, and this has been found the most efficient means of producing coagulation. This decoction on being added to the milk, in the proportion of one pint to a gallon, coagulates it to rubber, which is made into round flat cakes. Sometimes the fresh milk is mixed with the coagulating decoction, and then heated up to between 160° and 170° F. in the calabashes, and with a result apparently of a more elastic and less gummy india-rubber than that obtained by any other process. As the number of rubber trees becomes less, the methods employed in gathering the rubber become different. A few years ago the trees produced from 10 to 20 gallons of milk, and the rubber-hunter would then take the milk and put it into a large hole in the ground and make a cake of it, known as *torta*, but now that the trees do not yield a great quantity of milk, the plan of making a hole in the ground is fast being done away with. The best rubber is considered that which is taken from the long channels, which the *ullevos* cut in the trees, after the milk has been allowed to remain in the channels from one to two weeks. The rubber is known as *borricha*, and it is considered to be superior to all other because it contains less water. The natural supply of india-rubber is yearly decreasing in Nicaragua. The cause of this is the habit of the natives, until lately, of cutting down the trees, thinking that they could thereby secure more milk! The Government attempts no supervision of the forests; anyone may cut the trees, and great destruction is caused by the young trees being tapped as well as the full-grown ones. Consul Newell says it is an incontrovertible fact that so far, at least, as Nicaragua is concerned, the rubber tree is susceptible of cultivation, and in the district of Managua there are large tracts of land suitable for growing rubber trees. The rubber section of Nicaragua is that portion extending from the mountains in the vicinity of Chontales, the north-eastern part, to the Atlantic coast, and it is the opinion of those persons in Nicaragua who are interested in rubber production, that the cultivation and improvement of rubber plantations would be very profitable.—W. S.

The Relation between the Composition of Compounds and their Colour. M. Schütze. *Zeits. physik. Chem.* **9**, 1892, 109.

See under IV., page 807.

Copal Resins. E. Kressel. *Chem. News*, **66**, 90—91, and 103—104.

Of all copals Zanzibar copal is the only one entirely free from taste and aroma; all other kinds possess more or less aroma, and some of these (Borneo and Manila copal) a bitter aromatic taste. According to Brisson, the specific gravity varies from 1.045 to 1.139, but in these estimations the air enclosed in the copal has not been regarded. The melting point of a copal resin depends upon the hardness; the harder the resin the higher the melting point. Andés gives the following average scale for hardness, which the author found to be correct:—

“Zanzibar, Sierra Leone, Angola, Benguela, Acera, Benin, Loango, Kauri, Manila, Borneo, Singapore.”

A good, hard, and nearly colourless copal dried for some time over H_2SO_4 gave on analysis—

C = 79.12, H = 10.065, and O = 10.815

With benzene, chloroform, bisulphide of carbon, or ether, the powdered resin swells considerably; on standing, a gelatinous mass separates from the solution, which remains clear at the surface. Freshly-distilled ether entirely free from water was used as a solvent. The extraction of the resin with ether was repeated until a few drops left little or no residue on evaporation. The substance insoluble in ether requires some considerable time to dry and to become of constant weight, and when so, it appears like horn. It is called “swell copal,” as it only swells in every solvent, and does not form a clear solution. The amount of swell copal was found to be in proportion to the hardness of the raw copal resin. The copal now in question contained about 64.5 per cent. of swell copal. Owing to the nature of this substance, copal resins cannot be used for varnishes in their raw state, but on heating to a high temperature conversion is effected into “pyro-swell copal,” which is easily soluble in any solvent.

The analysis of “swell copal” gave—

C = 79.24, H = 11.02, and O = 9.74

The ether extraction of the raw copal leaves on distilling off the ether a light yellow resin, which is soft, and remains so when even subjected to 100° C. for some time. On distillation, an oil passes over at about 132° C., leaving a brown brittle resin.

The substance dried at 130° C. gives on analysis—

C = 78.50 %, H = 10.30, and O = 11.20 %.

It is easily soluble in benzene, ether, chloroform, &c., but scarcely in alcohol.

The melting point of copal resins varies from 175° to 370° C. When carefully roasted, at first a small quantity of gas, about 4 to 5 per cent., is obtained, which consists of—

$CH_4 = 40.3—41.27\%$, $CO_2 = 23.57—23.83\%$, and $CO = 36.13—34.88\%$.

On further heating, the copal oil distils over. Many careful experiments were made in order to estimate what loss in weight must occur before a soluble resin, fit for further manufacture of varnishes, can be obtained, and it has been found to be on an average from 8 to 12.5 per cent., but when the roasting process is carefully conducted, the loss need not exceed 10 per cent., and the raw product is fully converted into the soluble “pyro-copal.”

Naturally when a closed vessel is in use for roasting, the vapours are condensed and the copal oil collected for other uses.

When the melting point is reached, the heat should be so regulated that the temperature does not increase; it is indeed better that it be barely maintained. The mass will soon flow evenly, and after about 15 to 20 minutes the whole is sufficiently treated to be ready for further manufacture. This time is calculated for about 10 to 12 lb. of raw copal, and more time would be required should larger quantities be treated at once.

Quite analogous with this process is the conversion of starch into soluble dextrin; the former is heated to about 150°, and if a small quantity of HNO_3 or HCl be added to

the starch the transformation takes place much more rapidly. This is also, with certain modifications, the case with copal.

The analysis of the carefully roasted (at 352° C.) soluble product, "pyro-copal," gave—

C = 83.17, H = 10.64, and O = 6.19 %.

After increasing the heat to 365° C.—

C = 84.30, H = 10.75, and O = 4.96 %.

After increasing the heat to 375° C.—

C = 85.06, H = 10.85, and O = 4.09 %.

From the chloroform solution of pyro-copal, alcohol precipitates the pyro-swell copal. The substance dried at 100° C. gave on analysis—

C = 82.86, H = 10.71, and O = 7.44 %.

Comparing now the raw copal with the "pyro-copal" and the "swell-copal" with the "pyro-swell copal," it is pointed out that roasting causes in every instance an increase of C and a decrease of O, while the H remains nearly constant.

—W. S.

PATENTS.

Improvements in the Manufacture of Pigments or Paints. J. C. Martin, London. Eng. Pat. 12,840, July 23, 1891.

THIS invention relates to a treatment of all such pigments, which like zinc oxide, zinc sulphide, and white lead produced by any of the wet processes, are generally of inferior body and covering power, and require an excess of oil for conversion into paints. By treating such pigments in the form of a powder in a pug mill and adding as much water as will produce a slightly damp powder, and subsequently submitting the damp powders to the action of edge-runners, their bulk is considerably reduced and their specific gravity proportionately increased. This partially-treated material is then dried and again treated in a similar manner with addition of such a quantity of oil as will allow it to remain in powder. The pigments so treated are considerably improved in covering power, and a considerable saving in oil is effected on their being ground into paints.—C. O. W.

Improvements in Apparatus for Oxidising Lead Sulphide and Zinc to Form White Pigments. F. J. Rowan, Glasgow, and B. Dawson, Worcester. Eng. Pat. 16,129, September 23, 1891.

THE invention comprises a new apparatus or furnace so constructed as to prevent the admixture with the products of carbonaceous or other foreign particles which might diminish the purity of the pigments. For the manufacture of the lead pigment, galena or any suitable sulphide of lead, or a lead ore or compound supplemented with more or less sulphur or sulphur-yielding material may be employed, and for the zinc pigment zinc or any suitable ore or compound of zinc can be used. A gas furnace is employed in the process having a reverberatory chamber across which are placed a series of retorts into which the pulverised material is fed by means of a jet of air or steam, or any of the well-known mechanical means may be used for this purpose. The retorts are inclined so that any slag from the material may flow to one end, where it is discharged through a duct. The oxidised material, being converted into a fume, passes from the higher ends of the retorts into condensing chambers, where it is collected, steam or air being applied to propel the fume into the condenser. The gas furnace may also be constructed on the system known as a blow-pipe furnace, in which case the combustible gas is injected into the furnace chamber through a nozzle, together with the necessary air for combustion. The construction of these chambers is otherwise similar to that of the before-mentioned retorts.

—C. O. W.

Improvements in the Manufacture of Aniline Lakes suitable for the Manufacture of India-Rubber Cloth and other Purposes. I. Frankenburg, Lancaster. Eng. Pat. 16,582, September 30, 1891.

THE invention refers to the manufacture of compound lakes from any of the acid or sulphonated aniline colours, by converting them into barium-alumina, calcium-alumina, barium-chromium, or calcium-chromium lakes, which are capable of withstanding all the influences incidental to the manufacture of india-rubber articles.—C. O. W.

Improvements in the Manufacture of Gold, Silver, and Bronze Paints. W. Cutler, Birmingham. Eng. Pat. 7688, April 23, 1892.

THE object of this invention is to prevent bronze paints from tarnishing by exposure to the atmosphere, and it is effected by dissolving pyroxilin in spirits, ethers, essences or acids, and mixing with this liquid celluloid enough of the bronzes to bring it to the consistency of ordinary paint. This paint is then applied in the usual manner. On drying a transparent film of celluloid is formed on top of the coat of bronze, and this film being water- and air-proof protects the bronze against atmospheric, gaseous, and other influences.—C. O. W.

Improvements Relating to the Extraction of Gutta-Percha and to Apparatus therefor. D. Rigole, Paris, France. Eng. Pat. 4252, May 3, 1892.

THIS invention relates to the extraction of gutta-percha from the leaves and twigs of *Isonandras*, *Dickopsis*, or other gutta-percha trees, by means of bisulphide of carbon. For this purpose the leaves and twigs are suitably pounded and placed in an exhausting vessel in which they are treated with bisulphide of carbon. The solution of gutta-percha returns then to the bisulphide of carbon boiler, from where it is again evaporated and after being condensed, again acts upon the material to be extracted. In this manner the carbon bisulphide which is continually being purified by the distillation effects in a short time the complete exhaustion of the leaves. By working a set of valves arranged on the apparatus the previous connection between the bisulphide of carbon boiler and the extractor is now closed, and a current of superheated steam forced through the extractor and from there into the bisulphide of carbon boiler. The bisulphide of carbon evaporates and leaves the boiler together with the steam through a specially provided pipe terminating in a condenser. The superheated steam thus carries away all the bisulphide of carbon, leaving the solid gutta-percha behind.—C. O. W.

Improvements in Enamel Paints for Resisting Damp, Fire, and Atmospheric Influences, and in Imitation Mosaic and other Articles made therewith. O. Terp, London. Eng. Pat. 12,175, June 30, 1892.

TWENTY-THREE parts of a 50 per cent. solution of chloride of calcium and 77 parts of a 66 per cent. solution of chloride of magnesium are mixed together. To this 2 per cent. of commercial hydrochloric acid and 1 per cent. of a saturated solution of chlorine in water are added. To this mixture or solution any desired pigment may be added, and when required for use the solution is mixed with about an equal quantity of Silesian "bittererde" (oxide of magnesium), and this mixture is then applied to the surface to be coated. In order to give the coloured enamelled surface a brighter colour it may be coated with linseed oil. The hardness of the enamel can be modified by using in the above mixture more or less hydrochloric acid. By enamelling with the above preparation suitably formed polygonal pieces of various materials and colours, and piecing them together a kind of mosaic may be manufactured.—C. O. W.

XV.—MANURES, Etc.

The Manufacture of Iron in its Relations to Agriculture.
Sir Lowthian Bell, Bart., F.R.S.

See under X., page 819.

XVI.—SUGAR, STARCH, GUM, Etc.

Detection and Removal of Protein Substances in Beet Juice by Means of Tannin. E. Bruck. Chem. Zeit. 16, 222.

If a tannin solution be added to the clear juice or diluted syrup a deep violet flocculent precipitate is formed, and the filtered fluid appears considerably lighter and brighter than the original. The reaction takes place in all the raw, intermediate, and final products of manufacture, and is an index of the purity and concentration of the solution. The use of tannin thus enables the amount of dissolved albuminates to be determined both qualitatively and quantitatively, the precipitate being collected in the latter case upon a tared filter, well washed with hot water, dried at 100°—110°, and weighed. The estimation is of course relative, but suffices for practical purposes. In order to avoid the formation of soluble tannin salts it is advisable to conduct the process in a solution as nearly neutral as possible, after it has been previously treated with a stronger acid than tannic acid, for this purpose sulphurous acid is recommended. The juice clarified with tannin is distinguished by its ready and rapid evaporation in vacuo, and the product can be easily treated in the centrifugal machine, which is not always suitable for the untreated juice in the latter periods of the harvest. As regards the yield of crystallised sugar this is decidedly increased, the molasses remaining being distinctly less than in the ordinary method, being only about 1.15 per cent. The author also calls attention to the further advantage of removing protein substances from the juice, since these serve as carriers of colouring matters and form a pabulum for fermenting germs.—F. W. P.

PATENTS.

Improvements in the Refining of Sugar Juice or Molasses.
A. Schneller and W. J. Wisse, the Hague, Holland.
Eng. Pat. 14,575, August 28, 1891.

This is an improvement on Eng. Pat. 5236 of 1891 (this Journal, 1892, 448); besides treating the syrup with ozonised air, it is also treated with carbonic acid in the same or a separate scrubber, by means of which the mineral matters are precipitated.—A. L. S.

Improvements in Multiple Effect Apparatus for Evaporating or Concentrating Sugar Juice and other Liquids. R. W. Deacon, Birmingham. From W. Maxwell, Java. Eng. Pat. 17,274, October 10, 1891.

An outlet pipe, at the level the liquid is required to be maintained in the upper chamber of each vessel in the multiple effect apparatus, leads into the lower chamber of the next vessel, through a steam trap, which allows only liquid to pass and not vapour, the upper portion of this trap being also connected with the vapour space in the succeeding vessel. The pressure in the first vessel being greater than that in the next one, the liquid in the first vessel will always flow into the next, until its level falls below the opening of the outlet pipe, at the same time the

trap prevents the passage of vapour; in this way the excess of the feed to the first vessel is automatically transferred to the next and so on throughout the series.

Similarly, by connecting the middle chamber of the first vessel with the middle chamber of the second in the series, by a pipe leading through a similar trap, the water of condensation is automatically transferred from one vessel to another.—J. C. C.

Improvements in Apparatus for Liquoring Sugar. F. Scheibler, Bartscheid-Aachen, Germany. Eng. Pat. 18,292, October 24, 1891.

The apparatus is intended to effect the liquoring of sugar by exposing a number of blocks of sugar at one operation to contact on one side with fine liquor under pressure, while the green syrup is exhausted from the other side. Two sets of open frames are slung by perforated lugs on horizontal rods fixed between standards. Half the number of frames are connected to an overhead reservoir containing fine liquor, while the other half, composed of alternate members, is coupled to the vessel, provided with a gauge glass, for receiving the green syrup, and thence to the exhaust pump. The sugar to be liquored is contained in moulds open on their opposite sides and supported by carriers on the horizontal bars. When the frames and moulds are in place they are brought into close contact by a moveable head-plate similar to that of a filter-press and actuated by a fixed screw and loose nut. The joints are packed and the whole apparatus tightened up by the end-screw before mentioned. The fine liquor is admitted at a pressure of about $1\frac{1}{2}$ atmospheres to half the frames (termed the "liquor frames"), while green syrup is drawn off by the pump from the other half of the frames (the "syrup frames") its quantity being ascertained by the gauge glass on the vessel into which it is drawn by the action of the pump.—B. B.

XVII.—BREWING, WINES, SPIRITS, Etc.

The Action of Beer on Aluminium. R. Kobert. Chem. Zeit. 16, 1892, 821.

It has been shown that beer stored in aluminium vessels takes up 8 mgrms. of the metal per litre, yet Aubry concludes that aluminium is a suitable material to use for the manufacture of vessels intended for the storage and transport of beer. At present there is only one work extant on acute and subacute poisoning by aluminium salts, (viz, Siem, Ueber die Wirkungen des Aluminiums und Berylliums, Dorpat, 1886), but it has been shown that even the smallest quantity circulating in the blood has a toxic effect. Siem's experiments show that the fatal dose per kilo. of weight of the animal was 300 mgrms. for rabbits, 250 to 280 mgrms. for cats, and 250 mgrms. for dogs. Experience with other metallic poisons has shown that the susceptibility of man is greater than that of animals, and therefore the use of aluminium for vessels to contain beer should be prohibited, as it would accumulate in the system, and produce slow poisoning.—G. H. R.

The Action of Beer on Aluminium. Chem. Zeit. Rep. 16, 1892, 173.

The action of beer on aluminium has been investigated at the Wissenschaftliche Station für Brauerei at Munich, at the instance of the Aluminium Industrie Actien Gesellschaft of Neuhausen. Beer kept in aluminium flasks was scarcely affected in flavour, provided that the dirt in the flasks was removed from the manufactory was carefully removed. When kept in aluminium vessels in a cellar for three weeks at 10°—12° C., the greatest quantity dissolved was 0.8 mgrm.

per 100 cc. Similar results were obtained with beer in a case of fermentation, the metal being unaffected by the nascent carbon dioxide. Aluminium was also found available for yeast cultivation flasks, and its use is proposed for brewing laboratories. The only precaution requisite is that when such vessels are cleaned with caustic soda solution, that liquid should not be allowed to remain in contact with them for any considerable time.—B. B.

The Alcohols of Fusel Oil. R. C. Schlüpphaus. J. Amer. Chem. Soc. **14**, 1892, 45—60.

ABOUT a decade ago fusel oil or commercial amyl alcohol was practically a waste product, being only employed to a comparatively small extent in the manufacture of alkaloids, certain ethers, &c., and a few organic dyes. H. Briem (Organ Centr. Vereins Rübenzucker Ind. Oest. Ung. Monarchie, 1877, 180, and 1879, 265) recommended the fusel oil from the fermentation of beet-sugar molasses as a source for illuminating gas of superior quality; and in 1880 (*ibid.* 1880, 20) he reported that several factories, including a distillery, had introduced the process. This was, however, but a poor way of utilising the raw material, as was rightly pointed out by Wagner (Wagner's Jahresh. 1879, 1216). But better uses were found for it. In 1882, J. H. Stevens (U.S. Pat. 269,343, 1882) introduced fusel oil instead of grain alcohol as a solvent for nitro-cellulose, in the manufacture of celluloid. In this connection, it is worthy of note that A. H. Elliott (J. Amer. Chem. Soc. **4**, 1882, 147), mentions amyl alcohol as a solvent for nitro-saccharose. The pyroxylin varnish industry, which first began to flourish in 1879, owes its development to the use of amyl acetate as a solvent; and in 1882, J. H. Stevens (U.S. Pat. 269,340, 1882) patented the use of this substance in the manufacture of celluloid. O. P. Amend (U.S. Pat. 371,021, 1887; 372,100, 1887; U.S. Re-issue, 10,879, 1887) employed for a similar purpose the chlorination products of amyl alcohol and acetate. In 1884 the author discovered that propyl- and *i*-butyl alcohols (U.S. Pat. 410,204, 1884) which are present in commercial fusel oils, are preferable to amyl alcohol in the manufacture of celluloid. At the same time he proposed the use of propyl and butyl acetates in the preparation of pyroxylin varnishes. W. D. Field (U.S. Pat. 381,354, 1887; this Journal, 1888, 443) obtained a patent for such varnishes. Large quantities of propyl, butyl, and amyl acetates are consumed in the manufacture of photographic films; and amyl acetate also forms a constituent of some smokeless powders, and is employed as illuminant in Hefner's standard lamp. Amyl acetate, butyrate, and valerate enter into the composition of a number of artificial fruit essences and flavours. E. Liebert (Ger. Pat. 51,022, 1889; this Journal, 1890, 326) adds amyl nitrate to nitro-glycerol to diminish its sensitiveness to cold and concussion. Fusel oil and its derivatives also find application in analysis, the preparation of artificial musk, &c., valeric acid, and valerates (used in medicine).

Le Bel (Compt. rend. **86**, 1878, 213) described a method of preparing inactive amyl alcohol from fermentation products, and showed that the valeric acid obtained from it was identical with the official acid.

As a consequence of the enormous increase in the consumption of fusel oil the supply is now no longer equal to the demand. Moreover, every progressive distiller aims at counteracting its formation as much as possible, and the researches of Lindet (this Journal, 1891, 717) and Springer's (Scient. Amer. Suppl. 1891, 13,125) method of producing alcohol point to success in this direction.

Fusel oil was discovered by Scheele (Crell's Annalen, **1**, 1785, 61) in the tailings of rye whisky; whilst Pelletan (Ann. Chim. Phys. (1), **30**, 1825, 221) examined a similar product from potato spirit. Dumas (Ann. Chim. Phys. (1), **56**, 1834, 314) isolated amyl alcohol from potato fusel and ascertained its percentage composition, without, however, recognising its alcoholic nature. Cahours (Compt. rend. **4**, 1837, 341; and Ann. Chim. Phys. (1) **70**, 1839, 81, and **75**, 1840, 193), however, showed its analogy to, and classed it with ethyl alcohol. Balard (Ann. Chim. Phys. (3), **12**, 1844, 294) obtained it from the fusel of grape-skins, and prepared a series of amyl compounds. In a fusel of the

same origin, Chancel (Compt. rend. **37**, 1853, 410) discovered *n*-propyl alcohol. Wurtz (Compt. rend. **35**, 1852, 310; and Ann. Chim. Phys. (3), **42**, 1854, 129) detected *i*-butyl alcohol in the fusel oils from potato and beet-sugar molasses spirit. Kolbe (Annalen, **41**, 1842, 53), Wurtz (Ann. Chim. Phys. (3), **42**, 1854, 129), and Perrot (Compt. rend. **45**, 1857, 309) examined the ethers and fatty acids of fusel oil. Although in crude fusel oil, amyl alcohol preponderates, the composition of distillates varies greatly. Instances of fusel oil free or nearly free from amyl alcohol, such as mentioned by H. Briem, (Organ Centr. Vereins Rübenzucker Ind. Oest. Ung. Monarchie, 1877, 180), must be regarded with suspicion. One such case investigated by the author was found to refer to a distillate from fusel oil (A. Freund, J. prakt. Chem. **12**, 1875, 25). In 1873, G. L. Ulex (Dingl. Polyt. J. **208**, 379) described a method for the determination of ethyl alcohol in fusel oil, and pointed out the gross inaccuracy of the process adopted by the British Excise authorities. Details of these methods, as well as of one devised by A. H. Allen, may be found in "Allen's Commercial Organic Analysis," vol. I., 1885, 119. Ulex (*loc. cit.*) also incidentally remarks that "wine" fusel oil contains no amyl alcohol because it distils over completely below 130° C. The weakness of this argument must be evident to all who have experience of fractional distillation, and know how imperfect a separation is effected by a single distillation of even so simple a mixture as amyl and ethyl alcohols (see Roscoe and Schorlemmer, "A Treatise on Chemistry," Vol. III. 147). A further complication ensues in presence of water. A mixture of water and amyl alcohol, boiling point 130° C. (Pierre and Puchot, Ann. Chim. Phys. (4), **22**, 1868, 234), boils at 96° C., and the distillate consists of 2 vols. of water and 3 vols. of amyl alcohol. In the case of butyl alcohol, boiling point 108° C., the boiling point drops to 90.5° C., and the constituents pass over in the proportion of one volume of the former to five of the latter. Whenever a rational separation is aimed at, complete dehydration is indispensable.

The German Excise authorities (Wagner's Jahresh. 1890, 1078) employ the following tests for fusel oil:—

1. 10 cc. of fusel oil are shaken with 30 cc. of calcium chloride solution of sp. gr. 1.225 (25 grms. CaCl₂ and 100 cc. of water). After one minute's agitation at least 7.5 cc. must remain undissolved.

2. 100 cc. of fusel oil must show a decided turbidity when shaken for one minute with 5 cc. of distilled water.

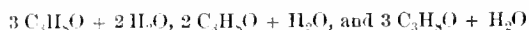
The author has analysed several samples of distillates from fusel oil. A sample from a German factory consisted of propyl and butyl alcohols, and was anhydrous. Another distillate of American origin was similar in composition, but contained in addition a little amyl alcohol. Certain other samples which had been responsible for most objectionable troubles in the manufacture of celluloid were also examined. These samples had been certified to be practically free from amyl alcohol, and to contain as chief constituent propyl alcohol, with an average of only 4 per cent. of water. Analysis revealed a considerable proportion of water, and, as might have been expected, all the alcohols of fusel oil were found to be present. The anhydrous samples on fractionation yielded four fractions boiling at 78°—80° C., 97° C., 109° C., and 128°—132° C. respectively. The slight residue boiling above 132° C. consisted probably of amyl ethers. The following results were obtained in the case of four different samples (see next page).

Kraemer and Pinner (Ber. **2**, 1869, 401, and **3**, 1870, 75) and also Pierre and Puchot (Ann. Chim. Phys. (4), **22**, 1868, 234) have likewise investigated the composition of the first runnings of fusel oil. The four distillates previously mentioned, mixed with methyl alcohol in the proportions employed in the manufacture of celluloid, yielded a clear camphor solution. When only camphor, however, was added, a portion of the water separated; and this behaviour accounts for the disagreeable experiences with the solvents. Large blocks of celluloid when cut into sheets were found to be interspersed with cavities containing a fluid, which proved to be chiefly water. Since these samples were stated to be free from amyl alcohol, the fraction 128°—132° C. was carefully tested and proved to consist of iso-amyl alcohol

Sample.	Specific Gravity.	Water.	Ethyl Alcohol.	<i>n</i> -Propyl Alcohol.	<i>i</i> -Butyl Alcohol.	Fermentation Amyl Alcohol.	Residue.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
I. Clear yellow liquid of neutral reaction.	0.8425 at 18° C.	14.0	30.0	14.5	25.2	15.0	1.3
II. Clear yellowish liquid of neutral reaction.	0.8523 at 19.5° C.	20.0	19.4	11.7	24.9	22.0	2.0
III. Slightly cloudy liquid of brownish tinge. Reaction neutral.	0.8431 at 21.5° C.	18.3	15.0	8.2	19.9	30.8	1.8
IV. Colourless clear liquid of neutral reaction.	0.8630 at 16.5° C.	23.0	32.8	5.7	11.0	7.0	0.5

But the chief constituent was said to be propyl alcohol, and in view of Rabuteau's researches (Compt. rend. **87**, 1878, 500) on potato fusel, it was thought possible that isopropyl alcohol might be contained in the fractions of low boiling point.

This body was prepared from acetone by Friedel (Compt. rend. **55**, 1862, 53), who pointed out that it is not freed from water even by distillation from barium oxide. Berthelot (Ann. Chim. Phys. (3), **43**, 1855, 385), the discoverer of isopropyl alcohol, found its boiling point, when still containing a little water, to be 81°—82° C. Friedel's compound boiled at 84°—86° C., and after treatment with metallic sodium, at 86°—88° C. Linnemann (Annalen, **136**, 1865, 37) investigated the subject fully and laid great stress on starting with pure acetone. He found the boiling points of isopropyl alcohol and its three hydrates—



to be 83°—84° C., 78°—80° C., 80° C. and 81° C. respectively. Since fractional distillation would be useless in this case, the fractions between 78°—88° C. were tested chemically for isopropyl alcohol with entirely negative results. Rabuteau (*loc. cit.*) found no less than 150 cc. of isopropyl alcohol, boiling point 85° C., in one litre of Swedish potato fusel oil and identified it by ultimate analysis, by conversion into acetone, and by its acetate, boiling at 76° C. But according to Berthelot (*loc. cit.*) and Friedel (*loc. cit.*), isopropyl acetate boils at 90°—93° C.; whilst 76° C. is the boiling point of ethyl acetate. Rabuteau's figure, however, may be an error. It is interesting to note, that so late as 1868, Mendelejeff (Zeits. Chem. 1868, 25) doubted the very existence of *n*-propyl alcohol, and consequently its presence in fusel oil; and he failed to isolate it from Chancel's (Compt. rend. **37**, 1853, 410) alcohol. Its presence in fusel oil was, however, proved beyond a doubt by Pierre and Puchot (*loc. cit.*) and Kraemer and Pinner (*loc. cit.*). That Perrot (Compt. rend. **45**, 1857, 309) and Y. de Schepper (Zeits. Chem. 1868, 520) failed to find *n*-propyl alcohol is attributable to the fact that they employed fusel oil containing water. As regards isopropyl alcohol, Pierre and Puchot, and Kraemer and Pinner, although working under the most approved conditions, were unable to detect it in fusel oil from different sources. Barbaglia (Ber. **6**, 1873, 1064) found in isobutyl aldehyde from Kahlbaum's factory considerable quantities of acetone, and ascribed its formation to the presence of large quantities of isopropyl alcohol in the commercial isobutyl alcohol from which the aldehyde had been prepared. Kraemer (Ber. **7**, 1874, 252), the manager of the above factory, replied that the isobutyl alcohol employed was practically pure, and showed that acetone was a constant product of its oxidation under the conditions obtaining in their process of making isobutyl aldehyde. Lipp (Annalen, **205**, 1880, 1) described a method by which the formation of acetone may be almost wholly avoided. If Rabuteau's data be considered in the light of all these facts, the conclusion is inevitable that the presence of such large quantities of isopropyl alcohol in fusel oil is somewhat doubtful. The boiling point is no criterion of the purity of the alcohol; the ultimate analysis is of little value; and the boiling point of the acetate is not 76° C. Nor is the formation of acetone sufficient proof, until it is shown that it is produced in such quantities as to preclude the possibility of its formation from small amounts of isobutyl alcohol.

All the alcohols, which have hitherto been isolated from the products of the fermentation of saccharine solutions, and about which there can be no reasonable doubt, are primary alcohols, viz., methyl, ethyl, *n*-propyl, *n*- and *i*-butyl, and *i*-amyl alcohols. Normal butyl alcohol was found by Clandon and Morin (this Journal, 1888, 513) in the heavy oils of French brandy, in which, however, it is only formed under abnormal conditions. Morin (this Journal, 1888, 224) proved its absence in normal brandy. Methyl alcohol is a product of the spontaneous fermentation of sugar-cane juice in tropical climates (Mareano, this Journal, 1889, 561). Kraemer and Pinner's (Ber. **2**, 1869, 401) opinion that hexyl alcohol might possibly exist among the alcohols of fermentation has not been verified; although Faget (Compt. rend. **37**, 1853, 730) isolated a substance from the fusel oil formed by the fermentation of grape-skins, which he was inclined to regard as hexyl alcohol. The researches of Wurtz (Ann. Chim. Phys. (3), **42**, 1854, 125), Perrot (Compt. rend. **45**, 1857, 309), Clandon and Morin (this Journal, 1888, 513), and Morin (this Journal, 1888, 224) show that no alcohols higher than amyl alcohol exist in fusel oil. Referring to Swedish potato fusel oil the author remarks that if it really contain such a large quantity of isopropyl alcohol, there can be no difficulty in establishing the fact. It is only necessary to separate from the thoroughly dehydrated product the fraction boiling below 85° C., and prepare from the latter an acetate of correct boiling point. If the alcohol regenerated from the acetate yields acetone on oxidation, and furnishes a benzoate (Linnemann, Annalen, **161**, 1872, 51) which on heating splits up into propylene and benzoic acid, the existence of isopropyl alcohol in the original substance will be proved.—H. T. P.

Relations between Fat-hydrolysing and Glucoside-resolving Ferments. W. Sigmund. Monatsh. **13**, 567—577.

See under XXIII., page 849.

PATENTS.

Improvements in Distilling and Rectifying Alcohol or other Liquids, and in Apparatus Employed therefor. O. Perrier, Paris. Eng. Pat. 13,729, August 14, 1891.

THE chief feature of the apparatus is the use of rectifiers which are each kept at a constant and uniform temperature; this is maintained by a bath of boiling liquid, the vapour from which is immediately condensed and returned.

The rectifiers may be made in the usual form with plates; or they may be filled with beads.

In the distillation of alcoholic liquids the temperature of the rectifiers may be so arranged that one condenses the water while allowing all the more volatile portions to pass through, the next condenses the least volatile portions of these, *i.e.*, the tail products; the next the least volatile portions of what has passed through these, *i.e.*, the alcohol and the head products having passed uncondensed through all of them are condensed in a refrigerator. A special arrangement is described, by means of which the flow of wash into the boiler is regulated by the temperature, of the vapours passing out of the boiler; thus producing a regular and even distillation.—A. L. S.

Improvements in Malt Mashing Apparatus. F. J. Money, London. Eng. Pat. 14,658, August 29, 1891.

THE patentee proposes to grind the malt to a fine powder and mash it in a churn-like machine in order to obtain all the starch in solution, which he says cannot be done by the present methods.—A. L. S.

An Improved Method and Apparatus for Straining Brewer's Wort. S. A. Croxford, Bedminster, Bristol. Eng. Pat. 15,467, September 12, 1891.

THE apparatus consists of a strainer which is placed in the copper or underback and rests on the bottom thereof, and is withdrawn when the albuminoid matters have been coagulated. The strainer consists of a wire frame, supporting a web of horsehair or other suitable material.—A. L. S.

Improvements in the Apparatus for the Making and the Drying of Malt. A. Gough, London. Eng. Pat. 15,764, September 17, 1891.

THE apparatus consists of a cylinder of relatively large radius and short length; part of it is a closed chamber for steeping and germinating, and part is provided with perforated flues passing through the drum in a plane at right angles to its axis. Hot or cold air may be passed through the flues. The drum is provided with edge gear, by means of which it may be made to revolve on its axis.

In the preparation of malt by means of this apparatus, the barley is introduced into the closed part of the drum and there steeped; the water is then drawn off and the drum turned to promote even germination, and the temperature kept within the proper limits by passing cold air through the flues. When germination has proceeded as far as necessary, the cold air is replaced by warm and the drying and curing takes place.—A. L. S.

Improvements in Apparatus for Filtering Beer and other Alcoholic and Gaseous Liquids. H. Gehrke, Berlin, Germany. Eng. Pat. 8290, May 2, 1892.

THE filtering vessel is cylindrical and is divided into partitions by filter plates. The unfiltered beer is led into alternate compartments, and passes through the filtering material into the other compartments of the filter. No pressure is used except that due to the difference of height between the settling back and the cask to receive the filtered beer. It is claimed that the special arrangement of the filter gives a greater surface in the same bulk than any other.—A. L. S.

Improvements in Apparatus for the Manufacture of Malt Liquors. P. M. Justice, London. From A. W. Billings, Brooklyn, New York, U.S.A. Eng. Pat. 8952, May 11, 1892.

THESE improvements relate to an apparatus described by the inventor in Eng. Pat. 10,135, of 1891 (this Journal, 1892, 628).

The mash tub is made in the shape of a cylinder, provided with stirrers working on an axis coincident with the axis of the cylinder.

The cylinder is closed except for a narrow opening at the top, which can be hermetically closed by plates provided with pipes for water, malt, and raw grain.—A. L. S.

Improvements in Spraying Devices for Cooling Beer and other Liquids. C. C. Hanford, Medford, Middlesex, Massachusetts, U.S.A. Eng. Pat. 9975, May 26, 1892.

THIS is a modification of the apparatus protected by a previous patent (13,428, of 1890; this Journal, 1890, 1057), and is specially suited for small breweries. The modification consists in altering the shape of the valve from circular

to semicircular, and an arrangement for opening the valve by which the aperture remains practically semicircular, and the spray is thrown out only on one side of a line passing through the straight side of the semicircle. The valve can thus be fixed over the side of the cooler, without risk of losing any of the wort.—A. L. S.

Process and Apparatus for Impregnating Beer with Carbonic Acid. B. J. B. Mills, London. From The Universal Carbonating Company, Newark, New Jersey, U.S.A. Eng. Pat. 10,305, May 31, 1892.

IN the ordinary method of preparing lager beer for market it is customary to add to the ruh-beer a small quantity of young beer, whereby fermentation is again started, and the beer becomes saturated with carbonic acid.

The inventor proposes to substitute for this the direct carbonating of the beer by means of compressed carbonic acid. To do this a circulation of the beer is caused by a pump, in a tube one end of which is attached to the top and one end to the bottom of a lager cask; into this tube carbonic acid gas is injected, and by this means the whole of the beer is soon carbonated.—A. L. S.

Improvements in the Manufacture of Colour Malt. W. P. Thompson, Liverpool. From L. Schmied, Zizkow, Bohemia. Eng. Pat. 10,442, June 1, 1892.

THE green malt before watering is frozen; this is done in a chamber, built like a malt kiln with one hurdle, under which are placed cooling tubes in communication with an ice machine. After some hours the frozen malt is brought on to the second floor of a kiln with the hood closed and heated for 4 or 5 hours at 50° C. With gentle turning it is allowed to remain for 2 or 3 hours more in its own vapour, and then removed to the first floor of the kiln and quickly dried.

The colouring malt thus obtained does not, like ordinary colouring malt, show inside a roasted "amylum," but a crystalline malt sugar which tastes sweet like caramel.

—A. L. S.

Improvements in the Method of and Apparatus for Mashing and Brewing Ale, Beer, and other Fermented Liquors. J. Barton, Dewsbury, Yorkshire. Eng. Pat. 10,496, June 2, 1892.

THIS is an arrangement for completing the whole operation of brewing in one vessel, and is specially adapted for domestic use.

It consists of a cast-iron stand supporting a copper or other metal vessel. To the interior of this is fitted a removable perforated metal vessel, to the under surface of which is attached an attenuator coil.

To use the apparatus, a sufficient supply of cold water is introduced into the copper vessel and heated by a gas-burner or other convenient source of heat to the required temperature. The ground malt is placed in the inner perforated vessel, and the whole lowered by suitable gear into the water. After standing a sufficient time the perforated vessel is raised, and carries the spent grains with it; these are washed with a stream of water from a rose nozzle, and after draining the perforated vessel is swung to one side and the spent grains removed. The hops are then put in the place of the grains and lowered into the wort, which is then boiled. The hops are removed in the same way as the grains, and the boiled wort is cooled by the attenuator. Yeast is introduced, and when the fermentation is finished the beer is drawn off by a tap.

—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOODS.

Caffeine and Coffee Distillate and their Physiological Effects. W. Heerlein. Arch. Physiol. 52, 165.

THE experiments of the author show that coffee, as far as its alkaloid caffeine is concerned, is neither a food nor decreases the bodily waste, but rather excites and increases it. As the distillate from coffee was also found to have no diminishing effect on the consumption of oxygen, the author considers that coffee should be struck off the list of direct or indirect foods, and its action as an exciter of the nervous system alone recognised.—F. W. P.

An Unusual Form of Spring Water. J. H. Stebbins. J. Amer. Chem. Soc. 14, 1892, 115—116.

THE water in question came from New Jersey; it was clear, without taste, and neutral to test paper, but it had a slight smell when the bottle containing it was uncorked. It possessed a very considerable viscosity, which was ascertained not to be due to gelatinised silica, but to the presence of organic matter in the form of either algae, bacteria, or some other form of growth.

Total solids were 8.2 grains per gallon; inorganic matter obtained on ignition, 3.2 grains per gallon.

The nature of the organism contained in the water is unknown to the author, who asks for any information on the point. The water is free from chlorine, but contains traces of sulphates; it has no ill-effects on those drinking it.—T. L. B.

The Behaviour of Antiseptics toward Salivary Digestion. H. A. Weber. J. Amer. Chem. Soc. 14, 1892, 4—14.

THE author draws attention to the custom, extensively practised, of adding antiseptics to perishable articles of food in order to preserve them, and points out that their action on the consumer is in many cases decidedly injurious. Many preparations, more particularly of salicylic and boracic acids, are sold as "lard bleachers" and "fruit, wine, and cider preservatives," &c.

As H. Leffman and W. Beam (this Journal, 1888, 582—583) have shown that certain preservatives completely arrest the saccharifying action of diastase and pancreatic extract on starch, experiments were made to determine whether a similar influence is exerted by these substances on the diastatic conversion of starch-paste by saliva (at 40° C.). The antiseptics employed were salicylic acid, borax, calcium sulphite, and saccharine. From the results obtained, which are embodied in a series of tables, it appears that in the presence of 1 part of preservative to 210 parts of "food mixture," salicylic acid and saccharine altogether arrest diastatic action; borax and calcium sulphite only have this effect at the beginning, after which the latter exerts no depressing influence, whilst borax retains its retarding action to the end. Used in the proportion of 1:420, salicylic acid and saccharine completely check the conversion of the starch; borax distinctly retards it, and calcium sulphite has no effect. In more dilute solutions (1:840) only borax and salicylic acid exert a marked depressing influence, especially at the beginning, but less strongly afterwards. At the rate of 1:1050 to 2,100 borax alone has a retarding effect.—H. T. P.

PATENTS.

Improvement in the Manufacture or Production of Butter. J. H. Duncan, London. Eng. Pat. 12,549, July 24, 1891.

By means of the inventor's centrifugal apparatus, butter of exceptional quality may be made in about 20 or 30 minutes. The number of revolutions required is 120 per minute if the cream has a temperature of 60° F., but if this is raised to 75° F., 60 revolutions per minute will suffice. The cream should be four days old. The apparatus chiefly consists of a vessel containing the cream, a rotary disc mounted so as

to be partly immersed in the cream and capable of picking this up in the form of films; and means whereby the contents of the vessel can be rapidly heated by the application of hot water to the jacket or false bottom, and by the circulation of the cream, by means of the discs, over the warm surface.—L. de K.

Process for the Production of a Palatable Kola-Nut Powder. B. Haseloff, Kottbuserdamm, Berlin. Eng. Pat. 12,729, July 27, 1891.

THE difficulty that presents itself in the utilisation of the kola-nut, the fruit of *Sterculia acuminata* and *S. macrocarpa*, for food purposes similar to the cocoa-bean, is the large quantity of tannic acid present, which communicates to it an astringent and unpalatable flavour. Availing himself of the property of tannic acid to absorb oxygen from the air in alkaline solution and form other non-astringent bodies, the patentee proposes to treat the partly-roasted and pulverised kola-nut with alkaline reagents, and expose the moistened kola-nut powder to the action of the atmosphere at 30° C. to 35° C. for several days, whereby the tannic acid is destroyed and an agreeable flavour developed. The alkaline substances used are caustic potash, alkaline carbonates, hydroxide of calcium, borate of soda, and phosphate and hydroxide of potassium, in dilute solutions, preference being given to the latter. The proportions adopted are from $\frac{1}{2}$ to 1 per cent. of alkali.—F. W. P.

Process of Producing Sterilised Butter. G. Müller, Zerbst, Germany. Eng. Pat. 8264, May 2, 1892.

THE production of sterilised butter has up till the present time not been a success, due to the fact that the proper sterilisation of the cream is prevented by the necessary changing of receptacles during the manufacture of butter. The cream is in consequence brought into contact with numerous surfaces and is necessarily subjected for a considerable time to the action of the air. By means of the patentee's apparatus the cream is sterilised and churned and the butter washed in one and the same apparatus. A product is thus obtained which will keep for a considerable time without getting rancid, and which is free from pathogenic bacteria.

The sterilisation of the cream is effected by means of low-pressure steam at a temperature of about 103° C. Any air which may enter on cooling is sterilised by being filtered through wadding. The receptacle containing the cream is then put into a shaking or churning apparatus to produce the butter. The butter-milk is then let off from the bottom, sterilised air entering at the top. Sterilised water is then let in to wash the butter, which operation is again performed in the shaking apparatus. Finally the butter is repeatedly shaken without addition of water, in order to separate the bulk of the mechanically-mixed water.

If it is desired to produce salt or coloured butter, sterilised salt or colouring is introduced into the receptacle before the dry shaking takes place.—L. de K.

(B.)—SANITARY CHEMISTRY.

Progress of the Match Industry. W. Jettel. Chem. Zeit. 16, 1892, 670.

See under XXII., page 839.

Poisonous Gases from Dynamite. P. F. Charon. Eng. and Mining J. 1892, 269.

See under XXII., page 840.

The Action of Beer on Aluminium. R. Kobert. Chem. Zeit. 16, 1892, 821.

See under XVII., page 830.

The Action of Beer on Aluminium. Chem. Zeit. Rep. 16, 1892, 173.

See under XVII., page 830.

XIX.—PAPER, PASTEBOARD, Etc.

Sulphite-Wood Liquor and Lignin. J. B. Lindsey and B. Tollens. *Annalen*, **267**, 341.

THE soluble by-products of the bisulphite process of pulping wood are derivatives of its lignin or lignone constituents, and the authors have investigated these waste liquors with the view of elucidating the constitution of the latter. The results of a general examination for carbohydrate constituents showed: (1) the absence of dextrose or bodies yielding dextrose, (2) the presence of galactose and of mannose, and (3) of pentaglucoses or derivatives of these. A series of observations of yeast fermentations of the liquor, after expelling sulphurous acid by evaporation with sulphuric acid, showed the formation of 5–6 cc. alcohol from 1 litre of the wood liquor (containing 95 grms. total solids). After hydrolysis by boiling with acid the quantity of alcohol formed amounted to 6.75 cc. It is obvious that these by-products are for the most part insusceptible of alcoholic fermentation.

The greater proportion of the constituents of these sulphite liquors are precipitated by lead acetate. This precipitate, decomposed by sulphuric acid, gave a solution from which alcohol threw down a flocculent substance having the empirical composition $C_{25}H_{30}SO_{12}$; the filtrate from this on evaporation yielded a gummy body, analysis of which also gave numbers expressed by the formula $C_{25}H_{30}SO_{12}$. The addition of hydrochloric acid to the original liquor precipitated a body $C_{25}H_{30}SO_{10}$; and bromine threw down a brominated derivative $C_{25}H_{28}Br_4SO_{11}$.

These products boiled with hydriodic acid for the determination of $O \cdot CH_3$ gave numbers proving the presence of 2 CH_3 groups in the above empirical formula. The S is present as SO_2H . For the original constituents of the pine-wood, of which these bodies are sulphonated derivatives, the authors arrive, after discussion, at the formula $C_{25}H_{32}(CH_3)_2O_{10}$, and point out its substantial identity with that assigned by Dietrich and König (*Landw. vers. Stat.* **13**, 222) to the *lignin* of woody tissue, as with that taken by Cross and Bevan for the *lignone* constituent of jute (*Chem. Soc. J.* **55**, 213).

Action of Nitric Acid (sp. gr. 1.35) on Pine-Wood.—From 100 grms. pine-wood, after treatment with this acid, the authors obtained 17 grms. of insoluble residue, which in composition ($C_{30}H_{40}O_{31}$) and properties was closely similar to the oxycellulose obtained by Cross and Bevan, by the oxidation with nitric acid of cotton and other celluloses (*Chem. Soc. J.* **43**). This body differs from the pectic group of plant constituents in not yielding to acid hydrolysis and containing no pentaglucose groups.

Preparation of Dextrose from "Sulphite" Cellulose.—On dissolving sulphite cellulose in concentrated sulphuric acid, diluting, boiling, and further proceeding as in the ordinary method of preparing "glucose" from cotton cellulose, the authors finally obtained 3.5 per cent. of its weight of a white sugar, and from this 2.0 per cent. of dextrose (calculated on the original cellulose). Pine-wood treated in this way yielded nearly 5 per cent. of its weight of dextrose.—C. F. C.

PATENTS.

Improvements in the Process of and Apparatus for Bleaching and Treating the Fibre of Peat or other Substances. G. A. Caunot, London. Eng. Pat. 13,102, August 1, 1891.

See under VI., page 813.

An Improvement in Oil and other Waterproof Sheets used in taking Press Copies of Letters and other Documents. A. C. Thomson, 113, Union Street, Glasgow. Eng. Pat. 18,448, October 27, 1891.

THE invention consists in combining with the oiled or waterproof paper a piece of calico, linen, or other fabric, or wire cloth or gauze, so that the sheet can not be torn when being used. "The fabric is preferably placed between two sheets or pieces of oiled paper, and secured thereto in any suitable manner."—C. O. W.

ERRATUM.

This Journal 1892, 771, col. 1, line 2, for "caustic lime" read *chloride of lime*.

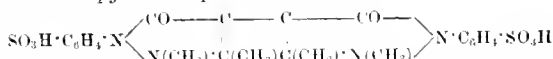
Ibid., col. 1, line 4, for " $C_{10}H_{10}N_6$ " read $C_6H_{10}O_6$.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Antipyrine-Sulphonic Acids. C. Möllenhoff. *Ber.* **25**, 1892, 1950–1951.

ANTIPYRINE dissolves with considerable evolution of heat in 30 per cent. fuming sulphuric acid, but no sulphonic acid is obtained after heating for an hour on a water-bath. Complete sulphonation is, however effected by heating for three hours at 130°. The barium salt dried at 120° forms a vitreous hygroscopic mass, having the composition $(C_{11}H_{11}N_2O_5S)_2Ba$. When its solution is acidified and sodium nitrite added, a blue-green coloration is produced.

Bisantipyridinesulphonic Acid—

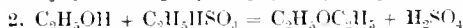
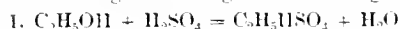


is obtained by heating on a water-bath bisantipyrene with four times its weight of fuming sulphuric acid until the product, after treatment with soda, is found to be soluble in water. The sulphonic acid can be crystallised from water in which it is readily soluble.—A. K. M.

Ether. A. C. Abraham. *The Chem. and Drug.* **41**, 520–523.

THIS paper was read before the Liverpool Chemists' Association, and is now published with numerous additions by the author. Ether, or, as it was formerly called, sulphuric ether, was known before 1540 when it was described by Valerius Cordus. It was worked at later by Boyle and Newton, and two of their assistants, Frobenius and Haukovitz, the latter of whom is said to have been the first to produce it on a large scale. The original process, which appears to have remained official until 1836, was to distil equal weights of oil of vitriol and highly rectified spirit of wine until a heavy liquid began to come over. The retort was then cooled, half the previous quantity of spirit was added, and the distillation repeated. These operations were carried on as long as ether was produced, and the crude product was then rectified. This process has been discarded in favour of the continuous one which was introduced by Boullay or Mitscherlich, and consists in running the alcohol into the sulphuric acid in a continuous stream instead of adding it in quantity from time to time. Not only is this a saving of time and fuel, but losses of ether are also avoided, as large quantities dissolved in the air admitted each time the still was cooled and expelled when reheated. Moreover it is possible to keep the temperature in the still much more constant, and thus prevent alcohol

coming over if the temperature is too low or the formation of olefiant gas, oil of wine, and other impurities, if it is too high. The author states that the reaction takes place in two stages according to the following equations—



and mentions that sulph-ethylic acid is a product of the action of alcohol on sulphuric acid, as its salts can be prepared, and also that ether is formed when alcohol and sulph-ethylic acid are distilled together. With regard to the actual proportions employed, form of apparatus, and details of manufacture, the author remarks that "makers are not generally disposed to enlighten outsiders." He mentions the temperatures given by various writers which yield the best results, and describes Squibb's process for the production of ether as giving a product superior to that ordinarily sold in this country. To every 9 parts by weight of sulphuric acid $2\frac{1}{2}$ parts by weight of spirit are put into a lead-lined still fitted with a leaden steam coil, and heated by this means to 130°C . The vapour passes first of all through a potash solution kept at such a temperature that ether and alcohol pass on uncondensed through six heated purifiers, similar to a Coffey's still, where the vapour meets warm distilled water. The ether, alcohol, and incondensable gases are then passed through a block-tin worm cooled to 35°C ., by which means the alcohol is condensed and returned to the still. The ether, containing about 4 per cent. of alcohol, is then condensed, and forms the stronger ether of the U.S. Pharmacopœia. Up to about 1846 ether appears to have been employed exclusively internally as a sedative, anti-spasmodic and carminative, and externally as a refrigerant. Its anæsthetic effect was described by Pereira in 1842, although in 1818 it was mentioned as acting in a similar way to nitrous oxide. It appears to have come into regular use as an anæsthetic after 1846, and was first employed by a surgeon in Boston. A considerable portion of the paper is devoted to a discussion of the impurities found in ether, together with their detection. They are divided into four classes:—1. Those pre-existing in the alcohol or decomposition products of such impurities. 2. Decomposition products from the alcohol and sulphuric acid. 3. Alcohol and water. 4. Products of the decomposition of the ether itself. The first impurities may be detected by allowing the ether to evaporate spontaneously, which should take place without change of odour, and should leave no residue which shows the presence of oil of wine. The impurities under 2 may be sulphurous and acetic acids, which can be detected by their action on moistened litmus paper. The presence of alcohol and water is shown by the specific gravity. Water, according to Squibb, is detected by a crystal of fuchsine (rosaniline acetate) and alcohol by the formation of iodoform when Lieben's test is applied. The fourth class of impurities would, according to the author, appear to consist of two bodies, one of which liberates iodine from potassium iodide, and the other forms a substance similar to aldehyde resin with caustic soda, but it is uncertain whether the impurities from which these substances are formed are the same or different ones. Dunstan and Dymond believe that hydrogen peroxide is the cause of the liberation of iodine, and that this body is produced from an unknown impurity formed during manufacture, and that light is not essential for the production of the peroxide. According to these investigators the ether may be purified by the use of an ample quantity of lime and twice washing with alkaline water. An ether so treated 10 years old showed no trace of peroxide. Other chemists arrive at different results. Poleck and Thummel conclude that vinyl alcohol is an impurity of commercial ether, but the author does not think this probable. His experiments show that the impurities may be removed entirely by treatment with a syrupy solution of caustic soda, but that rectification from solid caustic soda or prolonged contact with it in the cold in a finely-divided condition causes decomposition of the ether. Of the various ethers known in commerce, the following are described:—*Meth. 0.717*.—This, chemically, is an exceedingly impure article, as the specific gravity of pure ether, according to Squibb, is 0.7189 at 60°F . It is

used for producing local anæsthesia and for freezing specimens, the low gravity being due to the presence of dissolved methylic ether. *Meth. 0.725* is the purest ether derived from methylated spirit. It is said to be used for photographic purposes. *Pure 0.735*.—This is obtained from pure spirit, and is employed medicinally. *Absolute 0.720*.—This is the pure ether of the British Pharmacopœia, and is directed to be made by washing ether twice with distilled water, drying with freshly-burned lime and calcium chloride, and distilling therefrom after 24 hours. The author states that he believes it is impossible to obtain an ether of 0.720 by this means, and one firm of manufacturers for many years would not guarantee their absolute ether to have a gravity of 0.720. He also mentions, and his experiments have been confirmed, that of several samples examined, this ether was the least pure. He proposes that the following tests for *Æther Anæstheticum* should be insisted on:—1. Two fluid drachms allowed to evaporate spontaneously should not give rise to any foreign odour towards the end or after completion of the evaporation. 2. No effect should be produced upon solid sodic hydrate, solution of potassium iodide, or moistened red or blue litmus paper after 24 hours' contact. 3. Specific gravity should not exceed 0.722. In conclusion, he refers to the fact that ether made from methylated spirit contains a considerable quantity of gaseous methylic ether in solution, which lowers the specific gravity and boiling point. A methylated ether, therefore, of sp. gr. 0.720 must necessarily contain a larger proportion of alcohol, water, or other heavy impurity than one made from pure spirit, a fact which should be borne in mind.—T. A. L.

Chloroform Pietet. H. Helbing and F. W. Passmore.
Helbing's Pharm. Rec. March 1892.

THE paper describes the examination of a large number of specimens of chloroform which had been purified by Raoul Pietet's process of recrystallisation, as suggested by Professor O. Liebreich for the removal of impurities affecting its physiological value. The chemical examination of chloroform so purified agrees with the results of the physiological experiments of René du Bois Reymond in ascribing to it a high degree of purity. The authors point out the great variance in the specific gravity and boiling points of chloroform recorded by various observers as given in Carnelly's tables. They found an average specific gravity of 1.5002 at 15°C . in six specimens of chloroform Pietet, individual specimens ranging from 1.5000 to 1.5004. The boiling point observed under 756 mm. pressure was 61.0° to 61.1°C ., which most nearly approaches to Main's figure, 61.1° — 61.2°C . at 760 mm. The specimens were fractionally distilled and the specific gravity of each fraction determined, in no case any variation being found beyond the limits of experimental error and the temperature never rising above 61.1°C . In only one case did the residue amount to 0.00005 per cent. or one part in 2,000,000, and even then no bad odour was apparent. The usual tests with potassium bichromate, silver nitrate, and zinc iodide and starch gave negative results. Specimens were also examined to which a small percentage of absolute alcohol had been added, subsequent to the purification process, in order to increase their stability, but a few experiments that the authors made as to the decomposing influence of sunlight on chloroform in the presence of concentrated sulphuric acid renders the value of this addition to pure chloroform questionable. 20 cc. chloroform and 15 cc. pure concentrated sulphuric acid were exposed in nearly full bottles to sunlight. On the fourth day those specimens containing alcohol assumed a milky appearance which was not observed in the pure chloroform specimens until the sixth day. On the other hand the latter first gave evidence of hydrochloric acid with the zinc iodide test.

—F. W. P.

A Contribution to our Knowledge of Eucalyptus Oil.
H. Helbing and F. W. Passmore. *Helbing's Pharm.*
Rec. June 1892.

THE authors have made an examination of a number of commercial eucalyptus oils from various sources, which they show vary considerably in the amount of the active constituent, eucalyptol, present, and also in other characters which affect their value as medicinal agents. After determining the physical constants, the oils were submitted to careful fraction distillation and the fractions passing over between 170° and 180° C. placed in a freezing mixture of ice and salt to separate the eucalyptol, from which the cineolene was removed whilst still in the freezing mixture. Pure eucalyptol, $C_{10}H_{18}O$, crystallises at $-1^{\circ}C.$, boils at $176^{\circ}C.$, is optically inactive, possesses the specific gravity 0.923 at $15^{\circ}C.$, and is identical with cineole from wormwood oil. The results of the examination may be tabulated as follows:—

	Rotation in 200 mm. tube.	Specific gravity at $15^{\circ}C.$	Per cent. of Crystallisable Eucalyptol.
1. Ol. Eucalypti (Cumming's), I.	-11.65°	0.9205	50.1
2. " " " II.	-9.55°	0.9882	43.94
3. Ol. Eucalypti (Cumming's), redistilled.	-4.8°	0.9177	57.95
4. Ol. Eucalypti, (Australian)...	$+2.85^{\circ}$	0.9104	32.1
5. " " glob. (Californian)	$+11.7^{\circ}$	0.9022	1.8
6. " " " (Spanish) ..	$+1.2^{\circ}$	0.9281	15.8
7. " " " (French)...	-43.2°	0.8865	Nil

The Californian and Spanish oils contained in their first fractions traces of bodies of aldehydic nature, giving a crystalline compound with sodium bisulphite, which irritated the throat very much on inhalation, whilst the Spanish oil contained also a solid body that separated from the higher fractions in crystals melting about $250^{\circ}C.$ The authors do not think great stress should be laid upon the exact botanical source of an eucalyptus oil, as several varieties of eucalyptus contain as large or even a larger amount of eucalyptol than *E. globulus*, and recommend that in future editions of the British Pharmacopœia, a definite percentage of crystallisable eucalyptol shall be demanded. As eucalyptol is very difficult to purify from the last traces of terpenes it is further suggested that "crystallisable eucalyptol" should boil about $176^{\circ}C.$, and melt above $-5^{\circ}C.$, have a specific gravity between 0.922 and 0.924 at $15^{\circ}C.$ and not rotate polarised light in 100 mm. tube more than half a degree in either direction. A good oil should contain at least 40 per cent. of this constituent, and the greater portion (about 80 per cent.) distil between 170° and $190^{\circ}C.$, and of course should be free from such volatile aldehydic compounds as irritate the mucous membranes on inhalation. The other constituents met with were dextro-pinene and levo-limonene, together with levo-rotatory sesquiterpene, and according to the respective quantities of these the oil acquired its activity towards polarised light.—F. W. P.

Asaprol. Bang. *Pharm. Zeit.* 37, 324; *Chem. Zeit.* 16, 217.

ASAPROL is the name for the calcium salt of β -naphthol sulphonic acid recently given to it by Strachler and Dulieff on account of its antiseptic properties, but these are so slight as not to make this compound an important competitor with other antiseptics. It has an antithermic action on the human organism that has been proved beneficial in typhus and acute rheumatism.—F. W. P.

Carbon Tetrachloride. H. Eckenroth. *Pharm. Zeit.* 37, 339.

TETRACHLORIDE of carbon, which was discovered by Regnault and Dumas, has lately come largely into use as an extractive, solvent and crystallising medium for organic substances. It is prepared technically in large quantities by a modification of A. W. v. Hofmann's process of passing dry chlorine gas into boiling carbon bisulphide, preferably in the presence of antimony chloride. The product boiling below $100^{\circ}C.$ is boiled with caustic potash solution, and fractionated. The commercial product is a heavy colourless liquid, boiling between 75° and $80^{\circ}C.$, and on account of its non-inflammable properties is preferred in many factories to the more dangerous ether, ligroin (petroleum spirit), and carbon bisulphide, especially as its stability towards acids and halogens allows it to be used as a diluent in chlorination, &c. Chloride of sulphur, which is obtained as a by-product in the manufacture of carbon tetrachloride, finds abundant demand as a vulcanising agent in the india-rubber factory.—F. W. P.

Analysis of New Cinchona Barks. D. Howard. *Pharm. Journ.* 51, 875, 876, 898.

THESE barks were specimens of rich barks from New Granada, presented to the Pharmaceutical Society's Museum by R. Thomson, of Bogota, who is engaged in cinchona cultivation in that neighbourhood, and could not identify them with any known species or variety of cinchona. Four specimens were obtained from plants found wild in New Granada, and their analyses showed that *C. Thomsoniana*, *C. Negra*, and *C. Tuna* are very rich in quinine, yielding respectively 5.94, 7.30, and 9.04 per cent. of quinine sulphate, whilst other alkaloids were only present in comparatively small quantities. Five other cultivated varieties were also analysed, but were not on the whole so rich in quinine, though of good alkaloidal contents.

—F. W. P.

The Influence of the Carboxyl Group on the Toxic Action of Aromatic Compounds. W. Neucks and H. Bautmy. *Arch. Scienc. Biolog.* St. Petersburg, 1892, 61.

THE investigations of the authors, which include both new and old data, tend to show that the introduction of a carboxyl group into the molecule of most aromatic compounds effects a considerable decrease of their toxic action. This they attribute to be due to the fact that the carboxyl group is one that cannot be reduced in the animal organism readily, whilst poisoning is usually connected with reduction. As examples, the authors cite benzene, naphthalene, pyridine, and quinoline, which are acknowledged moderately strong poisons, whilst the corresponding carboxylic acids have been proved to be weak poisons. The toxic action of the phenols is also decreased by the introduction of a carboxylic group into the molecule. Amongst the more complex compounds the same relations have been traced between acetanilide, $C_6H_5.NH.CO.CH_3$ and malonanilic acid, $C_6H_5.NH.CO.CH_2.CO.OH$, between phenacetin, $C_6H_4(OC_2H_5).NH.CO.CH_3$, and phenacetin carboxylic acid, $C_6H_4(OC_2H_5).NH.CO.CH_2.CO.OH$, the therapeutic activity of the bases having entirely disappeared in the acids.—F. W. P.

Lead in Tartaric Acid. C. Buchet. *Journ. Pharm. Chim.* 25, 540.

THE author has found combined and even free lead in all the French and foreign tartaric acids yet examined by him.

—F. W. P.

Lead in Tartaric Acid. Guillet. Journ. Pharm. Chim. **25**, 541.

A FURTHER examination of tartaric acid for pharmaceutical use has shown lead to be present. The sample examined contained 0.0528 grm. combined and 0.0626 grm. of metallic lead per kilog.—F. W. P.

Detection and Estimation of Lead in Commercial Tartaric and Citric Acids. M. Bouquet. Repert. Pharm. **48**, 246.

See under XXIII., page 848.

The Oils of Lavender and Bergamot. J. Bertram and H. Walbaum. J. prakt. Chem. **45**, (12), 590—603.

THE etheral oil of the lavender blossom (*Lavandula vera* D.C.) is largely used in perfumery, the manufacture of lakes, and in the painting of porcelain. There are two varieties of the oil; the English oil or Mitcham oil of lavender which commands a high price, and the French article manufactured in the South of France to the extent of about thirty to forty thousand kilos. per annum. There are several varieties of the French article commanding prices varying from 3½ francs up to 16 francs per kilog. according to quality, and this quality vary considerably according to adulteration with other and cheaper etheral oils such as oil of turpentine, and the oil of *Lavandula Spica Chiaï* "Spike oil." Under such circumstances the determination of the quality and purity of oil of lavender is for the consumer of great importance. The tests hitherto adopted and based upon the smell, the specific gravity, solubility in dilute alcohol, optical properties and boiling point are approximate but still insufficient, and a research was undertaken with the object of ascertaining precisely the chemical constituents present in the oils.

The results obtained are briefly summarised as follows:—

The chief constituent of the French oil of lavender is an alcohol $C_{10}H_{18}O$ with its esters, principally the acetic ester. The alcohol of lavender, $C_{10}H_{18}O$, absorbs 4 atoms of bromine to form an addition product. With hydrochloric acid it forms a liquid chloride $C_{10}H_{17}Cl$. On oxidation with chromic acid mixture it is converted into citral, $C_{10}H_{16}O$ (Geranial). Dehydrating agents split off hydrocarbon residues $C_{10}H_{16}$ from the alcohol, amongst which terpenes and dipentene can be recognised with certainty.

From these reactions and from the physical properties of the alcohol, it follows that it is identical with the Linalool of the oil of Linaloe.

The acetic ester of Linalool is found in oil of bergamot, and is the cause of its odour.—W. S.

A Direct Method for Preparing Antipyrine. J. prakt. Chem. **45**, (12), 589.

A. MICHAEL, in an article on the *Constitution of Sodium Acetic Ether* states that he has succeeded in preparing antipyrine direct, by heating hydriodide of phenylhydrazine methyl alcohol and aceto-acetic ether together. He has also obtained it by the action of salts of the symmetrical methylphenyl-hydrazine on aceto-acetic ether.—W. S.

The Colour Reactions of Furfural and a Modification of Weppen's Veratrine Reaction. E. Lewes. Pharm. Zeit. **37**, 338.

See under XXIII., page 848.

PATENTS.

Improvements in or Connected with Apparatus or Means for Obtaining Oxygen and Nitrogen from the Air. H. Brier, Crosshill, Renfrewshire. Eng. Pat. 15,975, September 21, 1891.

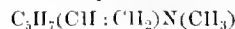
THE separation of oxygen and nitrogen from atmospheric air is rendered more efficient by the application of an arrangement of valves and cocks, which are so adjusted to the service pipes of the producing plant that during the time of transition of a furnace from the charging to the exhausting state, the excess of gases under pressure in the furnace will be delivered into a second furnace. The arrangement is applicable when the furnaces are served by two or more pumps, so that part of the installation may be under pressure and part under exhaustion simultaneously, whilst a mechanical device is added for controlling the cocks and valves. A considerable quantity of the gases and air otherwise blown to waste are saved, less nitrogen left in the furnace, and consequently a less diluted nitrogen obtained. If it is required to obtain as pure gases as possible an auxiliary exhauster and reservoir may be added to the apparatus to deal with the excess gases.—F. W. P.

Manufacture of Tropine. Meister, Lucius, and Brüning, Höchst-on-the-Maine. Eng. Pat. 16,371, September 26, 1891.

THE position of tropine as the base of several natural alkaloids, as shown by the researches of Liebermann and others, and the possibility of producing tropines by synthesis identical with or analogous to the natural alkaloids by introducing organic acid radicles into the tropine molecule, make the technical synthesis of tropine an important problem. The present patent deals with the manufacture of tropine from one of its decomposition products, dihydrobenzylidimethylamine, which can be prepared in several ways, and is isomeric with methyl-tropidine. This tertiary amine $C_6H_7 \cdot CH_2 \cdot N \cdot (CH_3)_2$ is a thin liquid oil that can be distilled and mixes with an equal weight of water. Hydrochloric acid is allowed to flow into such a mixture cooled in ice until saturated, and then allowed to stand 24 hours. A molecule of hydrochloric acid is absorbed to yield hydrochloridihydrobenzylidimethylamine, $C_6H_5Cl \cdot CH_2 \cdot N \cdot (CH_3)_2$, which is separated by dilution with ice-water and precipitation with soda-lye, when it forms a thin colourless oil. On heating this on a water-bath an isomeric change occurs and a tenacious syrup is formed, which is the chlormethylate of tropidine—



the hydrogenated benzene nucleus being broken and a new pyridine ring formed. When the temperature is still further raised this methylate gradually splits up into methyl chloride CH_3Cl , which evaporates, and tropidine—



On boiling the tropidine for several hours in a vessel with reversed cooler along with dilute soda-lye, a molecule of water is absorbed by the unsaturated side chain and tropine, $C_5H_7(CH_2 \cdot CH_2OH)N(CH_3)_2$ built up. The latter is taken up from the alkaline solution with chloroform.—F. W. P.

Improvements in the Manufacture of Granular Effervescent Mixtures. T. Kerfoot, Manchester. Eng. Pat. 12,998, July 15, 1892.

IN granulating for the manufacture of such effervescent mixtures as that commonly called citrate of magnesia, a mixture of tartaric or citric acid and bicarbonate of soda, by damping it, liberation of some of the carbon dioxide takes place, thus reducing the amount of effervescence when the mixture is finally used. To avoid this the inventor proposes to granulate the acid and carbonate separately, and to mix them afterwards in suitable proportions.

—C. O. W.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Substances of the Aromatic Series capable of Developing the latent Photographic Image. A. and L. Lumière. *Monit. Scient.* 1892, 30.

The authors have arrived at the following conclusions:—

1. A substance of the aromatic series in order to be a developer must contain at least two hydroxyl-, or two amido-groups, or one hydroxyl- and one amido-group in the benzene nucleus.

2. The preceding condition is necessary, but only holds good in the case of para-compounds. For example, orcinol does not act as a developer, but its isomeride toluquinone, does.

3. The developing property still remains when there is a number of OH and NH₂ groups in the molecule, as in the case of diamido-phenol, &c.

4. When two or more benzene nuclei, or a benzene and another nucleus are joined together, the above remarks only apply in case the OH and NH₂ groups exist in the same nucleus.

5. Substitution in the OH or NH₂ groups destroy developing properties, except when two or more of these groups remain intact.

6. Other substitutions do not seem to affect this property. Sulphonation does not destroy the developing property, if in the presence of an energetic base.

7. These remarks only apply to substances of the aromatic series.

8. Phenylhydrazine is an exception.

In a recent communication to the French Photographie Society the authors have compared paramidophenol, hydroquinone, and eikonogen. Out of contact with air, the aqueous solution of paramidophenol oxidises first, then eikonogen, and lastly hydroquinone.

The product of oxidation of paramidophenol, probably imidoquinone, is insoluble in water, but soluble in ammonia and alkalis with violet coloration, and in nitric acid with red coloration. The solution of eikonogen is coloured dark brown, changing to green with ammonia and to red with nitric acid. The oxidised solution of hydroquinone is reddish, turning yellow with ammonia and decolorised by nitric acid.

The products of oxidation of eikonogen and hydroquinone give gelatin a yellow tinge, whilst in the case of paramidophenol it is uncoloured. By means of Reeb's method the quantities of these substances required to reduce 1 gm. of silver nitrate were determined as follows:—

	Grm.
Hydroquinone	0.07
Paramidophenol	0.14
Eikonogen	0.30

The advantages of paramidophenol are as follows:—

It oxidises more rapidly and is therefore a more energetic developer.

Its oxidation products are not detrimental to the image or to the gelatin.

The authors give the following as the best developing formula—

Water	500
Carbonate of potassium	40
Sulphate of sodium	100
Paramidophenol	8

—J. C. C.

PATENTS.

Improvements in Apparatus for Producing Light. J. G. Hudson, London. Eng. Pat. 2226, February 6, 1891.

See under II., page 806.

A Simplified Form of Magnesium Lamp. P. Ellis, Wallington. Eng. Pat. 17,586, October 15, 1891.

See under II., page 807.

XXII.—EXPLOSIVES, MATCHES, Etc.

Denitration of Pyroxylin. D. Woodman. J. Amer. Chem. Soc. 14, 1892, 112—114.

The author records experiments on the reduction of celluloid to cellulose by means of ammonium sulphhydrate and other reducing agents.

Cellulose so prepared is said to be a suitable material for the production of incandescent electric lamp filaments.

—T. L. B.

New Dynamite-Conveying Plant at the Works of the American Forcite Company. Eng. and Mining J. July 23, 1892, 76.

ABOUT a year ago a serious explosion took place at the works of the American Forcite Company, at Hopatcong, N.J. It was then the custom to convey the nitroglycerin from the tank house to the five mixing houses on the side of the hill by means of slightly inclined pipes. A destructive explosion occurred in one of the mixing houses, and it was communicated by the nitroglycerin through the pipes to the tank house and to the other mixing houses. In rebuilding the plant it was obvious that a new type of conveying apparatus would have to be adopted, in order that any subsequent explosion should be confined to the particular locality in which it occurred. This was done by the construction of an aerial rope tramway, which starts from close to the tank-house and runs past the five mixing-houses. The line consists of a double rope on which a four-wheeled carriage travels, the framework of which is provided with pivoted hooks which carry buckets containing the nitroglycerin. The carriage is stopped at each station, and the required number of buckets is unhooked. These are returned empty on the return journey. The line was designed for the Company by the Union Wire Rope Tramway Co.—W. S.

The Analysis of Nitro-Explosives. P. G. Sanford. Chem. Trade J. 11, 1892, 161—162.

See under XXIII., page 843.

Progress of the Match Industry. W. Jettel. Chem. Zeit. 16, 1892, 670.

IN the first part of this article is demonstrated by various examples the uselessness, so far, of the attempts to entirely replace phosphorus by other substances or mixtures not containing it for the heads of matches or rubbing-surfaces of the match-boxes.

In order to reduce to the utmost the use of white phosphorus in the match manufacture, Switzerland is rapidly approaching a solution of the problem involved in the removal of the dangers of disease to the operatives in the match factories, by means of Government monopoly, so that the necessary restrictions may be thoroughly under control. Scarcely any other branch of chemical industry appears to be so exposed to monopoly as that of the lucifer match manufacture. In France, Greece, Servia, and Roumania the match monopoly is taken up by the State on financial grounds. On the same grounds, since 1891, in Italy, and since the beginning of the present year in Portugal, has this same monopoly been arranged, whilst, as already stated, it is to be adopted in Switzerland purely on hygienic grounds.

In the reports of the Swiss inspectors of factories there is complete unanimity as to the spread of phosphorus-necrosis of the jaw among the operatives of the match factories, and in 1891 the Bundesrath adopted the evidence as a principle. The gist of this united opinion embodied by the Swiss match factory inspectors in their report, was briefly this:—That even the newest improvements in the construction and working of the match factories do not suffice to keep down the inroads

of phosphorus-poisoning, and that the only possibility of abolishing phosphorus-neerosis lay in the complete abolition of the use of white phosphorus.

Since, moreover, experience acquired subsequently to the prohibition of white phosphorus in Swiss factories had taught the lesson that white phosphorus was still much employed secretly in the manufacturing operations, and in consequence the number of sufferers from neerosis still increased, notwithstanding the prohibition, it was deemed essential to prohibit this branch of manufacture as a private industry, and the introduction of the State monopoly was proposed, on the condition that only safety-matches, with absolute exclusion of the use of white phosphorus therein, shall be prepared under the control of the Bundesrath itself. This proposal is just now receiving confirmation and final and decisive reply. (September to October 1892.)

As regards Germany, it is not alleged that the conditions of the manufacture of lucifer matches could not be still more efficiently guarded in German factories, so as to render it possible to obey completely the necessary hygienic precautions laid down for the prevention of phosphorus-neerosis, or its limitation to a minimum. However, so far as statistical figures are concerned, the following are given in the Government reports ("*Jahresberichte der mit der Beaufsichtigung der Fabriken betrauten Beamten*") for the whole of Germany: In 1886, no cases; in 1887, eight cases; in 1888, three cases of neerosis. The figures, as reported, making it thus appear that for the whole of Germany an average of four cases per annum of neerosis result from the manufacture of matches. Assuming these figures to be correct, the author suggests that Switzerland might learn from Germany some of the hygienic precautions and improvements, as also strict factory surveillance, adopted in the Fatherland:—W. S.

Poisonous Gases from Dynamite. P. F. Charon. Eng. and Mining J. 1892, 269.

THE author states that in practice a complete explosion of nitroglycerin is never obtained, and that the gas produced always contains the vapour of nitroglycerin, which renders those breathing it liable to headache, nausea, and even vomiting. Carbonic oxide and nitrous oxide are also formed. The author advises in the treatment of the miners poisoned in this manner, that they be given strong black coffee, or better, that they should cautiously inhale ammonia, sulphurous acid, or concentrated acetic acid. He also suggests that the ventilation be made more perfect and that the noxious gases be reduced in quantity by the use of an increased quantity of detonator.—J. C. C.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

On an Appliance for Autographically Recording the Temperature of Furnaces. W. C. Roberts-Austen. Iron and Steel Inst. Autumn Meeting, 1892.

THE author has for some years advocated the use of thermo-junctions, which now appear likely to come into general use, Sir Lowthian Bell having led the way, but hitherto a systematic method of obtaining autographic records has been wanting, and the present device is the result of attempts to simplify a piece of apparatus, already described before the Institute, so as to render it serviceable for use in works. The original form consisted of a camera containing a reflecting galvanometer of the Depretz and D'Arsonval type, and of about 200 ohms resistance. The thermo-junction, placed where the temperature is to be measured, is connected with this galvanometer, the amplitude of whose deflection indicates the temperature to which the thermo-junction is exposed. An autographic record can then be obtained by allowing the spot of light from the

mirror of the galvanometer to fall upon sensitised photographic plate moved by clockwork or other suitable means. For practical use it was necessary (1) to simplify the portion of the apparatus recording the movement of the spot of light, and (2) to avoid the necessity for shifting a single thermo-junction from furnace to furnace by having a separate one in each furnace, provision being made for placing each centre of heat in turn in connection with a single galvanometer and recording instrument.

The first object was attained by substituting for the sensitised plate, a cylinder to move by internal clockwork at the rate of one revolution in twelve hours. The cylinder was covered with sensitised paper, whilst the portion of the camera containing it can be detached from the rest of the apparatus and removed to the dark room for the development of the record. To attain the second object the apparatus shown to the members was arranged for placing any one of six different centres of heat, e.g., hot blast stoves or furnaces, in connection with the galvanometer, the records being intermittent. The duration of the test in each case is according to the will of the operator, who by merely turning a handle determines which centre shall be placed in connection with the galvanometer and the duration of the test. The shifting can also be performed by clockwork, and is then entirely automatic. The method of indicating which furnace is placed in connection with the galvanometer is as follows:—For No. 1 furnace the light from the lamp passes through a single slit and gives a single datum line, while for No. 4 the light passes through four fine parallel slits, and produces four fine parallel lines, of which the lowest is the true datum line, and the deviation of the line traced by the light from the galvanometer mirror from the datum line when in use measures the temperature at the thermo-junction at that instant.

During the discussion it was stated that the platinum-rhodium junction was extremely durable and constant, varying only very little after several weeks' continuous use. Sir Lowthian Bell said that though they did wear out in time, yet with 11 furnaces in work they had not lost more than three or four, but the expense was so small as to make this of no moment. Professor Roberts-Austen said that the junctions might be covered by clay or not, but unless exposed to a shower of fine metallic rain he believed them best free, and the best resistance of galvanometer was 200 ohms.—A. W.

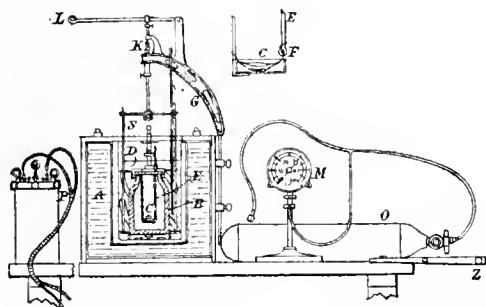
Report by A. Carnot and H. Le Chatelier on a Study of the Calorific Power of Combustibles used for Industrial Purposes, undertaken by P. Mahler. Bull. de la Soc. d'Encouragement pour l'Industrie Nat. 91 (1892), 317—374.

THE report, which occupies 57 pages of the Journal, consists of a description of researches undertaken by M. Mahler under the auspices of the Society for the Encouragement of National Industry. The object of the Society was to obtain accurate values for the combustible power of various kinds of coal, and for this purpose it voted the sum of 3,000 francs. M. Mahler, however, was not content with limiting his researches to coal, but extended them to several other combustible bodies, solid, liquid, and gaseous. He used for the purpose a modification of the calorimetric shell of M. Berthelot. The modifications have the approval of M. Berthelot, which is the surest guarantee that they in no way detract from the scientific value of the method, while, on the other hand, the approval of engineers and savants interested in the industrial applications testifies to the simplicity and manageableness of the apparatus. M. Mahler's calorimetric shell is rapidly being introduced into both scientific and industrial laboratories. In thus placing in the hands of manufacturers a method by which they can themselves ascertain with precision the calorific power of the combustibles they use, M. Mahler has rendered to national industry a service greater even than could result from the actual determinations he has made.

The principle of M. Berthelot's method is this:—The combustible body is enclosed in a shell lined with platinum, which is charged with oxygen under pressure and suspended

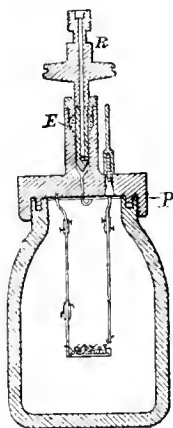
in a water-calorimeter. If the combustible is then fired by any suitable artifice, combustion is complete and practically instantaneous. The heat of combustion is transferred *without any loss*, to the water of the calorimeter. It is necessary that the oxygen should be under pressure that combustion may be complete. In M. Mahler's modification of the apparatus (Fig. 1) the shell is made of forged steel, and highly polished. The metal, which is very pure, is chosen with great care in order to ensure strength, and to facilitate the necessary enamelling. The shell has a capacity of 654 cc., and with its accessories weighs 4 kilos. Its walls are 8 mm. thick. The capacity of this shell is much greater than that of M. Berthelot in order to ensure perfect combustion, even when the purity of the gas leaves a little to be desired. Moreover, since many gaseous combustibles used for industrial purposes contain inert matters such as nitrogen and carbonic acid, it is necessary to take a large quantity of them if it is wished to obtain a measurable

Fig. 1.



rise of temperature. By thus increasing the capacity of the shell M. Mahler has united in a single instrument M. Berthelot's high-pressure shell and the older shell used by the same *savant* in his study of gaseous hydrocarbons. The shell is nickel-plated on the outside. Inside it is coated with a white enamel to preserve it from corrosion or oxidation. This coat of enamel replaces the lining of platinum, costing several thousands of francs, used by M. Berthelot. The enamel being very thin does not interfere with the transmission of the heat. The cover of the shell (Fig. 2), is of iron and carries on its inner

Fig. 2.



surface a ring of lead, P, which fits into a corresponding circular groove cut in the rim of the shell. The gas is admitted to the shell by a conical stop-cock R, made of nickel-iron, an almost unoxidisable metal. Through the cap passes a well-insulated electrode, prolonged on the inside by a rod of platinum. The cap also carries another similar rod of platinum, to which is attached the plate or

capsule upon which the combustible is placed. Attached to the two platinum rods is a small spiral of fine iron wire, and ignition of the combustible is caused by sending an electric current through this at the desired moment.

The calorimeter, the outer vessel (A, Fig. 1), the arrangement for supporting the shell, and the agitator all differ in various details from the analogous parts in M. Berthelot's apparatus, the object being to diminish the cost as much as possible. The calorimeter is of thin brass, and owing to the size of the shell is of considerable capacity. M. Mahler uses 2.2 kilos. of water, thus eliminating all error due to evaporation, and to drops of water clinging to the calorimeter. This makes the correction for loss of heat during the experiment almost negligible. From a scientific point of view the apparatus is thus very satisfactory, and is well adapted for industrial use. The agitator, of spiral form, is worked by a simple arrangement which allows the experimenter to move it regularly without fatigue. The only other parts of the apparatus that need be referred to are the thermometer, which should indicate one-hundredth of a degree, and the electric generator, either magneto-electric machine or battery, which should be capable of giving a current of 2 amperes under a pressure of 10 volts.

For the supply of oxygen, M. Mahler uses one of the cylinders of a manufacturing oxygen company. This company supplies gas free from carbonic acid but containing generally from 5 to 10 per cent. of nitrogen. The mode described of filling the shell is easy of manipulation and prevents the introduction of fatty matters such as might occur from the use of an ordinary laboratory pump.

Method of Determination.—A gramme of the substance to be experimented upon is weighed out in the capsule C (Fig. 1), which is then placed in position, and to its support is attached the fine iron spiral of known weight. This spiral should be about No. 26 to No. 30 British gauge. The lid of the shell is then firmly screwed down, and oxygen admitted slowly by the stop-cock R until the manometer M shows a pressure of from 20 to 25 atmospheres. The stop-cock is then securely closed, the shell placed in position in the calorimeter, and the thermometer and agitator properly adjusted. The water, already measured out, is then poured in and the whole is well stirred to obtain a uniform temperature. The temperature is then observed from minute to minute for four or five minutes in order to ascertain the law of cooling suitable to the apparatus. At the desired moment the combustible is ignited by connecting one pole of the generator to the electrode passing through the cap of the shell and the other pole to any part of the shell itself. Combustion is practically instantaneous, but it takes some time for the heat to pass through the shell. The temperature is observed from minute to minute until the thermometer begins to fall regularly, and for about five minutes longer in order to ascertain the law of cooling after the temperature has attained the maximum, the water being well stirred during the whole observation. On the conclusion of the experiment the stop-cock is *first* opened, and *then* the shell itself (which is washed out with distilled water in order to collect the acid liquid formed during combustion). The proportion of the acid carried out with the gas is negligible. The quantity of the acid may be estimated volumetrically by titration with potash. If the combustible contains little hydrogen, and so is unable to furnish, by combustion, sufficient water for the formation of nitric acid, it is well to place a little water at the bottom of the shell. Having made these observations, the calorific power Q can be easily calculated. If Δ is the observed rise of temperature, α the correction for cooling, P the weight of water taken, P¹ the water equivalent of the shell and its accessories, p the weight of nitric acid, p¹ the weight of the iron spiral, 0.23 cal. the heat of formation of nitric acid, and 1.6 cal. the heat of combustion of 1 grm. of iron, then—

$$Q = (\Delta + \alpha)(P + P^1) - (0.23p + 1.6p^1)$$

The details given above are applicable when the combustible is a solid, tar, or one of the fixed oils. If the combustible, however, is a volatile liquid, it must be weighed in a bulb of glass (C, Fig. 1), through the tapering orifices of which passes the iron spiral. Immediately before

closing the shell the ends of these orifices are broken off in order to allow a more ready access of the oxygen to the combustible. Solid bodies must be reduced to powder before weighing, and care must be taken when the oxygen is admitted to the shell that none of the powder is blown out of the capsule.

Determination of the Calorific Power of a Gas.—In using the shell to determine the calorific power of a gas at constant volume, its capacity is first exactly gauged. It is then filled with the gas, exhausted, and lastly filled with the gas at atmospheric pressure and at the temperature of the laboratory. The shell may then be considered filled with pure gas. The rest of the operation is the same as for liquids and solids, with this exception, that the quantity of oxygen must not be more than sufficient to make an explosive mixture. With ordinary lighting-gas, five atmospheres of oxygen are sufficient; with the gas of Siemens generators half an atmosphere should not be exceeded. This must be measured by a mercury manometer, as metallic manometers invariably give false indications for feeble pressures.

A very important part is played in these investigations by the number representing the water equivalent of the shell and its accessories. This may be calculated directly from the weights and known specific heats of the various parts, a method which would give 485.6 for M. Mahler's apparatus. It may also be obtained experimentally. M. Mahler placed in the calorimeter 2,000 grms. of water at the temperature of the laboratory, and then added about 200 grms. of water at 0° C. From the fall of temperature observed the water-equivalent is at once obtained. The mean of two experiments gave 477 grms. M. Mahler finally adopted the mean of the numbers furnished by the two methods, viz., 481 grms. He checked this value by determining the heat of combustion of naphthalene. A large number of experiments assign to this body 9,692 cal. per 1 kilogram. The details of three experiments with this substance are given below.

	1st Experiment.	2nd Experiment.	3rd Experiment.
Weight of body	1 grm.	1 grm.	1 grm.
Weight of water	2,200 "	2,200 "	2,200 "
Water-equivalent of calorimeter, shell, &c.	481 "	481 "	481 "
Corrected difference of temperature.	3.640°	3.637°	3.640°
Nitric acid formed	0.11 grm.	0.11 grm.	0.11 grm.
Weight of iron spiral ..	0.030 "	0.025 "	0.025 "
Heat of combustion'...	9.6855 cal.	9.6855 cal.	9.6935 cal.

The mean of these three experiments gives 9,688 calories per kilogramme, a value differing by less than 1 in 2,000 from the usually accepted value. M. Mahler therefore considers that the water-equivalent can be thus exactly determined.

The agreement of the three results is very remarkable, and M. Mahler has repeated a large number of experiments, and has found that, without exception, the result of the second experiment agrees very perfectly with that of the first, a fact which testifies to the value of the method.

Example of Method of Calculation.—1 grm. of colza oil is taken. The calorimeter contains 2,200 grms. of water, and the water-equivalent of the apparatus is 481 grms. The pressure of the oxygen is 25 atmospheres. The apparatus being set up in the manner described, the temperature is allowed to become uniform and then noted from minute to minute.

Min.	Preliminary Period.
0.....	10.23
1.....	10.23
2.....	10.24
3.....	10.24
4.....	10.25
5.....	10.25

The law of variation of temperature in the calorimeter before the combustion is therefore expressed by—

$$a_1 = \frac{10.25 - 10.23}{5} = 0.004^\circ$$

The electric circuit is then closed.

Period of Combustion.

Min.	°
5.....	10.80
6.....	12.90
7.....	13.79
8.....	13.84 <i>max.</i>

Subsequent Period.

9.....	13.82
10.....	13.81
11.....	13.80
12.....	13.79
13.....	13.78

The law of variation after the maximum is therefore —

$$a_2 = \frac{13.84 - 13.78}{5} = 0.012^\circ$$

The apparent variation of temperature has been—

$$13.84^\circ - 10.25^\circ = 3.59^\circ$$

During the minutes (7, 8) (6, 7) the system lost an amount of heat 2a, or 0.024°.

During the half-minute (5½, 6) the system lost a quantity of heat represented by—

$$\frac{1}{2} (a_1 + 0.005) = 0.0035^\circ.$$

But during the half-minute (5, 5½) it gained—

$$\frac{1}{2} a_0 = \frac{0.004}{2} = 0.002^\circ.$$

Hence, in the whole minute (5, 6) the quantity of heat lost is—

$$0.0035 - 0.002 = 0.0015.$$

Therefore the total heat lost before the temperature reached its maximum = 0.024 + 0.0015 or 0.0255°. This added to the 3.59° already found gives the corrected temperature-variation or 3.615°. The heat of combustion is therefore equal to 9.692 cal.

If a more exact result is wanted it is necessary to take account of the nitric acid formed and of the iron spiral.

The heat of formation of 0.13 grm. of nitric acid is 0.13 × 0.23.....	= 0.0299
The heat of combustion of 0.025 grm. of iron is 0.025 × 1.6.....	= 0.0400
Total	0.0699

The final result is, therefore, 9.6918 — 0.0699 = 9.6219 cal. per grm. of oil, or 9621.9 cal. per kilogram.

M. Mahler has carried out a number of experiments before railway engineers, miners, and metallurgists, and the opinion of these competent men is that the apparatus is of great service for industrial purposes owing to the accuracy of the determinations, the agreement between the experimental results, and the ease with which it can be used. The personal skill of the operator plays but an unimportant part in the use of this apparatus, whereas it seriously affects the results obtained in the most simple analyses.—D. E. J.

PATENT.

An Apparatus to Produce Sulphuretted Hydrogen and other Gases. M. Royon, Ostend, Belgium. Eng. Pat. 5801, April 4, 1891.

THE apparatus consists of two cylinders made of "enamelled china" or other suitable material, one within the other. The top of the outer one is open and the inner one is provided with a neck to which is applied an india-rubber stopper, through which passes a glass delivery tube fitted with a pinch tap. A short distance from the bottom of the inner cylinder is a perforated disc upon which the sulphide of iron is placed. Four holes in the side of the inner cylinder

below the level of the perforated disc establish a communication between the outer and inner cylinder. The acid is placed in the outer cylinder, and finding its way to the inside of the inner cylinder when the tap is open, decomposes the sulphide of iron liberating sulphuretted hydrogen.

—H. S. P.

INORGANIC CHEMISTRY.— QUALITATIVE.

A Rapid Test for Alkaline Bicarbonates. G. Patcin. J. Pharm. Chim. **25**, 1892, 448.

THE conventional test with magnesium sulphate is fallacious unless much neutral carbonate be present, as the latter forms sesquicarbonate in contact with bicarbonate, as can be proved by adding calomel to a solution of bicarbonate to which neutral carbonate has been added, there being no blackening, provided the amount necessary to form sesquicarbonate be not exceeded, although calomel, when treated with neutral carbonate alone, blackens at once. The author recommends the use of a very dilute alcoholic solution of phenolphthalein, which is not coloured, or only faintly coloured with a solution of bicarbonate. In any case the colour disappears on the addition of a few drops of an aqueous solution of carbon dioxide, or 1 per cent. hydrochloric acid. The method of making the test proposed consists in dissolving 1 grm. of the bicarbonate in 20 cc. of water and adding a few drops of the phenolphthalein solution. 20 drops of a 1 per cent. solution of hydrochloric acid should be more than enough to discharge any rose colour that may be produced.—B. B.

The Analysis of Nitro-Explosives. P. G. Sanford. Chem. Trade J. **11**, 1892, 161—162.

THE class of compounds that have come into the most extended use for the purposes of mining, blasting, &c. are the nitroglycerin compounds, more especially the gelatin compounds, composed of nitrocellulose and nitroglycerin, and generally containing some admixture of nitrates and wood pulp or similar materials.

KIESELGUHR DYNAMITE.

This material generally consists of 75 per cent. nitroglycerin and 25 per cent. of the infusorial earth, kieselguhr. The analysis is very simple, and may be conducted as follows:—Weigh out about 10 grms. of the substance, and place over calcium chloride, in a desiccator, for some six to eight days, and then re-weigh: the loss in weight gives the moisture; this will generally be very small, probably never more than 1 per cent. The dry substance may now be wrapped in filter-paper, the whole weighed, and the nitroglycerin extracted in the Soxhlet apparatus with ether. The ether should be distilled over at least twenty-four times. I have found, however, that results may be obtained much quicker, and quite as accurate, by leaving the dynamite in contact with ether in a small Erlenmeyer flask for some hours—leaving it overnight is better—and then decanting, and again allowing the substance to remain in contact with the ether for a few hours, and finally filtering through a weighed filter, drying at 100° C., and weighing. This gives the weight of kieselguhr. The nitroglycerin must be obtained by difference, as it is quite useless to evaporate down the ethereal solution to obtain it, as it is itself volatile to a very considerable extent at the temperature of evaporation of the ether, and the result, therefore, will always be much too low. An actual analysis of kieselguhr dynamite gave—moisture, 0.92 per cent.; kieselguhr, 26.15 per cent.; and nitroglycerin, 72.93 per cent., this last being obtained by difference.

GELATIN COMPOUNDS.

The simplest of these compounds is, of course, blasting gelatin, as it consists of nothing but nitro-cotton and nitroglycerin, the cotton being dissolved in the glycerin to form a clear jelly, the usual proportions being about 92 per cent. of nitroglycerin to 8 per cent. of nitro-cotton, but the

cotton is found as high as 10 per cent. in some gelatins. Gelatin dynamite and gelignite are blasting gelatins with varying proportions of wood pulp and saltpetre (KNO_3), mixed with a thin blasting gelatin. The method of analysis is as follows:—weigh out about 10 grms. of the substance, previously cut up in small pieces, and place over calcium chloride in a desiccator for some days. Re-weigh; the loss equals moisture. This is generally very small. The dried sample is then transferred to a small thistle-headed funnel which has been cut off from its stem, and the opening plugged with a little glass wool, and round the top rim of which a piece of fine platinum wire has been fastened, in order that it may afterwards be easily removed from the Soxhlet tube. The weight of this funnel and the glass wool must be accurately known. It is then transferred to the Soxhlet tube and exhausted with ether, which dissolves out the nitroglycerin. The weighed residue must afterwards be treated with ether-alcohol to dissolve out the nitro-cotton.

But the more expeditious method is, perhaps, to transfer the dried gelatin to a conical Erlenmeyer flask of about 500 cc. capacity, and add 250 cc. of a mixture of ether-alcohol (2 ether to 1 alcohol), and allow to stand overnight. (Sometimes a further addition of ether-alcohol is necessary, but not often). The undissolved portion, which consists of the wood pulp, and potassium nitrate, and other salts, is then filtered off, dried, and weighed.

Solution.—The ether-alcohol solution contains the nitro-cotton and the nitroglycerin in solution. To this solution add excess of chloroform, when the nitrocellulose will be precipitated in a gelatinous form. This should be filtered off through a linen filter, and allowed to drain. It is useless to attempt to use a filter pump, as it generally causes it to set solid. The precipitated cotton should then be redissolved in ether alcohol, and again precipitated with excess of chloroform. This precaution is absolutely necessary, as otherwise the results will be much too high, owing to the gelatinous precipitate retaining very considerable quantities of nitroglycerin. The precipitate is then allowed to drain as completely as possible, and finally dried in the air-bath at 40° C. until it is easily detached from the linen filter by the aid of a spatula, and then transferred to a weighed watch-glass, replaced in the oven, and dried at 40° until constant in weight. The weight found, calculated upon the 10 grms. taken, gives the percentage of nitrocellulose.

The residue left after treating the gelatin with ether-alcohol is, in the case of blasting gelatin, very small, and will probably consist of carbonate of soda. It should be dried at 40° C. and weighed, but in the case of either gelignite, or gelatin dynamite, this residue should be transferred to a beaker and boiled with distilled water, and the water decanted three or four times, and the residue finally transferred to a tared filter and washed for some time with hot water. The residue left upon the filter is wood pulp. This is carefully dried at 40° C., until constant, and weighed. The solution and washings from the wood are evaporated down in a platinum dish and dried at 100° C. in the oven and weighed. It will consist of the potassium nitrate, and any other mineral salts, such as carbonate of soda, which should always be tested for by adding a few drops of nitric acid and a little water to the residue, and again evaporating to dryness and re-weighing. From the difference in weight, the soda can be calculated, sodium nitrate having been formed.

The nitroglycerin is best found by difference, but if desired, the solutions from the precipitation of the nitrocellulose may be evaporated down upon the water-bath at 30° to 40° C., and finally dried over CaCl_2 until no smell of ether can be detected, and the nitroglycerin weighed. It will, however, always be much too low. An actual analysis of a sample of gelatin dynamite gave the following result:—

	Per Cent.
Nitrocellulose	3.819
Nitroglycerin	66.691
Wood-pulp	16.720
KNO_3	12.890
Water	9.340
	<hr/> 100.000

This sample was probably intended to contain 30 per cent. of absorbing material to 70 per cent. of explosive substances.

Gun-cotton.—Collodion cotton, and other forms of nitro-cellulose, *i.e.*, the hexa-nitrocellulose and lower nitro bodies. The first thing upon opening a case of wet gun-cotton, or in receiving a sample from "the poacher," that requires to be determined is the percentage of water that it contains; it is best done by weighing out about 1,000 grms. upon a paper tray, which has been previously dried in the oven at 100° C. for some time and become constant in weight. The tray full of cotton is then placed in a water-oven, kept at 100° C., and dried as long as it loses water. The loss gives the percentage of water. It varies from 20 to 30 per cent. as a rule, in what is known as wet cotton.

The Solubility Test.—The object of this test is to ascertain, in the case of gun-cotton, the percentage of soluble (penta and lower nitrates) cotton that it contains, or in the case of soluble cotton, the quantity of gun-cotton. The method of procedure is as follows:—5 grms. of the sample, which has been previously dried at 100° C. and afterwards exposed to the air for two hours, is transferred to a conical flask and 250 cc. of ether-alcohol added. The flask is then corked and allowed to digest, with repeated shaking, for two or three hours. The whole is then transferred to a linen filter, and when the solution has passed through, the filter is washed with a little ether and pressed in a screw-press between folds of filter-paper. The sample is then returned to the flask, and the previous treatment repeated, but it will be sufficient for it to digest for one hour the second time. The filter is then opened up and the ether allowed to evaporate. The gun-cotton is then removed from the filter and transferred to a watch-glass, and dried in the water-oven at 100° C. When it is dry it is exposed to the air for two hours and weighed. It equals the amount of gun-cotton and unconverted cotton. The non-nitrated cellulose must be determined in a separate 5 grms. and deducted.

ESTIMATION OF THE NON-NITRATED COTTON.

The sample is extracted with acetone or acetic ether, and the insoluble residue left is weighed.

ALKALINITY.

Five grms. of the air-dried and very finely-divided sample are taken from the centre of the slabs or discs and digested with about 20 cc. of $\frac{1}{4}$ hydrochloric acid, and diluted with water to about 250 cc., and shaken for about 15 minutes. The liquid is then decanted and the nitro-cotton washed with water until the washings no longer give an acid reaction. The solution, together with the washings, are then titrated with $\frac{1}{4}$ sodium carbonate, using litmus as indicator.

NITROGEN.

The estimation of the percentage of nitrogen in a sample of gun-cotton or collodion cotton is perhaps of more value, and affords a better idea of its purity and composition than any of the foregoing methods of examination, and taken in conjunction with the solubility test, it will generally give the analyst a very fair idea of the composition of his sample. If we regard gun-cotton as the hexa-nitrocellulose— $C_{12}H_{14}O_4(ON_2)_6$ the theoretical amount of nitrogen required for the formula is 14.14 per cent., and in the same way for collodion cotton, which consists of the lower nitrates, that is the penta and tetra-nitro bodies, the theoretical nitrogen is 11.11 per cent. and 6.76 per cent. respectively; so that, if in a sample of gun-cotton the nitrogen falls much lower than 14 per cent., it probably contains considerable quantities of the lower nitrates, and perhaps some non-nitrated cellulose as well ($C_{12}H_{14}O_4$), which, of course, would also lower the percentage of nitrogen. The most expeditious method of determining the nitrogen in these nitro-bodies is by the use of Lunge's nitrometer, and the best way of working the process is as follows:—Weigh out with the greatest care 0.6 gm. of the previously dried cotton in a small weighing-bottle of about 15 cc. capacity, and carefully add 10 cc. of concentrated sulphuric acid

from a pipette. Allow to stand until all the cotton is dissolved. The nitrometer should be of a capacity of 150 to 200 cc., and should contain a bulb of 100 cc. capacity at the top, and should be fitted with a Greiner and Friederich's three-way tap. When the nitro-cotton has entirely dissolved to a clear solution, raise the pressure of the nitrometer, so as to bring the mercury in the measuring tube close up to the tap. Open the tap in order to allow of the escape of any air-bubbles, and clean the surface of the mercury and the inside of the cup with a small piece of filter-paper. Now close the tap, and pour the solution of the nitro-cotton into the cup. Rinse out the bottle with 15 cc. of concentrated sulphuric acid, contained in a pipette, pouring a little of the acid over the stopper of the weighing-bottle, in case some of the solution may be on it. Now lower the pressure-tube a little, just enough to cause the solution to flow into the bulb of the measuring-tube, when the tap is slightly opened. When the solution has run in almost to the end, turn off the tap, wash down the sides of the bottle, and add to the cup of the nitrometer; allow it to flow in as before, and then wash down the sides of the cup with 10 cc. of sulphuric acid, adding little by little, and allowing each portion added to flow into the bulb of the nitrometer before adding the next portion. Great care is necessary to prevent air-bubbles obtaining admission, and if the pressure tube is lowered too far, the acid will run in with a rush and carry air along with it. The solution being all in the measuring tube, the pressure tube is again slightly raised, and the tube containing the nitro-cotton solution shaken for 10 minutes with considerable violence. It is then replaced in the clamp and the pressure relieved by lowering the pressure tube, and the whole apparatus allowed to stand for 20 minutes, in order to allow the gas evolved to assume the temperature of the room. A thermometer should be hung up close to the bulb of the measuring tube. At the end of the 20 minutes, the levels of the mercury in the pressure and measuring tubes are equalised, allowing about three inches of the sulphuric acid to one inch of mercury, and the final adjustment obtained by slightly opening the tap on the measuring tube (very slightly), after first adding a little sulphuric acid to the cup, and observing whether the acid runs in or moves up. This must be done with very great care. When accurately adjusted, it should move neither way. Now read off the volume of the NO gas in cc. from the measuring tube. Read also the thermometer suspended near the bulb, and take the height of the barometer in millimetres. The calculation is very simple.

Example Collodion Cotton.

0.6 gm. taken. Reading on measuring tube = 114.6 cc. NO.

Barometer, 750 mm. Temperature 15° C.

Since 1 cc. NO = 0.0006272 gm. N

and correcting for temperature and pressure by the formula—

$$760 \times (1 + dt) \quad (d = 0.003665) \text{ for temperature of } 15^\circ = 801.78;$$

$$\text{then } \frac{114.6 \times 100 \times 750 \times 0.006272}{801.78 \times 0.6} = 11.22 \text{ per cent. N}$$

Theory = 11.11 per cent. for $C_6H_5(NO_2)_2O_3$

The following is the analysis of a good sample of collodion cotton suitable for the manufacture of blasting gelatin, &c.:—

Soluble cotton = 99.118 per cent. } = Nitrogen = 11.67 per cent.
Gun-cotton = 0.642 " }
Non-nitrated cotton = 0.240 " Total ash = 0.25 "

The nitrogen in nitroglycerin may, of course be determined by the nitrometer, but in this case it is better to take a much smaller quantity of the substance; from 0.1 to 0.2 gm. is quite sufficient. This will give from 30 to 60 cc. of gas, and therefore a measuring tube without a 100 cc. bulb must be used.

Example.

0.1048 gm. nitroglycerin taken; barometer, 761 mm.; temperature, 15° C.; gave 32.5 cc. NO

$$32.5 \times 100 \times 761 \times 0.006272 = 18.46 \text{ per cent. N}$$

Theory for $C_3H_5(ONO)_3 = 18.50 \text{ per cent.}$

— W. S.

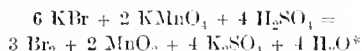
INORGANIC CHEMISTRY.— QUANTITATIVE.

The Accurate Determination of Phosphorus in Steel in Two Hours. R. Wdowiszewski. *Stahl. u. Eisen*, **12**, 1892, 381.

Two to five grms. of steel are dissolved in 30–75 cc. of nitric acid of sp. gr. 1.2, brought to the boil and treated with 10–25 cc. of potassium permanganate solution (1 per cent.). The precipitate is dissolved by the addition of hydrochloric acid (2 cc. for each gm. of steel) and heating for 20 minutes. Strong ammonia and nitric acid are then added, as in Emmerton's method, the liquid heated to 85° C., and precipitated with 25–30 cc. of molybdate solution. The precipitating flask is stoppered, shaken for five minutes, the precipitate collected on a filter, washed with a 15 per cent. solution of ammonium nitrate, and then two or three times with water. The precipitate is dissolved in standard ammonia, and the solution titrated with hydrochloric acid in the manner prescribed by E. Tilo. The results are found accurate when compared with the gravimetric method.—B. B.

A New Direct Separation of Chlorine, Bromine, and Iodine. P. Jannasch and K. Aschoff. *Zeits. anorg. Chem.*, **1**, 1892, 248 (through Chem. Rep.).

THE process depends on the facts that sodium nitrite when added to a solution of the salts of the three halogens, slightly acid with acetic or sulphuric acid, liberates iodine, and that no chlorine is evolved from a solution of an alkaline chloride containing sodium acetate and acetic acid on the addition of potassium permanganate, while in the case of a bromide all the bromine is given off according to an equation stated as follows:—



The operation is carried out in a flask of about 1 litre capacity with a ground-in stopper carrying an inlet and an outlet tube, the latter being arranged so as to prevent splashings from the contents of the flask passing into the receiving cylinder with which it is connected. The receiver has a capacity of about 500 cc., and contains 50 cc. of pure caustic soda solution and 50 cc. of hydrogen peroxide. It is kept cool by a vessel of cold water, and is connected with a second receiver to retain any traces of iodine that may find their way over. The distillation of the contents of the flask is effected by blowing in steam until all colour has disappeared. At the end of the operation the contents of the receiver is transferred to a covered porcelain dish and heated on the water-bath with a further quantity of hydrogen peroxide in order to oxidise any small quantity of sodium nitrite that may be present, and after some hours precipitated as silver salts until the colour of the precipitate, which is at first dark (silver oxide), becomes yellow (silver iodide). (No attempt is made to show that all the iodine is present as silver iodide.) The precipitate is treated with nitric acid, warmed for some hours on the water-bath, heated until the silver iodide has settled thoroughly, filtered hot, dried, fused, and weighed.

The separation of chlorine and bromine is effected by making the solution in the flask perceptibly alkaline with caustic soda, concentrating to about 50 cc., and, after cooling, adding 60 cc. of acetic acid (1:3) and a solution of 1–1.5 gm. of potassium permanganate in a little water. Caustic soda solution is placed in the receiver, and the distillation effected as before, by blowing in steam. All the bromine is carried over in $\frac{3}{4}$ to $1\frac{1}{4}$ hours. The contents of the receiver is heated for some time in a porcelain dish, and precipitated with a 10 per cent. "silver solution" mixed with an equal volume of concentrated nitric acid. (No attempt is made to show that all the bromine is present as bromide.) After standing for one or two hours on the water-bath, the silver bromide is filtered off and estimated as in the case of the iodide.

The chlorine is determined by reducing the excess of permanganate with alcohol in alkaline solution, filtration, and washing of the precipitate with lukewarm water, acidulation with nitric acid, and precipitation with "silver solution." The removal of the manganese can be effected by the alternative method of treatment with ammonia and hydrogen peroxide, the precipitate being washed with a 1 per cent. solution of sodium nitrate to prevent the occurrence of any trifling turbidity. Examples are quoted showing the accuracy of the process.—B. B.

The Quantitative Separation of Iodine and Chlorine by Precipitation with Thallous Sulphate. P. Jannasch and K. Aschoff. *Zeits. anorg. Chem.*, **1**, 1892, 248 (through Chem. Rep.).

THE process depends on the insolubility of thallous iodide in dilute alcohol in the presence of ammonium salts, while thallous chloride remains in solution under these conditions. About 0.5 gm. of a mixture of salts of the two halogens (e.g., NaCl and KI) is dissolved in 40–50 cc. of water, and 50 cc. of a 20 per cent. solution of ammonium sulphate and 30 cc. of alcohol added. A 4 per cent. solution of thallous sulphate is then added until precipitation is complete. The yellow thallous iodide separates on gently warming. After standing 12 hours in the cold, it is collected on a weighed filter by the aid of the pump, washed twice with a solution of 5 parts of ammonium sulphate in 70 parts of water and 30 of alcohol, and finally with 30–50 per cent. alcohol dried and weighed. The chlorine in the filtrate is determined by driving off the alcohol on the water-bath, diluting with water to 300 cc., heating to boiling, adding 10 cc. of concentrated nitric acid and precipitating with silver nitrate. In order to avoid the deposition of silver sulphate, the liquid and its precipitate are kept hot over a lamp for some hours and filtered hot. The process cannot be applied to the separation of bromine and chlorine as the solubility of thallous bromide is too great.—B. B.

A Modified Method for the Electrolytic Determination of Copper. G. P. Drossbach. *Chem. Zeit.*, **16**, 1892, 818.

MERCURY, silver, bismuth, antimony, arsenic, and tin are known to act disturbingly in the electrolytic separation of copper. Copper can also be completely separated from ammoniacal solutions, and that very quickly, when the solution contains fairly good conducting salts; hence it is important to know how it behaves in comparison with other metals. Silver, lead, quicksilver, and cadmium are separated at about the same rate as copper; then nickel is very slowly separated. Antimony, arsenic, and tin are not separated, that is, under the conditions of the experiments in which a weak current was used. The method adopted was as follows:—A quantity of added salt and the metallic copper were dissolved in heat in nitric acid, mixed with excess of ammonia (after the addition of sulphuric acid and filtration when lead and silver were present), filtered, and electrolysed. In the experiments Nos. 1 and 2, aluminium, antimony, arsenic, chromium, iron, cobalt, manganese, uranium, bismuth, tin, and zinc were present; and in No. 3, silver, lead, and nickel also. In experiment No. 3 the deposition took three hours, and in No. 2 from five to six hours. With a strong current kept on for a long time (12 hours) weighable quantities of cobalt and tin are deposited after the complete separation of the copper. If nickel is present the current must be stopped soon, or it will be deposited. Mercury and cadmium always act disturbingly. Under the before-mentioned conditions:—

1. 0.1350 gm. electrolytic copper yielded 0.1348 gm. Cu.
2. 0.1221 gm. electrolytic copper yielded 0.1220 gm. Cu.
3. 0.062 gm., after the separation of the added lead and silver, yielded 0.0622 gm. Cu.
4. A sample of pyrites yielded 23.47 per cent. Cu, which by the other method had given 25.53 per cent. Cu.

—G. H. R.

* The equation is given as stated although the text prescribes acetic acid instead of sulphuric acid.

The Determination of Zinc in Ores. Eng. and Mining J.
August 20, 1892, 178.

THE Colorado Scientific Society some time ago appointed a committee to inquire into the relative merits of the various processes for the determination of zinc in ores, invented and employed by Western chemists. This committee accordingly carried out a series of tests with the methods of seven chemists, viz.: Von Schulz and Low, of Denver; Mr. L. W. W. Jones, of the Pueblo Smelting and Refining Co., Pueblo, Colo.; Mr. E. N. Hawkins, of the Holden Smelting and Refining Co., Leadville, Colo.; Mr. F. C. Knight, of the Boston and Colorado Smelting Co., Argo, Colo.; Mr. Mann Page, of the Omaha and Grant Smelting Co., Denver, Colo.; Mr. F. Menzel, of the San Juan Smelting and Mining Co., Durango, Colo.; and Dr. H. C. Hahn, of the Colorado Smelting Co., Pueblo, Colo.

The tests were all conducted by Mr. L. G. Eakins, one of the staff of assistants to Mr. F. W. Clarke, chief chemist to the United States Geological Survey. Mr. Eakins also analysed each ore chemically in order to compare the accuracy of the various processes with an exact standard. The ores treated were from five different and distinct mines in Colorado, and they were chosen on account of their difficulty of analysis. They consisted chiefly of mixtures of galenite, pyrites and sphalerite, accompanied by greater or less percentages of manganese in the form of rhodochrosite, associated with a quartzose gangue.

The results of the tests are given in the following table:—

Analyst.	Percentage of Zinc.				
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Standard (Eakins).	14.64	24.11	10.71	6.31	16.00
Von Schulz & Low.	15.31	24.31	10.76	6.12	16.14
Jones.	15.39	24.53	10.83	6.28	16.46
Hawkins.	15.66	24.23	11.88	8.74	15.86
Knight.	15.08	23.80	10.69	6.85	15.90
Page.	14.62	22.00	10.50	6.30	15.37
Menzel.	..	23.62	11.07	6.89	16.08
Hahn.	14.30	23.03	8.89	5.44	13.22

From this table it will be seen that Von Schulz and Low's method gives the nearest figures to the chemical analysis. Nos. 1 and 2 give rather high figures, but in these samples Mr. Eakins detected the presence of cadmium, though unfortunately he did not estimate it quantitatively; so that this discrepancy in Von Schulz and Low's figures is thus accounted for. Dr. Hahn's method has the advantage of giving the figures for manganese and zinc from one solution, but his figures for zinc are uniformly too low. If this difficulty could be obviated the method would be highly commendable. Mr. Menzel's method is open to objection on account of the repeated use of sulphuretted hydrogen. Mr. Jones's method is practically the same as Von Schulz and Low's; and those of Messrs. Page, Hawkins, and Knight give very fair results.

Von Schulz and Low's Method.—Prepare a solution of ferrocyanide of potassium by dissolving 44 grms. of the pure salt in distilled water and diluting to 1 litre. Then prepare a standard solution as follows: Dissolve 200 mgrms. of pure oxide of zinc in 10 cc. of pure, strong hydrochloric acid. Add 7 grms. of chemically pure chloride of ammonium (free from copper) and about 100 cc. of boiling water. Titrate the clear liquid with the ferrocyanide solution until a drop tested on a porcelain plate with a drop of a strong aqueous solution of acetate of uranium shows a brown tinge. About 16 cc. of ferrocyanide solution is required. When the brown tinge is obtained, see if any of the previous tests subsequently develop a similar colour, and, if so, correct the burette reading accordingly. Usually the correction for two previous drops has to be made. One c.c. of this standardised solution equals about 0.01 grm. of zinc.

In the test take exactly 1 grm. of ore and treat it in a $\frac{3}{16}$ -in. porcelain crucible with 25 cc. of a saturated solution of chlorate of potash in nitric acid. Do not cover the casserole at first, but warm gently until any violent action is over and greenish vapours have ceased to come off. Then cover with a watch-glass and boil rapidly to complete dryness, but avoid overheating and baking. A drop of nitric acid adhering to the cover does no harm. Cool sufficiently and add 7 grms. of chloride of ammonium, 15 cc. of strong ammonia water, and 25 cc. of hot water. Cover and boil for one minute, and then, with a rubber-tipped glass rod, see that all solid matter on the cover, sides, and bottom of the casserole is either dissolved or disintegrated. Filter into a beaker and wash several times with hot chloride of ammonium solution (10 grms. to the litre). A blue coloured filtrate indicates the presence of copper. In that case add 25 cc. of strong pure hydrochloric acid and about 40 grms. of granulated test lead. Stir the lead about in the beaker until the liquid has become perfectly colourless, and continue the stirring for a short time, to make sure that the copper is all precipitated. The solution, which should still be quite hot, is now ready for filtration. In the absence of copper the lead is omitted and only the acid added.

About one-third of the solution is now set aside, and the main portion is titrated rapidly with the ferrocyanide until the end point is passed, using the uranium indicator as in the standardisation. The greater part of the reserved portion is now added, and the titration continued with more caution until the end point is again passed. Then add the remainder of the reserved portion and finish the titration carefully, ordinarily by additions of two drops of ferrocyanide at a time. Make corrections for the final reading of the burette as in the standardisation. In this process cadmium behaves like zinc, and must be separated if necessary by some other method.

Dr. Hahn's Method.—Place half a grm. of ore in a large porcelain crucible and treat it with 3 cc. dilute sulphuric acid (1 acid to 2 water), 2 cc. concentrated nitric acid and 6 cc. concentrated hydrochloric acid. Heat the solution to dryness or until fumes of sulphuric acid appear. Then remove the crucible from the hot plate and allow it to cool. Add 20 cc. of water and heat the solution to boiling for about one minute. Transfer the contents of the crucible to an 8-oz. beaker and nearly neutralise by adding a saturated solution of carbonate of soda. Add to the solution an excess of basic carbonate of lead suspended in water, until after vigorous stirring the precipitated hydroxide of iron settles quickly to the bottom, leaving the liquid clear. The solution is then heated to boiling without previous filtration and the manganese determined with a standard solution of permanganate of potash (4.86 grms. to 1 litre of water). After each addition of the permanganate the solution should be briskly stirred, as it facilitates the settling of the precipitate. If the solution appears yellow or turbid continue the stirring until it is clear. When the rose tint appears, indicating the complete precipitation of the manganese, add a few grms. of chloride of ammonium and 5 cc. of ammonia water, and filter the solution without previous beating. Wash the precipitate with water containing about $\frac{1}{15}$ th of its bulk of strong ammonia water. Add to the filtrate $12\frac{1}{2}$ cc. of hydrochloric acid. If copper is present remove it by means of granulated lead, after which determine the zinc by titrating with a standard solution of ferrocyanide of potassium and by using a uranium salt as an indicator.

—W. S.

ORGANIC CHEMISTRY.—QUALITATIVE.

Reaction of Sodium Nitroprusside with Aldehydes and Ketones. B. von Bitté. *Annalen*, 267, 372.

In a recent work on the colour reactions of the carbon compounds by E. Nickel (*Die Farbenreactionen der Kohlenstoffverbindungen*; this Journal, 1890, 904) an account is given of various observations of reactions obtained with sodium nitroprusside, which suggested to the author the need of systematic investigation of the subject. This he has carried out in regard to the aldehydes and ketones both of the aromatic and fatty series.

It appears from his researches that (1) in the fatty series colour reactions are obtained with all compounds in which the CO or COH are directly united to a hydrocarbon group; and this holds further in cases where such hydrocarbon group is on the other side united to a group in which hydrogen is replaced by other elements or radicals. (2) In the aromatic series the presence of CO or COH does not determine a leolour reaction, excepting when there is present in addition a hydrocarbon group replacing the "aromatic" hydrogen (*e.g.*, $C_6H_7.C_6H_4.CO.H$), or where the CO- or COH-group is present in a side chain (*e.g.*, $C_6H_5.CH:CH.CO.H$).

The method of observing the reaction is as follows:—A fresh solution of the nitroprusside of 0.5 per cent. strength is added in small quantity (1 cc.) to the solution of the body under observation. On making alkaline—using preferably potassium hydrate solution of 1.14 sp. gr.—the colour rapidly develops. On acidifying with mineral acids the colour is weakened and disappears more or less rapidly; organic acids and metaphosphoric acids, on the other hand, cause in many cases characteristic changes of colour.

Bodies insoluble in water may be dissolved in alcohol or ether, which, however, must be previously ascertained to be free from aldehyde or ketone. When ether is used the colour reaction is usually observed only in the underlying aqueous solution.

The reactions may be regarded as having rather a group value than as individually characteristic. From a somewhat extensive table of results we select the following as typical.

Compound.	Colour with Nitroprusside and Alkali.	Change of Colour with Organic acids and Metaphosphoric Acid.
Aldehydes:		
Acetaldehyde, $CH_3.CO.H$	Cherry red.	} Colour gradually weakened and disappearing.
Valeraldehyde, $CH_3(CH_2)_3CHO$	Violet red.	
<i>p</i> -Cuminlaldehyde, $C_6H_4.C_3H_7.CO.H$.	Yellowish red.	
Anisaldehyde, $C_6H_4.OCH_3.CO.H$...	Cherry red.	
Ketones:		
Acetone, $CH_3.CO.CH_3$	Red.	Violet red.
Methylmethylketone, $CH_3.CO.C_2H_5$...	Violet red.	Rose.
Acetophenone, $CH_3.CO.C_6H_5$	Deep red.	Indigo blue.

The author instances a number of compounds, more particularly the carbohydrates, giving no colour reactions under the above conditions:—On the other hand reactions were obtained with the following sulphur compounds: ethyl mercaptan (violet red): ethyl sulphide (red): ethyl thiocyanate (dark red).—C. F. C.

The Chemical Examination of Hand-writing. A. Robertson and J. Hofmann. Pharm. C H. N. F. 1892, 13, 225.

THE authors' method consists in drawing a goose feather, dipped in the tabulated re-agents, over the letters, &c. composing the writing, and observing the alterations produced under a power of 100 diameters.

VARIETIES OF INK.

Re-agent.	Iron-gallie Acid.	Logwood with Potassium Bichromate.	Logwood with Cupric Sulphate.	Nigrosin.	Vanadium Ink.	Resorcinol Ink.
Oxalic acid, 3 per cent.	Disappears.	Violet.	Orange-yellow.	Unaltered.	Bleached and runs slightly.	Bright-red.
*Citric acid, 10 per cent. ...	Bleached.	Violet.	Orange-yellow.	Runs and becomes dark-blue.	Bleached and runs.	Disappears.
Hydrochloric acid, 10 per cent.	Disappears but leaves a yellow colour.	Purple-red.	Blood-red.	Little altered.	Bleached slightly. runs slightly.	Bright-rose.
Sulphuric acid, 15 per cent.	Disappears.	Red.	Purple-red.	Unaltered.	Bleached slightly.	Bright-red.
Nitric acid, 20 per cent.	Disappears.	Red.	Purple-red.	Runs slightly.	Bleached slightly.	Bright-rose.
Stannous chloride, 1 part... Hydrochloric acid, 1 part... Water, 10 parts.....	} Disappears.	Red.	Magenta red.	Unaltered.	{ Bleached slightly. }	Disappears.
Sulphur dioxide (sat. sol.)..						
	Bleached.	Grey-violet.	Red.	Unaltered.	Bleached slightly and runs.	Bleached.
Chloride of gold, 4 per cent.	Bleached slightly.	Red-brown.	Brown.	Unaltered.	Unaltered.	Becomes brown and runs.
Sodium thiosulphate, 1 part Ammonia, 1 part..... Water, 10 parts.....	} Dark red.	Unaltered.	Dark-blue.	{ Becomes dark-violet and runs. }	Runs freely.	Brown.
Potassium ferrocyanide, 1 part... Hydrochloric acid, 1 part... Water, 10 parts.....						
	Blue.	Red.	Brick-red.	Unaltered.	Unaltered.	Rose.
Sodium hydrate, 4 per cent.,	Dark red.	Brown.	Becomes dark-red and runs.	Becomes dark-violet and runs.	Becomes dirty-brown and runs.	Unaltered.
Chloride of lime, 2 per cent.,	Disappears.	Disappears.	Disappears, leaving a yellow colour.	Brown.	Unaltered.	Brown.

* Tartaric acid is specified in text, citric acid in table.

Fraudulent alterations of writing are alleged to be detectable by these means.—B. B.

The Colour Reactions of Furfural and a Modification of Weppen's Veratrine Reaction. E. Laves. Pharm. Zeit. **37**, 338.

THE author shows that the colour reactions of sugar with sulphuric acid and other reagents as α -naphthol are not due to the sugar itself, but to furfural formed by the action of the acid upon the sugar. In consequence of this observation he points out the advisability of replacing sugar in Weppen's test for Veratrine, by furfural, since the reaction is less likely to be disturbed or masked by the formation of brown humin substances. He proposes a modification of the tests as follows:—Three or four drops of a 1 per cent. aqueous furfural solution are mixed with 1 cc. of concentrated sulphuric acid and brought to the edge of the substance to be tested. If veratrine be present, blue to dark green streaks appear in the liquid, which, when thoroughly mixed, assumes a dark green colour, becoming violet on warming.—F. W. P.

Adulteration of Linseed Oil. Industries, **13**, 1892, 212.

BOILED linseed oil, used in the manufacture of printing inks and varnishes, is now frequently adulterated with resin oil, and since the detection and estimation of this adulterant is a problem of some little difficulty it is likely that this form of sophistication may exist to a formidable extent. Coreil has recently shown that if chlorine gas be passed through the oil to be examined, it is rapidly blackened if any appreciable amount of resin oil is present.—W. S.

The Oils of Lavender and Bergamot. J. Bertram and H. Walbaum. J. prakt. Chem. **45** (12), 590–603.

See under XX., page 838.

Detection and Removal of Protein Substances in Beet Juice by means of Tannin. E. Bruck. Chem. Zeit. **16**, 222.

See under XVI., page 830.

The Preservation of m-Phenylenediamine Solutions for Nitrite and Hydrogen Peroxide Testing. G. Deniges. Journ. Pharm. Chim. **25**, 591.

THE general application of this excellent reagent for nitrites and hydrogen peroxide has been hitherto hindered by the instability of its solutions. The author recommends a solution of 2 grms. of hydrochloride of *m*-phenylenediamine in 100 cc. of ammonia, which will keep in a well-stoppered bottle in which 5 grms. of animal charcoal have been placed, for any reasonable length of time. The bottle is to be occasionally shaken, and the solution removed by means of a pipette when required. More concentrated solutions of the base, or any aqueous or alcoholic solutions of the salt, will not keep.—F. W. P.

ORGANIC CHEMISTRY.—QUANTITATIVE.

Detection and Estimation of Lead in Commercial Tartaric and Citric Acids. M. Bucket. Répert. Pharm. **48**, 246.

THE commercial acids are frequently contaminated with both metallic lead and lead compounds, owing to their preparation in leaden vessels. To estimate the metallic lead a quantity of 200 grms. of the acid is dissolved in three times its weight of water, a slight excess of ammonia being added to bring any crystalline lead sulphate present into solution. After 24 hours the liquid is decanted and the precipitate collected upon a filter, carefully washed, and dissolved in nitric acid. The nitric acid solution is evaporated and first sulphuric acid and then a double volume of alcohol added. The precipitated sulphate of

lead is washed with alcohol, incinerated and weighed. To determine the combined lead in the ammoniacal solution of the acid, the solution is first acidified with hydrochloric acid, the lead precipitated as sulphide, converted into sulphate and weighed.—F. W. P.

The Analysis of Coal-Tar Preparations. H. Helbing and F. W. Passmore. Helbing's Pharmacol. Rec. July 1892.

IN the absence of any concise description for the determination of the individual value of tar preparations as disinfectants by chemical methods, the authors publish a method which they have employed in their laboratory with considerable success, which consists in an adaption and refinement of the usual commercial method of estimating the hydrocarbons and tar acids. According to the concentration of a coal-tar preparation 50 or 100 grms. is taken, and if a liquid, is shaken with a double volume of ether, made strongly alkaline and extracted several times with 10 per cent. caustic soda, about 50 cc. being employed for each shaking. The process is repeated until nothing more is extracted from the ethereal layer, which can be determined by the colourlessness of the alkaline layer or the absence of turbidity when acidified. The alkaline liquors are then shaken twice with about 50 cc. ether at each shaking, and the ethereal layers added to the first. The ether now holds the whole of the hydrocarbons and any bases present in solution. The latter are removed by extraction with dilute sulphuric (not hydrochloric) acid, the acid liquors neutralised, evaporated to dryness and extracted with absolute alcohol, whereby the organic sulphates alone go into solution and can be removed and weighed. The ether is evaporated from the hydrocarbons and the latter, which usually commence to boil about 170° C. fractionally distilled in the usual way. The tar acids contained in the alkaline liquors are separated by acidification, extraction of the acid liquors with ether several times, evaporation of the ether and fractional distillation of the products. Frequently large quantities of resin acids are found to be present, which do not commence to distil until above 250° C., whereas the phenols usually present distil between 180° to 215° C. On account of the relative poisonousness of carboic acid as compared with the cresols, it is also necessary to determine the respective amounts of these, as a preparation of the latter is far more valuable as a disinfectant on account of the freedom from danger accompanying its employment. The difference in the boiling points of these compounds not being sufficient to separate a small quantity of carboic acid, and the usual tests for the latter being valueless in the presence of cresols, the authors resort again to the principle of a manufacturing process and fractionally precipitate the alkaline solution of the tar acid with small quantities of mineral acid, in which case the carboic acid is concentrated in the first fraction. In dealing with disinfectant powders containing coal-tar constituents it is necessary to remove or bring into solution the inorganic constituents and then proceed as with fluids. It is also advisable before distilling the ether from the hydrocarbons and tar acids to first wash once or twice with water to remove adherent alkalis or acids and then dry over calcium chloride.—F. W. P.

Testing Olive Oil for Adulterants. L. Paparelli. Chem. Trade J. **11**, 207–208.

THE author states that the iodine absorption values for olive oils may vary from 79–88 according to the state of maturity of the olives and to the age of the oil. The more mature the olives are, the higher is the iodine absorption, whilst old and rancid oil has a lower value. The method of oil-making is not without its influence; oils extracted by chemical solvents have a lower absorption than the same obtained by pressure; oils obtained from "pits" absorb more iodine than those prepared from the fruit. The largest influence is due to the variety of olive fruit, some genuine oils showing as high a value as 88. For the detection of cotton-seed and rape oils quite a number of

valueless tests is given (this Journal, 1892, 637). Baudouin's test for sesamé oil is recommended. It is based on the property which sesamé oil possesses of turning crimson a solution of sugar in concentrated hydrochloric acid.—J. L.

The Alcohols of Fusel Oil. R. C. Schüpphans. J. Amer. Chem. Soc. **14**, 1892, 45—60.

See under XVII., page 831.

A Method for Separating the Xylenes. J. M. Crafts. Compt. rend. **114**, 1110—1113.

A WEIGHED quantity (10 to 20 grms.) of the crude xylene is poured upon $2\frac{1}{2}$ parts of concentrated sulphuric acid, contained in a tube of hard Bohemian glass. The depth of the column of xylene is measured in millimetres, and after sealing, the tube is heated to about 120°C . for one hour, with occasional violent shaking. A saturated hydrocarbon remains floating on the surface as an insoluble layer, but before measuring it, 3 or 4 parts of a mixture of equal parts of hydrochloric acid and water must be added, with agitation and standing for an hour, in order to separate a portion which has been dissolved by the sulphonic acid. Complete cooling of this tube is avoided, so as to prevent a premature deposit of crystals.

The measuring and separation of the hydrocarbon are effected in a tap-funnel, the solvent acid being returned to the tube, which is sealed up again and heated to 122°C . for 20 hours. By this treatment 97 per cent. of the metaxylene is separated in a layer, which can be measured. The measurement is controlled by weighing, after having distilled the metaxylene with water, to free it from certain black substances, a process which yields about 0.2 gm. of such matter.

The sulphonic acids of para- and orthoxylene and ethylbenzene only exhibit traces of decomposition at about 122°C . They are, however, easily and smoothly decomposed when heated to still higher temperatures, and it is best, after removing the metaxylene, to heat up the solution to 175°C . for 20 hours. It is true that the analysis can be continued without this process, but the products are in such case not so pure.

The three regenerated hydrocarbons are dissolved in three parts of sulphuric acid, and to the cooled solution is added one volume of concentrated hydrochloric acid. When the metaxylene has been separated, only the sulphonic acid of paraxylene is precipitated in beautiful plates, which can be easily washed with concentrated hydrochloric acid on an asbestos filter, to the point at which barium chloride solution shows no longer any evidence of the presence of sulphuric acid.

It is only necessary to expose the crystals to the air until a constant weight is obtained, to estimate the proportion of paraxylene.

The crystals melt at 88°C ., and have the composition represented by the formula $(\text{C}_8\text{H}_6\text{SO}_3\text{H})_2 + 3 \text{H}_2\text{O}$, and this corresponds to 49.77 per cent. of paraxylene. The crystals are nearly insoluble in hydrochloric acid, but they are partially soluble in the sulphonic acids, and it is for this reason that a portion of the paraxylene remains in admixture with the orthoxylene.

It remains to separate the orthoxylene from the ethylbenzene. The only process for this purpose that is suitable for exact analysis has been devised by the author and M. Friedel. (*Dictionnaire de Wurtz Suppl.* 1655).

The xylenes, treated in the cold with 20 times the weight of bromine, to which some iodine has been added, yield a tetrabromide nearly insoluble in petroleum spirit, whilst ethylbenzene yields a less brominated and very soluble compound.

The first processes of this method of separation furnish an excellent means for preparing pure meta- and paraxylene, and it is evident that the preparation of orthoxylene and ethylbenzene by crystallisation of the salts of their sulphonic acids, is much simplified, when all the metaxylene and a great part of the paraxylene have been removed from the crude product.

For large-scale operations, it is preferable to operate in a closed vessel, in decomposing the sulphonic acid of metaxylene by hot steam at 122°C ., and after having twice repeated the operation a very pure substance is prepared. Even the product of a first decomposition crystallised at -52°C ., instead of -51°C . There is sacrificed about one-tenth part of the metaxylene in each treatment, and about one-fourth of the substance, which should be heated by steam at 160° — 170° for its decomposition.

The sulphonic acid of benzene does not yield benzene on heating its solution in sulphuric acid with steam. Very pure toluene can be prepared by heating the sulphuric acid solution of its sulphonic acid, with steam at 160°C . This toluene does not crystallise even at -95°C .

The results obtainable by applying these methods of separation by fractional decomposition at fixed temperatures and by precipitations with concentrated hydrochloric acid, to the very complicated case of the higher homologues of xylene, and to some products of substitution, will be communicated later on.

The influence of the mass of the sulphuric acid or hydrochloric acid on the rapidity of decomposition of the sulphonic acids, exhibit interesting phenomena which will also be later on discussed.—D. B.

ANALYTICAL AND SCIENTIFIC NOTES.

Relations between Fat-Hydrolysing and Glucoside-Resolving Ferments. W. Sigmund. Monatsh. **13**, 567—577.

CONTINUING his researches on vegetable ferments (this Journal, 1890, 959), the author has examined the action of glucoside-resolving ferments on glycerides, and, farther, the action of oleaginous seeds (or of their isolated ferments) on glucosides. As representatives of the first class, emulsin and myrosin were chosen. It was found that they were able to hydrolyse olive oil to some extent. In the second series of experiments amygdalin and salicin were acted upon by the triturated seeds of hemp, poppy, and rape, or by emulsions prepared from these seeds. The presence of hydrocyanic acid, benzaldehyde, and glucose on the one hand, and of glucose and saligenin on the other hand, proved that amygdalin and salicin had undergone hydrolysis under the influence of the ferments, special experiments having shown that albuminoid substances have no such effect. Experiments with pancreas have not been concluded yet, but seem to point to the power of the pancreatic ferment of resolving glucosides.—J. L.

The Interaction of Magnesium (Metal) and Chlorides. K. Seubert and A. Schmidt. Annalen, **267**, 218.

THE results of a systematic investigation of the action of magnesium upon chlorides of the elements of the first two groups of each of the eight classes of the "periodic" system of arrangement.

Generally it appears that in aqueous solution the magnesium replaces the elements in combination with chlorine, with exception of the more strongly basic metals of the alkali and alkaline earth groups. On heating magnesium with the anhydrous chlorides these all undergo decomposition.

The reactions are recorded in detail, and a general summary is given at the end of the paper. From the results the authors select for special mention those which point to the advantageous use of magnesium in the laboratory (1) for the separation of tin and antimony from the solution of their chlorides, e.g., as obtained in the course of their separation from other metals, by the solution of the sulphides in hydrochloric acid. The advantages of magnesium over zinc are—that the reduction is more rapid, the excess of magnesium is easily and rapidly dissolved away by dilute acids, and any disturbance resulting from the presence of lead as an impurity is not to be feared.

(2.) Magnesium is also to be recommended for the reduction of ferric salts in the process of volumetric estimation of iron, and also in the Marsh's arsenic test.—C. F. C.

Trade Report.

GENERAL TRADE NOTES.

THE ELECTRICAL INDUSTRY AND THE FUTURE SUPPLY OF GUTTA-PERCHA.

Since 1843, when Montgomery introduced gutta-percha into European industry, and it was found to be an excellent insulating material for electrical conductors, its use has rapidly increased. In 1845 the import of gutta-percha into Europe was about 9,000 kilogrammes, in 1851 it amounted to 14,000, in 1855 it was 300,000, whilst in 1890 the import was about 3,000,000 kilos. Strange to say, the electrical industry did not seem to be troubled much about the nature and production of this material which it found almost indispensable. All that was known was that gutta-percha was the dried milky juice of a tree which grew on one of the islands of the Malayan Archipelago, and on the peninsula of Malacca, and which was extracted by the natives and originally brought into commerce by the Chinese. There was some discrepancy between the descriptions of various travellers as to the process of preparing, and it is only in recent years that the authentic gutta-percha tree has been re-discovered—the *Isonandra percha* or *Isonandra gutta Hookerii*, described by W. J. Hooker as far back as 1847. The reason may have been that the natives dreaded having their industry spoiled, and therefore kept secret the places where the tree was to be found. But it was more likely that, by using a destructive method of extracting gutta-percha, it really was a question as to whether the original species was not gradually disappearing or had already disappeared.

So it happened that, in consequence of years of carelessness on the part of the various interested governments and commercial circles, the price of gutta-percha kept on increasing—in 1887 it was 2s. 6d. per kilogramme, in 1891, 4s. 6d.—and at the same time the market had to put up with increasingly impure and bad products. These were at first mixtures of pure gutta-percha and the juice of kindred trees; afterwards they consisted entirely of the latter. For certain purposes, especially for the covering of conductors for submarine cables, pure gutta-percha is really indispensable, and long experience shows that it is quite proof against salt water, which “eats” through the several coverings of tinned hemp and iron wire. Its insulating capacity even seems to increase with time. But there has been no lack of experiments and suggestions respecting substitutes for gutta-percha. For even the kindred india-rubber, which insulates nearly as well, and is, therefore, extensively used in the electrical industries, is not quite so good for cable work. And other insulating materials, such as paraffin, ozokerite, and various artificial mixtures, have partly been recognised as unsuitable, and partly require further tests as to durability. Now, the greatest care is necessary, when the enormous cost and risk of manufacturing and laying a submarine cable are considered. Two years ago the French Government could nowhere obtain tenders for two cables to Algiers, which were to be made to the original specification as to quality of insulating material, simply because it was impossible to get sufficient pure gutta-percha. Indeed we are already hearing expressions of doubt as to the insulation and consequent working of some submarine cables laid in recent years.

The difficulties of this state of affairs have been acknowledged for a series of years. In 1871 the Electrical Congress in Paris pointed them out, and asked the French Government to take measures to remove them. That Government thereupon sent M. Seligmann, the telegraph engineer, to the East Indies, to investigate the possible cultivation of the gutta-percha tree in the French colonies, and, in case of its non-existence there, to find out where the tree grew, and to acclimatise it in the French possessions. The whole of this mission was, however, only preparatory. M. Seligmann found a species of tree in the highlands of Assam, on the island of Sumatra, which apparently yielded excellent gutta-percha. He took a

number of young specimens of the tree to be grown in the Botanical Gardens of Saigon; these, however, were lost soon after their arrival.

Whilst France applied to the Dutch Colonial Office for further specimens, England, and, later on, Holland, sent out expeditions, which brought to light much interesting matter concerning the different varieties of the gutta tree and its home, without, however, definitely solving the now burning problem. Thereupon France again took the initiative, and sent M. Sérullas to the Malay Archipelago, where that gentleman had spent some time since 1887. After several failures he was able to re-discover the authentic *Isonandra gutta Hookerii*. According to his experience he asserts that the specimens of this name found in botanical gardens have very little, if any, relationship to the real tree. The gutta tree itself occurs in several varieties, which all belong to the same species, and which furnish a very good product. But there are besides quite a number of related kinds, the products of which now almost exclusively fill the market. The peculiarities of the authentic gutta-percha tree, according to M. Sérullas, consist not only in the characteristic colour and structure of the leaves, but especially in the fact that the milky juice which flows from a cut in the tree, immediately stiffens on contact with the air. This feature distinguishes it from less valuable kinds, whose juice—like that of the india-rubber tree—remains fluid for some time. This also points to a different way of extracting the juice.

Whilst in Brazil india-rubber and the less valuable kinds of gutta-percha are obtained by collecting the juice which flows from a cut in the tree, this method is impossible in the case of pure gutta-percha, because the very first drops of juice harden and close the cut. The valuable juice can only be obtained by cutting down the whole tree, and treating its various parts. Even then the whole of the juice is not obtained. The amount of gutta-percha obtained from a whole tree is about 100 grms., rarely more than 250 grms. in the younger specimens. M. Sérullas, who has seen this method in operation, contradicts other reports of travellers. During the last half century millions of trees have been sacrificed in this fashion, and if, in spite of this, the real gutta-percha tree has not quite disappeared, it is solely due to the fact that it takes 30 years before the tree can be used. But M. Sérullas considers that the natives might be brought to recognise a less destructive method of extracting, if such a method were discovered.

The tree is found, according to the reports of the various expeditions, on the south of the peninsula of Malacca, the east coast of Sumatra and adjoining isles, and on Bornen, excepting its northernmost part. We may presume that it might grow anywhere in a zone formed by the latitudes 6° N. and 6° S. of the equator. On the island Celebes, for instance, the tree is not met with at all; but this island, though in climate akin to Borneo, has a flora and fauna like the Australian continent, of which, as Wallace has shown, it was at one time a part.

The problem before us is to try to acclimatise and systematically cultivate the gutta-percha tree wherever possible in the above zone, so that European industry may again have a sufficient supply and pure quality of this important material. In the French possessions in the Indies, especially in the neighbourhood of Saigon, efforts are now being put forth; and we may look to certain success in those parts, provided the necessary care be taken. M. Sérullas, who has made a systematic study of the cultivation of the gutta tree, and has experience extending over several years, hopes to be able to grow the tree in other parts, and has for this purpose brought with him from his last expedition some hundreds of specimens, with which to experiment in Algiers and in Guiana.

In any case, it will take some time before such plantations will yield any results. Meanwhile it will be necessary to adopt a more rational method of extracting the gutta, so that existing trees shall not be altogether destroyed. M. Sérullas maintains that he and Mr. Jungfleisch have really discovered such a method. In their communication to the “Société d'Encouragement,” they declare that the greatest part of the gutta-percha is not contained in the trunk and branches, but in the leaves of the tree, and can be extracted from these by a chemical process. The dried

leaves are treated with toluene, and from the solution thus obtained the toluene is removed by a jet of steam. Gutta-percha remains, though sometimes it has a slightly green colour, due to chlorophyll. Otherwise it is, according to the discoverer of the process, perfectly pure, and in quality quite equal to that of the material obtained by the old method. A single full-grown tree yields annually about 11 kilos. of dried leaves, and these again 1 kilo. of gutta-percha, whilst the life of the tree has in no way been affected. It is hoped that the Malays may be induced to exchange the felling of the tree for the easier collecting and drying of leaves. The further treatment of the latter can then be gone through in Europe, since it has been found that the leaves are not spoilt by storage. Deceit on the part of the natives would be impossible, because the leaves of *Isonandra gutta* are easily distinguished when dried, by their structure and colour. In the interests of important branches of telegraphy and electrical industry it is certainly desirable that these hopes may be realised. At the same time it is remarkable that cable manufacturers—especially English—have been very sceptical, and have not as yet conceded the claims of equal quality and durability to the chemically-extracted gutta-percha and to that extracted by the old method.

Nevertheless even in England it is granted that the method now to be introduced will ultimately succeed, even if it takes some time, as M. Scruilas states, before French capital will make great profits by the cultivation and preparation of gutta-percha.—*Industries*.

THE SCOTCH OIL TRADE.

Young's Paraffin Company, the Pumpherston Oil Company at Uphall, and the Broxburn and Holmes Companies were the only establishments, of all the oil companies in Scotland, working at a profit during last year, and even at these works the keen competition in this industry with American and Russian oils has made the prospects for this year of a very gloomy character, especially as the price of American petroleum has still further fallen. The Scotch industry exists, however, owing to the fact that necessity has stimulated improvements in the recovery and utilisation of the residuals, and, like the Scotch iron trade, by the sale of sulphate of ammonia has been able to continue the work without very serious losses. As each ton of shale yields from 20 lb. to 60 lb. of sulphate of ammonia, those works which are located in districts where the shale is not only rich in oil, but also in nitrogen, profitable working is possible, but those companies working shales which only yield the smaller quantity of sulphate show less favourable results. The Scotch shales also yield about 12 per cent. of solid paraffin scale, which has a net selling price of about six times that of the average net selling price of the refined oil. As the Russian petroleum yields no solid paraffin, and the American never more than 1 or 2 per cent., the maintenance of a high price for scale by a combination of the Scotch shale companies should give them a fresh lease of life. Without this combination the price of scale has risen during the last few years to nearly twice the selling price at which it then stood, so that the individual companies have already adopted this policy. The question of freight is also an important one in connection with the future prospects of these companies, as without doubt the reduction in freight of the foreign petroleum brought about by the introduction of tank steamers has contributed largely to the keenness of the competition during recent years. Greater facilities of transit over the Scotch and English railways would immensely benefit the Scotch trade, and it is to be hoped that a reduction in the rates may be looked for in the future, seeing that a total stoppage of this industry would mean a loss to the railway companies.

It is interesting also to note that of the four works which, as already stated, showed a profit on last year's working, Young's is the oldest, and still employs in part of the works plant of the oldest description, whilst the Pumpherston works has had new plant within the last few years. The Pumpherston Oil

Company has, further, been fortunate in securing a field which contains shales of good quality and abundant in quantity, and although the yield of oil is low, by working with Young and Beilby's retorts a large yield of sulphate of ammonia is obtained. As the Pumpherston field was only leased to Mr. Fraser—the present managing director—in 1883, it was possible to erect plant on the most modern lines, and thus save the incubus of capital sunk in antiquated machinery under which some of the older companies are suffering. The shale is here worked by incline mines. The daily output is equal to about 1,000 cubic feet per hour, or 600 tons per day. For this large quantity of shale 424 retorts of the Young and Beilby type are required, each capable of dealing with 30 cwt. of shale per day, and the ammonia obtained necessitates a sulphate plant capable of manufacturing 20 tons of sulphate per day. This part of the plant is very efficient, and shows a marked contrast to the old fashioned "cracker boxes" which are still used by Young's Company for absorbing the ammonia. On the other hand, this company sell their sulphate in lump, while Young's company find that by crushing the crude sulphate between rollers they obtain a white granular product which is more acceptable to the farmer, and realises a slightly higher price. The serious drop in the price of sulphate from 18s. per ton, when the company first started, to the present price of about 9l. 15s., means a difference in their receipts of about 40,000l. per annum, and had not this loss been partially balanced by the increased value of the scale, the company would have passed into the non-dividend paying list.

In the whole of Scotland during 1891 the total quantity of sulphate produced was equal to 43,695 tons, and, excluding that obtained from gas liquor and iron works, the amount derived from the shale works was no less than 26,600 tons, or upwards of half the total quantity. When open contained saturators—with which it is possible to "fish" the salts directly instead of conducting a separate evaporation in shallow open pans—are employed, a greater economy in working, and therefore increased profit, on sulphate is possible.

The oil refinery at Pumpherston is in close proximity to the retorts, and has a capacity of about 120,000 gallons per week.

At Addiewell the retorts are about the same size as those at Pumpherston, and are made by Messrs. A. F. Craig and Co., Paisley. At present only 320 out of the 480 retorts are at work, so that, although the plant is larger, Young's Company at the time of the visit were not producing so large a quantity of oil.

The refinery at Young's is at present being fitted with new refrigerating plant, consisting of a 25-ton ammonia machine made by Messrs. Pontifex and Wood. Messrs. Siddeley and Mackay's ice-making machine is also in use at this establishment.

The refining of the scale is similar in the two works, and presents no novel features. At Young's, besides supplying any demands for the crude wax, as is well known, the company manufacture it into candles and night lights, and the works are equipped with plant for this purpose. At the Pumpherston Oil Works the paraffin scale is sold to candle-makers and other users of it. Quite recently a new departure is being made in utilising this material, under the name of "Laundrine," as a cleansing agent, for which it is well adapted, as, when used in small quantities in conjunction with soap, it is very efficacious for removing dirt from soiled linen, &c., and is said to render the articles of a much whiter colour than when soap alone is employed. Tablets of suitable size packed in soap boxes are now being introduced by the company.—*Ibid*.

THE SHALE OIL PRODUCTION IN SCOTLAND.

It is now some 80 years since Dr. Young, of Edinburgh, discovered that paraffin oil could be obtained by distilling the shales which are found in close proximity to the coal-fields in the south of Scotland. The deposits of this shale still appear to be practically inexhaustible, although they

have been worked for over 80 years. Of course the industry is in very small compass when compared with the enormous transactions in Russian and American oils, for during 1890 the total output of oil in Scotland was only one-fifteenth of that in this country and one-twelfth of that in Russia. The price per gallon obtained at the works is far higher, however, than here.

Their market is a home one and there is no export business, and they can obtain the same price as that of the imported article. The retail selling price of petroleum for lighting and heating purposes in Great Britain varies from 7d. to 1s. per gallon in different districts. Moreover there is a large amount of sulphate of ammonia produced in the distillation, and this chemical is sold at over 10l. per ton. The cost of production is greater, however, than here and in Russia, as the oil has to be distilled from the shale. Mr. T. Moore, in a communication to the British Federated Institution of Mining Engineers, expresses the opinion that oil and gas may yet be found in these deposits, for in some districts the geological formations present remarkable similarities to those of Pennsylvania. To the same authority we are also indebted for the following official figures of the output of shale and its products in Scotland during the last 19 years:—

Output of shale in tons of 2,240 lbs. in Scotland from 1873 to 1891—

Year.	Tons.	Year.	Tons.	Year.	Tons.
1873	524,005	1880	730,777	1887	1,390,320
1874	351,910	1881	912,171	1888	2,052,202
1875	424,926	1882	904,487	1889	1,986,990
1876	541,273	1883	1,139,729	1890	2,180,483
1877	684,118	1884	1,469,649	1891	2,337,932
1878	645,939	1885	1,741,750		
1879	712,428	1886	1,669,144		

Products obtained from one ton of shale, and total price realised at works from the refined products obtained from one ton of shale—

Year.	Crude Oil.	Naphtha.	Sulphate of Ammonia.	Total Price received per Ton of Shale.
	Galls.	Galls.	Lb.	£ s. d.
1877	30'49	..	17'37	1 3 2
1882	29'84	..	13'77	0 14 4
1887	27'96	..	28'95	0 11 2½
1891	25'00	1'73	27'23	0 13 2

Yield of finished products from 100 gallons of crude oil—

Year.	Lighting and Heating Oil.	Lubricating Oil.	Medium Oil.	Scale.	Total.
	Galls.	Galls.	Galls.	Galls.	Galls.
1877	40'35	10'70	4'43	8'26	63'74
1882	31'64	11'35	11'08	10'41	64'48
1887	34'12	13'45	6'25	13'12	66'94
1891	30'81	12'63	11'78	14'72	69'87

Net prices realised at works for products—

Year.	Burning and Heating Oil.	Lubricating Oil.	Medium Oil.	Scale.	Naphtha.	Sulphate of Ammonia. Per Ton.
	Pence per Gall.	Pence per Gall.	Pence per Gall.	Pence per Lb.	Pence per Gall.	£ s. d.
1887	9'3	11'0	6'7	4'3	..	17 5 6
1882	4'3	7'4	4'1	2'4	..	15 2 3
1887	3'2	2'2	1'1	2'1	..	10 3 0
1891	4'2	3'7	2'8	2'3	5'1	10 7 1

--Eng. and Mining Journal.

THE PETROLEUM INDUSTRY IN RUSSIA.

The *Journal de St. Pétersbourg* says that one of the questions now occupying the attention of the press in Russia is the crisis which has supervened in the petroleum industry of that country.

In 1891 there were at Bakn 77 companies for the extraction of naphtha. The production was 288,500,000 pounds (pound = 36 lb. avoirdupois), extracted with the aid of 6,000 permanent workmen, without counting day labourers.

Comparing the results of last year with those of the preceding year, it is remarked that in 1891 there were obtained 48,000,000 pounds more naphtha than in 1890, which is equivalent to an increase of 21 per cent. This increased yield does not arise from the increase in the natural wealth of the soil, but from the large number of new wells which have been opened at great expense.

Certain fissures correspond to springs so rich in naphtha that the liquid bursts out from the soil. But this is only exceptional, and in the majority of cases recourse is obliged to be had to mechanical means to extract it from the fissures. The number of naphtha fountains diminishes each year; in 1887 they formed 42 per cent. of the total production; in 1888 this figure was reduced to 40 per cent., and it fell to 22 per cent. in the course of the two following years. In 1891 the fountains only gave 39,000,000 pounds, or 14 per cent. of the general total.

Although this considerable diminution in the yield of the fountains indicates that the extraction of naphtha will meet with greater difficulties, the *Revue* (a report issued by the Association of Russian Naphtha Producers) looks upon this phenomenon with satisfaction for, thanks to it, a certain equilibrium in the extraction of naphtha may be hoped for. At present the annual production of the wells varies to the degree that the results of some often exceed 50 and 60 times the quantity of naphtha extracted in the adjacent wells, and this immense difference in the natural conditions of production generally acquires some significance in the years of over-production, as was the case at Bakn last year. In these conditions there is but little question of regulating the production by the aid of an agreement between the owners of the springs. At the end of 1891, for example, prices fell to 1½ copecks per pound of naphtha, that is to say, to a rate less than the average cost of extraction, and notwithstanding this certain producers having realised large profits owing to the exceptional richness of their wells.

The *Revue* mentioned above divides the producers of naphtha into several groups: the first, which it calls "the permanent beneficiaries of naphtha production," possess the best lands, where each new well yields two or three million pounds per annum. The latter do not think of extending their operations, being contented with what few million pounds they get for almost nothing (with the exception of one copeck per pound). In proximity to these large companies, some small producers, having accidentally discovered a rich fountain or a naphtha well, come and establish themselves. Up to 30 per cent. of the total supply passes through the hands of these permanent or temporary beneficiaries.

The second group, which forms the business centre, consists of a few large houses who obtain 50 per cent. of the total naphtha. Being given the dimensions of their production, even the discovery of new fountains has no influence on the prices of production, which falls but little below two copecks per pound.

The worse conditions are those of the third group of operators, who have not discovered wells sufficiently rich in naphtha.

Prices have undergone marked fluctuations during the last 10 years. By reason of a large diminution in production, prices rose considerably in the summer of 1890, and reached eight or nine copecks per pound, but the following autumn a reaction set in, and the prices were reduced to four and five copecks towards the end of the year. The following year this tendency became more marked, so that the average price of naphtha in 1891 was 2½ copecks. Notwithstanding the evidence of over-production, digging operations, far from diminishing, were largely extended in 1891.

In 1889, 6,500 sagesnes (sagene = 6 ft.) were dug; in 1890, 15,000 sagesnes; and in 1891, 20,000 sagesnes. This activity was kept up until July 1891, after which it somewhat subsided. The expenses incurred in connection with these works last year are estimated at four millions of roubles. Such a considerable expenditure can only render very critical the position of several companies in presence of the large drop in prices.

Under the influence of the depreciation of naphtha and petroleum the general results for 1891 have been very insufficient in the industrial district of Baku. The average profits have sufficed neither to pay the interest nor to cover expenses. Taking into consideration the very unequal distribution of the losses between the manufacturers, it is seen that a number of the latter have suffered very severely.—*Board of Trade Journal*.

MINERAL AND METALLURGICAL OUTPUT OF AUSTRIA IN 1891.

	1891.	1890.	1891.	1890.
	Metric Tons.		Value in Florins.	
Gold ore	4,397	15,468	14,446	18,619
Silver ore	115,383	144,941	3,180,885	3,167,179
Quicksilver ore	706,332	707,299	1,035,561	891,687
Copper ore	93,180	75,032	354,575	343,422
Iron ore.....	12,312,484	13,615,478	2,854,889	3,105,765
Lead ore	133,607	112,736	1,068,512	969,622
Nickel ore } .....	..	4	..	318
Cobalt ore }				
Zinc ore	288,282	326,322	575,547	558,812
Tin ore.....	7,205	5,692	3,600	5,168
Bismuth ore	10,833	7,929	25,476	19,032
Antimony ore.	3,334	7,701	42,575	51,881
Arsenic ore	42	..	391	..
Uranium ore.....	225	256	19,314	41,674
Wolfram ore	567	378	21,380	12,337
Sulphur ore.....	30,885	54,223	37,204	64,263
Alum and alum stone.	343,943	588,384	20,950	35,968
Manganese ore	52,793	80,068	70,743	102,625
Graphite.....	213,462	237,283	693,327	726,036
Asphalt.....	1,800	1,808	2,808	2,962
Lignite	161,830,762	153,290,565	30,769,056	27,639,115
Bituminous coal	91,928,846	89,310,649	32,681,693	30,401,078
			73,465,432	68,270,343

METALLURGICAL OUTPUT OF AUSTRIA IN 1891.

	1891.	1890.	1891.	1890.
			Value in Florins.	
Gold, kilos.....	14,717	21,573	19,273	29,095
Silver, kilos.	36,037.46	35,862.7	3,219,048	3,197,585
	Metric Tons.			
Quicksilver	570.2	541.7	1,383,683	1,596,563
Copper.....	1,033.1	992.5	584,720	602,163
Copper vitriol.....	197.8	338.4	42,287	108,805
Pig iron	517,388.2	574,711.4	20,582,753	23,295,187
Forge iron	99,156.6	91,558.9	4,298,332	4,015,430
Lead.....	7,583.3	8,297.0	1,206,105	1,399,495
Litharge.....	2,267.6	1,912.7	353,059	296,554
Nickel sulphate	1.5	..	1,050	..
Zinc	5,005.6	5,448.7	1,375,076	1,467,841
Tin	56.2	49.7	63,718	59,437
Bismuth	0.64	0.116	5,606	1,914
Antimony.....	115.4	200	45,318	83,585
Uranium salts	4.13	3.95	45,244	64,213
Sulphur	45.0	37.3	3,417	2,642
Vitriolstein	2,831.0	3,717.0	48,523	66,596
Sulphuric acid.....	12,267.9	11,333.8	374,577	441,947
Alum	1,126.6	1,463.6	74,340	101,633
Copperas.....	1,184.3	1,288.2	33,158	38,655
Mineral paint	838.4	778.3	25,351	22,137
			33,784,598	36,891,477

MINERAL AND METALLURGICAL OUTPUT OF AUSTRIA IN 1891.

The Austrian Government has shown commendable promptitude in publishing so early the statistics relating to her mining and metallurgical industries. The figures here given are taken from the "Statistisches Jahrbuch" for 1891, recently issued by the K. K. Ackerminister, and for them we are indebted to the "Oesterreichische Zeitschrift für Berg und Huttenwesen."

There was a notable increase in the total value of the ores produced, due almost entirely to the increased amount of lignite and bituminous coal mined. There was also a slight increase in the values of silver, quicksilver, lead and copper ores which was more than counterbalanced by the decreased value of the output of gold, iron, manganese and graphite ores. Metallurgical products show a decided falling off, the value of the output but very slightly exceeding that of 1889.—*Eng. and Mining Journal*.

GROUND MICA INDUSTRY IN NORTH CAROLINA.

Western North Carolina has for many years been known as one of the principal mica producers of the world. But two years ago this valuable industry came to a sudden termination by the importation of Indian mica. Within the past year, however, many of the mines in Mitchell and Yancey counties, North Carolina, have been reopened, owing to the increased tariff on imported mica—30 per cent. *ad valorem*—and at present the outlook is good for a complete revival of the mica mining operations in this State on a larger and more extensive scale. As is well known, the mining of merchantable cut mica is attended with a great many factors of uncertainty; and particularly when it is carried on, as it has been, without system, and hence

without regard to the future developments of the mines. The nature of the deposits, the irregularity of the veins in themselves, and the great irregularity of the vein matter, carrying the large blocks of good mica, such as will do for cutting metachantable patterns, greatly increases the cost of mining; there is much waste and consequently great expense. This waste is now about to be turned to an economical purpose by the grinding of the heretofore almost worthless scrap mica, for use in the manufacture of wall paper and lubricants, particularly the former. For this purpose the powdered mica must be in a floating condition, which is effected by wet grinding. The scrap is first roughly hand-picked and washed, after which the general principles of the process consist in a wet grinding, drying, and finally bolting to different sizes or grades. There are at present three mills in Mitchell county, N.C.—at Plum Tree, Hanson's Creek, and Spruce Pine—in the valley of the North-Tae River.

The Margarine Mica Company of North Carolina, with New York office at 4, Gold Street, is operating a small mill, having an output at present of about 10 tons per month; it is hoped to increase this yield in the near future. They grind to five sizes—80, 100, 140, 160, and 200 meshes to the square inch. The quoted prices of these products delivered in New York are respectively 5, 7, 8, 9, and 10 cents per pound. The progress of this industry may be watched with interest, and, in connection with the increased use of the more inferior spotted or discoloured mica for insulating purposes in electrical appliances, its importance to the development of this mining district cannot be over-estimated.—*Eng. and Mining Journal*.

REPORT OF THE PRINCIPAL OF THE LABORATORY OF THE BOARD OF ISLAND REVENUE.

The total number of samples analysed during the year was 48,566, 130 more than in the previous year.

The increased facilities granted in the latter part of 1888 for the exportation on drawback of medicinal tinctures are evidently developing an important branch of trade, as is shown by an increase of no less than 872 samples submitted during the year for estimation of the amount of spirit present.

A fresh investigation into the character of the milk now generally produced, in order to ascertain whether any material changes which would affect the standards of quality hitherto relied on as a guide in dealing with suspected samples, has been undertaken and will be continued during the current year.

An important series of experiments on disinfectants undertaken for the Board of Trade is mentioned. The object was to fix a standard of efficiency for disinfectants intended to be used on board passenger and merchant ships, and to revise the list of disinfectants in the medical scales of the Board of Trade. It was decided to adopt as standards a solution containing 80 per cent. of carbolic acid, and a powder containing 20 per cent. of carbolic acid. Every disinfectant on the Board of Trade list was examined bacteriologically, in order to determine whether it was equal in value to the standard as an antiseptic and disinfectant. The experiments extended over several months, the result being that nearly every liquid disinfectant on the list was found to be inferior to an equal bulk of the carbolic acid solution, and in the case of powders to an equal weight of the carbolic acid powder. Revised medical scales have now been issued by the Board of Trade embodying the recommendations of this committee.

An elaborate investigation was made as to the gas-producing quality of a sample of Indian coal, to see whether it was fitted economically for use in India. It gave about three-fifths as much gas as ordinary English coal and the coke was very inferior.

Of the 539 miscellaneous samples examined for the Indian Government, 141 were either not genuine or inferior in quality. Among these may be mentioned rape oil adulterated with mineral oil, pearl barley faced with chalk, white lead mixed with barium sulphate, zinc white with white lead, lamp black with a large excess of mineral matter, brass tubing lined with so-called tin more than half

of which was lead, and two samples of verdigris mixed with 40 per cent. of sodium sulphate in one case and 25 per cent. of cupric sulphate in the other.

810 samples of naphtha have been examined and of these 64 were rejected as unfit for methylating purposes. Pressure is stated to be put upon producers of naphtha by methylators to supply a comparatively pure naphtha, such as, from a revenue point of view, is unsuitable for the purpose. Attempts to obtain approval for such naphtha during the past year have been numerous, and have resulted in so large a number of the samples being rejected.

Dr. Bell mentions the change made during the year in the character of methylated spirits allowed to be sold by retail. In order to prevent the use of such spirit as a beverage, the Board decided, at his suggestion, that while methylated spirit for general use in the arts and manufactures should be still allowed as hitherto, that portion sold by retail to the general public should contain a small addition of petroleum. This admixture renders the methylated spirit turbid when diluted, and also more offensive in character. The retail sales since its introduction have largely fallen off, and there is every reason to believe that the practice of using such spirit for drinking purposes has been extensively abandoned, if not altogether stamped out. By the course adopted it is further stated a more effective control can now be exercised over the uses to which the spirit is applied.

From the requests made to the Board for the use of ordinary methylated spirit, it has been evident in some cases that the applicants had hitherto been making an improper use of such spirit.

NITRATE OF POTASH AND PLUMBAGO IN MASHONALAND.

The British South African Company has received a report from Mr. Griffiths, mining engineer of the De Beers Syndicate, stating that he has made a valuable discovery of nitrates near Mount Darwin, in the direction of the Ilunyan River. The deposit, which consists of pure nitrate of potassium, lies in beds varying in thickness from 3 feet to 20 feet, and extending over an area of some 20 miles. He has also discovered a rich bed of plumbago in the same neighbourhood. This latter lies in the alluvium, but is very pure, and he says there is a sufficient quantity to be worked for 50 years.—*Chemist and Druggist*.

FERTILISERS IN THE WEST INDIES.

Special reports from United States Consuls located in the West Indies indicate that American fertilisers are not making much headway in the West Indies. We give the following extracts:—

Jamaica.—Intelligent and practical users of fertilisers assure Vice-Consul Wright that if American manufacturers will hold out the same inducements in regard to analysing the soils and manipulating the manure to supply the requirements thereof, as English manufacturers do, and in addition thereto will sell at the same price fertilisers of the same commercial value, the item of freights being so much in favour of the United States, our manufacturers can turn the tide in their favour.

Martinique.—There are no duties on fertilisers, and wharfage is nominal. Small lots of sulphate of ammonia and nitrate of potash have been recently imported from the United States through a commission house.

Matanzas.—No attempt has been made to introduce fertilisers from abroad.

St. Thomas.—There is no demand for fertilisers; all planters have home-made manure.

St. Christopher.—A few years ago the English fertiliser companies sent out a chemist who analysed the soil and prepared a special formula of a fertiliser for the sugar-cane plant, which is very popular here and sells at the highest price, 60 dols. per ton.

Trinidad.—The United States got somewhat of a foothold last year; it is still not fairly in the market.—*Eng. and Mining Journal*.

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

	Month ending 30th September	
	1891.	1892.
	£	£
Metals.....	1,837,262	1,570,592
Chemicals and dyestuffs.....	498,734	530,529
Oils.....	575,161	535,865
Raw materials for non-textile industries.....	4,029,509	4,073,661
Total value of all imports....	34,089,301	31,485,305

SUMMARY OF EXPORTS.

	Month ending 30th September	
	1891.	1892.
	£	£
Metals (other than machinery)	3,041,307	2,837,498
Chemicals and medicines	722,206	744,709
Miscellaneous articles.....	2,629,592	2,360,083
Total value of all exports.....	20,793,543	19,104,859

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Alkali..... Cwt.	6,501	4,341	4,216	3,237
Bark (tanners, &c.) ..	46,564	45,715	21,453	18,009
Brimstone	29,922	49,917	8,848	14,499
Chemicals..... Value £	..	..	101,348	127,015
Cochineal	948	354	5,753	2,111
Cutch and gambier Tons	2,278	1,349	50,718	28,164
Dyes :—				
Aniline .....	..	..	18,254	12,513
Alizarine .....	..	..	22,914	57,430
Other .....	..	..	967	47
Indigo	346	3,919	5,896	47,331
Nitrate of soda....	148,206	134,927	66,553	55,802
Nitrate of potash .	16,557	20,982	15,155	17,075
Valonia	929	2,043	17,860	26,271
Other articles... Value £	..	..	158,899	110,425
Total value of chemicals	..	..	498,734	530,529

IMPORTS OF METALS FOR MONTH ENDING 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Copper:—			£	£
Ore..... Tons	6,462	9,047	67,189	48,945
Regulus	8,740	7,492	224,284	167,046
Unwrought	3,618	3,362	202,931	153,998
Iron:—				
Ore.....	201,764	315,985	154,852	229,156
Bolt, bar, &c.	7,343	6,758	70,870	66,167
Steel, unwrought..	1,229	583	10,833	5,947
Lead, pig and sheet	13,076	15,651	164,430	169,107
Pyrites	39,173	34,340	66,038	62,790
Quicksilver	81,610	54,965	9,380	4,781
Tin..... Cwt.	48,890	46,839	223,080	222,084
Zinc	5,632	3,312	129,008	70,591
Other articles ... Value £	..	..	513,167	369,977
Total value of metals	..	..	1,837,262	1,570,592

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Bark, Peruvian .. Cwt.	4,973	5,601	12,377	11,597
Bristles..... Lh.	535,024	280,258	68,415	47,968
Caoutchouc..... Cwt.	14,937	20,920	153,937	213,178
Gum :—				
Arabic.....	3,767	5,932	10,712	13,704
Lac, &c.....	5,827	3,622	23,332	14,616
Gutta-percha	4,827	4,006	48,781	41,112
Hides, raw :—				
Dry.....	31,500	24,517	85,539	59,619
Wet	62,206	37,771	144,723	84,949
Ivory	980	1,014	49,914	46,906
Manure :—				
Guano	1,731	1,101	10,174	6,131
Bones.....	3,737	4,281	17,600	16,842
Paraffin..... Cwt.	45,271	43,254	67,104	61,920
Linen rags..... Tons	2,258	618	22,615	4,242
Esparto.....	8,799	14,147	45,859	71,181
Pulp of wood	14,340	12,011	75,460	69,750
Rosin..... Cwt.	121,824	127,296	30,170	32,269
Tallow and stearin	73,572	90,920	108,075	116,435
Tar	29,633	36,071	16,916	21,576
Wood :—				
Hewn	258,257	268,045	549,364	525,186
Sawn	637,248	672,602	1,320,143	1,467,504
Staves	17,348	17,383	70,999	61,479
Mahogany	3,954	5,830	38,359	50,578
Other articles.... Value £	..	..	1,059,050	1,007,829
Total value .....	..	..	4,029,509	4,073,661

Besides the above, drugs to the value of 68,699*l.* were imported as against 58,575*l.* in September 1891.

IMPORTS OF OILS FOR MONTH ENDING 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Cocoa-nut..... Cwt.	120	2,097	£ 291	£ 2,159
Olive Tuns	1,409	1,525	58,477	56,974
Palm Cwt.	81,433	81,278	94,578	82,586
Petroleum Gall.	10,212,360	7,154,843	221,024	136,952
Seed Tons	1,874	2,143	53,243	55,292
Train, &c..... Tuns	2,909	2,463	44,104	48,062
Turpentine Cwt.	29,275	71,501	40,601	74,857
Other articles .. Value £	..	..	62,843	78,983
Total value of oils ...	..	..	575,161	535,865

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Brass..... Cwt.	10,084	8,166	45,782	33,714
Copper:—				
Unwrought "	46,351	66,171	124,852	160,932
Wrought..... "	27,009	24,510	91,681	74,491
Mixed metal "	23,566	22,310	67,078	54,072
Hardware Value £	..	..	220,059	182,337
Implements..... "	..	..	104,462	99,500
Iron and steel.... Tons	283,806	267,603	2,085,691	1,933,965
Lead "	3,994	3,900	55,467	44,405
Plated wares... Value £	..	..	36,413	30,740
Telegraph wires, &c. "	..	..	78,662	68,944
Tin Cwt.	9,388	11,762	44,840	56,571
Zinc "	8,638	14,337	9,264	12,764
Other articles .. Value £	..	..	77,056	85,173
Total value .....	..	..	3,041,397	2,837,498

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Alkali..... Cwt.	569,000	519,098	£ 220,522	£ 184,744
Bleaching materials ..	132,307	141,294	46,235	57,418
Chemical manures. Tons	27,792	29,147	149,402	177,273
Medicines..... Value £	..	..	92,218	84,037
Other articles ... "	..	..	213,829	241,237
Total value .....	..	..	722,206	744,709

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Gunpowder..... Lb.	798,000	622,900	£ 20,946	£ 19,259
Military stores.. Value £	..	..	100,389	87,957
Candles..... Lb.	1,298,600	1,339,500	25,932	25,449
Caoutchouc Value £	..	..	102,038	101,035
Cement..... Tons	46,242	34,892	91,197	62,333
Products of coal Value £	..	..	99,524	104,508
Earthenware ... "	..	..	172,672	156,721
Stoneware ..... "	..	..	10,163	14,308
Glass:—				
Plate..... Sq. Ft.	273,227	236,416	17,535	8,904
Flint..... Cwt.	9,603	7,204	21,084	20,518
Bottles..... "	67,740	56,410	32,364	28,328
Other kinds.... "	16,094	21,221	13,824	17,779
Leather:—				
Unwrought "	13,016	10,718	116,093	98,229
Wrought Value £	..	..	33,066	37,883
Seed oil..... Tons	5,578	4,765	120,512	91,133
Floorcloth Sq. Yds.	1,665,500	1,265,200	70,182	57,556
Painters' materials Val. £	..	..	140,221	117,875
Paper Cwt.	80,280	73,132	152,495	123,575
Rags..... Tons	3,945	4,590	26,918	33,132
Soap Cwt.	46,534	40,778	46,842	44,893
Total value .....	..	..	2,629,592	2,360,053

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

16,726. E. Theisen. Method of and apparatus for producing intimate frictional action between liquids and gases or vapours, by means of centrifugal force, for effecting either the evaporation of the liquids of the interchange of temperature between the liquids and gases, or the mixing of the gases with, or their separation from, the liquids. September 19.

17,301. D. W. Noakes. Improvements in gauges used for ascertaining the pressure in compressed gas cylinders and other reservoirs. September 28.

17,458. W. W. Fyfe. Improvements in and connected with furnaces and means for calcining and treating complex ores. September 30.

17,519. W. H. Westwood, E. T. Wright, and W. W. S. Westwood. Improvements in washes for washing gases. October 1.

17,824. W. Mather. See Class VII.

18,325. F. T. Bond. An appliance for making infusions or extracts of vegetable or other matters. October 13.

COMPLETE SPECIFICATIONS ACCEPTED.*

1891.

18,488. J. Sutton. See Class XVII.

18,959. A. Feldman. Distilling apparatus suitable for the treatment of ammoniacal liquors. October 19.

20,142. J. C. Mewburn.—From The Maschinenfabrik Grevenbroich. See Class XVI.

20,677. W. R. Jones. Furnaces. October 5.

20,788. E. Goedicke. Reverberatory furnaces. October 5.

21,157. J. Dawson. Thermometers. October 19.

21,730. M. F. Purcell and G. Purcell. Apparatus for the purification of gaseous fumes, air, and the like, and the deposition of solid particles therefrom. October 19.

22,089. P. Labric. See Class XVI.

1892.

7753. J. Morrison. Ejectors for ejecting water, thick or thin, or tar and ammonia water. October 5.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

16,694. B. Ratcliff. Improvements in or additions to carbon lamps or carbon burners for illuminating purposes. September 19.

16,750. F. Grein. Charging machine for gas retorts. Complete Specification. September 19.

17,067. H. Collet and M. Merichenski. Improvements in making gas, and a compound therefor. September 24.

17,262. R. M. Bidelman. Improvements in the manufacture of gas. Complete Specification. September 27.

17,394. H. E. Newton.—From R. N. Oakman, jun., United States. Improved apparatus for the manufacture of illuminating gas. September 29.

17,419. F. J. Collin. Improvements in coke furnaces. Complete Specification. September 29.

17,484. P. Jensen.—From H. Stierner and M. Ziegler, Germany. Process of and apparatus for working up organic fibrines of large and hardened form for the purpose of procuring tar, oil, paraffin, asphalt, pitch, heating and illuminating gases, and large coke. Complete Specification. September 30.

17,519. W. H. Westwood, E. T. Wright, and W. W. S. Westwood. See Class I.

17,644. J. A. Yeadon and W. Adgie. Improvements in retorts for the distillation of oil from shale or other analogous substances. October 4.

18,047. N. McFarlane Henderson, J. S. MacArthur, and E. Hunt. See Class III.

18,521. H. H. Lake.—From T. G. B. de Ferrari di G. B., Italy. Improvements in and relating to apparatus for burning petroleum, naphtha, and other liquid fuels in steam-boiler furnaces. Complete Specification. October 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

19,496. J. Lyle. The treatment of ingredients for the manufacture of fuel briquettes. October 19.

19,758. Sir G. Elliot, Bart., and J. McGowan, jun. Manufacture of coke. October 19.

20,780. A. Jabs. Method of manufacturing producer- and water-gas. October 5.

21,249. E. Drorg. Apparatus for charging inclined retorts for use in the manufacture of coal-gas, and for similar purposes. September 28.

1892.

6697. J. Morley. Treatment of ingredients and the manufacture of compound blocks for use as fire-lighters. September 28.

7708. J. C. Chandler. Apparatus for washing, purifying, and scrubbing gas. September 28.

12,762. E. A. Erb. Combustion of carbonaceous fuel. October 19.

16,322. C. Winter. Artificial fuel. October 13.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

17,484. P. Jensen.—From H. Stierner and M. Ziegler, Germany. See Class II.

18,017. N. McFarlane Henderson, J. S. McArthur, and E. Hunt. Improvements in or connected with the destructive distillation of oil-yielding or gas-yielding minerals, and the obtaining of products therefrom. October 10.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

16,814. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of triphenylmethan dyestuffs. September 20.

16,815. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new basic colouring matters. September 20.

17,070. Read, Holliday, and Sons, Limited, and J. Turner. Improvements in the production of azo-colouring matters. September 24.

17,147. B. Willeox.—From F. von Heyden, Germany. Improvements in the manufacture of chloro-para-oxybenzoic acids. September 26.

17,546. H. H. Lake.—From K. Oehler, Germany. Improvements in the manufacture of colouring matters. October 1.

* See Note (*) on previous page.

17,673. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture or production of dyestuffs. October 4.

17,674. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture or production of colouring matters derived from anthraquinone. October 4.

17,770. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new azo-colouring matters, and processes for dyeing and printing therewith. October 5.

18,081. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Reduction of blue to blue-green colouring matters of the triphenylmethan series. October 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

19,062. B. Willeox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture and production of colouring matters. October 19.

20,275. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture and production of azo-dyes, and of materials therefor. September 28.

21,717. B. Willeox.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture and production of new derivatives of alizarin and its analogues. October 19.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

16,935. R. Cottam. An improvement for more effectually cleaning textile fabrics in the process of manufacture. September 22.

16,951. C. E. Wright. An improved method of treating silk textile fabrics for preventing the formation of mildew upon the same. September 22.

17,055. D. Donald. Improvements in the manufacture of jute yarns. September 24.

18,358. A. F. B. Gomess. A new or improved process for the treatment of textile vegetable fibres, and in apparatus connected therewith. October 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

17,325. G. E. Armstrong. Composition for treatment of fibres. September 28.

18,851. W. Golding. Compound of india-rubber and fibre formed by treating fibrous fabrics, yarns, cords, &c., with rubber, so that the fibrous material is permeated by the rubber, and the individual fibres are embedded therein, constituting a new manufacture to be called "Rubbric," and processes, apparatus, and machinery for producing the same. October 5.

19,710. F. G. Annison. Treatment of linen and other textile fabrics, applicable to the manufacture of show bills, show cards, posters, tablets, wall decorations and other purposes. September 28.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

18,031. T. Briggs and E. Webb. Improvements in apparatus for printing textile fabrics. October 10.

18,052. T. Lye and W. T. Lye. Improvements in the bleaching or dyeing of "chip," "straw," and "chip-plait," and "straw-plait." October 10.

18,395. S. W. Wilkinson and R. A. L. Hutchinson. An improved method or process of sizing fibrous materials. October 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

20,574. J. Longmore and R. Williamson. Dyeing silk and other fibres. October 5.

1892.

11,416. F. F. Grafton and W. Browning. Process for the production and fixation of colours in conjunction with aniline black upon woven fabrics. September 7.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

16,757. J. Rice. Improvements in or relating to the manufacture of sulphuric acid. September 20.

16,873. C. L. C. Berton. Improvements in the process of precipitating oxide of tin from solutions. September 21.

16,874. C. L. C. Berton. Improved process for the precipitation of tin from acid solutions containing same with other metals. September 21.

16,922. J. S. MacArthur. Improvements in obtaining cyanides. September 22.

17,216. H. C. Bull. An improved process for recovering sulphur from sulphurous acid and for obtaining bisulphide of carbon, and apparatus therefor. September 27.

17,228. W. P. Thompson.—From T. Mayer, Germany. A new or improved manufacture of double salts containing fluorine and an always constant amount of antimony. September 27.

17,240. A. V. Newton.—From A. Nobel, France. Improvements in the production of cyanides. September 27.

17,241. A. V. Newton.—From A. Nobel, France. An improved mode of producing nitrogen compounds. September 27.

17,661. H. H. Lake.—From E. Noriega, Mexico. See Class X.

17,824. W. Mather. Improvements in the dehydration of ammonia and other volatile liquids, vapours, or gases, and in apparatus therefor. October 6.

17,911. P. M. Justice.—From E. G. Acheson, United States. Improvements in and connected with carbonaceous compounds. October 7.

18,232. A. Vogt and A. R. Scott. Improvements in treating manganese nitrate for the recovery of nitric acid and manganese peroxide. October 12.

18,496. J. Morris. New or improved process for the production of crystals or crystalline masses. October 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

17,745. F. M. Lyte and C. H. M. Lyte. Production of chlorine conjointly with the purification of lead and the recovery of silver. October 19.

18,231. D. Rylands. Processes for producing carbonic acid gas. September 28.

18,481. J. E. Bott. Manufacture of salt. October 5.

18,693. W. Smith. See Class XIII.

18,959. A. Feldman. See Class I.

19,375. C. Hoefner. Manufacture of chlorine. October 19.

22,018. A. Vogt. Manufacture of nitric acid. October 12.

22,541. J. Brock and J. T. Marsh. Manufacture of carbonates of strontium and barium. September 28.

22,704. H. H. Lake.—From V. Hametelle. Apparatus for use in the concentration of sulphuric acid. October 19.

1892.

192. A. S. Caldwell. Apparatus for evaporating and incinerating spent or used alkaline lyes or similar waste products. September 28.

2415. J. Wetter.—From H. and E. Albert and Co. Process for obtaining alkali phosphates from neutral or acid alkali sulphates. October 19.

8276. La Société A. R. Pechiney et Cie. Apparatus for the manufacture of a mixture of hydrochloric acid gas and air. September 28.

10,450. E. J. Barbier. Process and apparatus for the production of neutral sulphate of soda and sulphuric acid from bisulphate of soda. October 12.

10,599. E. Lohmann. Process for producing pure carbonic acid gas. October 12.

15,275. W. Stones and R. Bardsley. Method and apparatus for the production of carbonic acid gas. October 5.

15,513. H. J. Haddan.—From P. Viscount Lambilly. New process for the production of the cyanides of the alkalis and alkaline earths by the simultaneous employment of a hydrocarbon and ammonia gases, with the addition, if desired, of free nitrogen. October 5.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

16,792. F. Shuman. Improvements in the method of and apparatus for manufacturing wire glass. Complete Specification. September 20.

17,042. A. Horsfall. Improvements in frits for the production of glazes, enamels, &c. applicable to china, earthenware, metals, &c. September 24.

17,848. P. Sievert. Process for producing flat objects of glass and means for carrying out such process. Complete Specification. October 6.

18,135. L. H. Pearce. Improvements in the manufacture of blown glass articles. October 11.

18,178. J. Wade, W. Wade, and H. Wallace. A new or improved process for decorating tiles. Complete Specification. October 11.

18,313. J. B. Adams. Improvements in the manufacture of spherical bodies from glass or the like, and apparatus therefor. October 13.

18,448. P. Sievert. Process and means for manufacturing glass pipes. Complete Specification. October 14.

18,510. J. C. Mewburn.—From E. F. W. Hirsch, Germany. Improvements in the process of and apparatus for melting glass composition in melting tanks or melting pots. October 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

18,230. D. Rylands. Furnaces or retorts used in the production of glass and for similar purposes. October 12.

19,777. T. C. J. Thomas. Construction of tank furnaces for the manufacture of glass. October 19.

20,280. Craven, Dunnill, and Co., Limited, and F. R. Smith. Manufacture of tiles and the like, and apparatus therefor. October 5.

20,861. J. E. G. Meran. A new product to serve as a substitute for pottery, for filtering purposes, and for the manufacture of tobacco pipes and the like. October 12.

1892.

16,241. J. C. Duntze. Process for producing colours on glass surfaces. October 19.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

16,717. J. C. Bloomfield. Improvements in the manufacture of plaster. September 19.

18,234. W. H. Pochin. An improved method of making Croft, Adamant, Victoria, and similar concrete paving slabs, kerbs, channels, window sills, steps, and tiles. October 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

17,050. J. U. Robertson.—From C. W. Kennedy. See Class XIII.

19,106. D. Ward. Making coloured stucco, coloured concrete blocks and tiles. October 12.

1892.

15,147. J. E. Keseling and C. Fuchs, jun. Artificial stone composition. September 28.

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

16,800. J. Strap. A process for recovering copper and nickel from ores or matters containing these metals. September 20.

16,891. E. Ruck and F. N. Raggatt. Improvements in or relating to the smelting of zinc. September 21.

16,894. J. C. Montgomerie. Improvements in the extraction of gold and silver from ores or compounds containing the same. September 21.

17,081. A. Culley. A silver-plating compound. September 24.

17,206. J. Colley and T. Twynam. Improvements in the manufacture of ingot iron and steel. September 27.

17,339. G. F. Thomson. Improvements in or relating to the manufacture of iron and steel. September 28.

17,521. J. H. Darby. Improvements in or appertaining to furnaces for the manufacture of pig or cast iron. October 1.

17,576. W. Mills. Improvements in the manufacture of sodium. October 3.

17,619. J. D. Gilmour and J. Finlay. Improvements in the extraction of copper or other metals from ore. October 4.

17,661. H. H. Lake.—From E. Noriega, Mexico. Improvements in and relating to the preparation of reagents for working gold and silver ores. October 4.

17,692. E. H. Saniter. Improvements in or relating to the purification of iron or steel from sulphur. October 4.

17,694. J. W. Kynaston. Improvements in the extraction of bismuth, especially applicable to the treatment of the flue dust of copper works. October 4.

17,825. H. Imray.—From La Compagnie Anonyme des Forges de Chatillon et Commentry, France. A process for facilitating the fusion of mild steel and other refractory metals. October 6.

17,908. W. Smethurst. A new or improved furnace for the reduction or smelting of zinc, lead, silver, gold, and other ores. Complete Specification. October 7.

17,918. C. A. Netto, J. Pfleger, and L. Hausmann. Improvements in the production of easily separable metallic deposits. October 7.

17,928. C. H. Hubbell. An improvement in the manufacture of mineral wool. Complete Specification. October 7.

17,951. T. Twynam. Improvements in the recovery of tin from tin-plate scrap. October 8.

18,082. C. D. Abel.—From Harder Bergwerks-und Hütten-Verein, Germany. Process for the removal of manganese from pig iron, ingot iron, and steel. Complete Specification. October 10.

18,163. C. Allen and C. Davey. Improvements in the manufacture of cast iron and steel, and apparatus therefor. October 11.

18,275. M. Lewthwaite. An improvement connected with the treatment of metals in a fluid state. October 12.

18,292. H. M. Hyndman.—From J. Vandessluis, France. A new or improved process for the production of aluminium. October 12.

18,307. T. F. Bardour. Improved process for extracting gold, silver, and other metals from ores. October 13.

18,394. W. Mills. Improvements in the manufacture of aluminium and apparatus therefor. October 14.

18,494. J. M. Stuart and J. W. Cohen. Improvements in obtaining precious metals from their ores. October 15.

18,495. J. M. Stuart and J. W. Cohen. Improvements in the apparatus to be used in obtaining precious metals from their ores. October 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

16,273. J. H. Bibby. Process of smelting copper ores and furnaces or apparatus applicable therefor. September 28.

17,745. F. M. Lyte and C. H. M. Lyte. See Class VII.

18,990. J. Colley. Adding metallic and non-metallic substances to steel and iron. October 12.

20,461. E. K. Dutton.—From A. Mathies. Production of hollow steel ingots, and apparatus therefor. October 5.

21,114. E. Norton. Coating metals. September 28.

1892.

8612a. E. H. Saniter. Purification of iron. October 19.

15,058. E. Martin. Process for alloying the surfaces of metal wires, strips, plates, sheets, and the like. September 28.

15,248. J. W. Sutton. Wet process for the extraction of gold or silver, or both, from pulverised ores or other finely-divided material, and apparatus therefor. September 28.

15,584. J. W. Chenall. Extraction of metals from their ores. October 5.

16,173. J. T. Wainright. Process of reducing un-smelted ore, including roasted ore, furnace cinders, and like material. October 19.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

16,822. T. Craney. Improvements in electrolytic apparatus. Complete Specification. September 20.

16,866. A. Müller. Improvements in electrode-plates for secondary batteries. September 21.

16,878. E. Bailey and J. Hall. Improved plates for secondary batteries. September 21.

16,892. D. Tommasi. Process and apparatus for the extraction, separation, and refining of metals by electrolysis. Filed September 21. Date applied for, April 1, 1892, being date of application in France.

16,893. D. Tommasi. Process and apparatus for the extraction, separation, and refining of metals by electrolysis. Filed September 21. Date applied for, May 21, 1892, being date of application in France.

16,919. J. Swinburne. Improvements in and connected with dynamo-electric machinery, alternating current motors, transformers, manufacture of ozone and oxide of nitrogen, recovery of tin from scrap, electro-plating with aluminium. September 22.

17,099. H. T. Barnett. An improvement in carbon electrodes. September 24.

17,169. C. Kellner. Improvements in or relating to the electrolytical decomposition of metallic salts, and in apparatus therefor. September 26.

17,222. W. P. Thompson.—From C. L. Coffin, United States. Improvements in or relating to electric metal working or welding. Complete Specification. September 27.

17,223. W. P. Thompson.—From C. L. Coffin, United States. Improvements in or relating to welding or working metals electrically. Complete Specification. September 27.

17,224. W. P. Thompson.—From C. L. Coffin, United States. Improvements in apparatus for electrically heating and working metal. Complete Specification. September 27.

17,225. W. P. Thompson.—From C. L. Coffin, United States. Improvements in the method of and apparatus for electrically welding metals. Complete Specification. September 27.

17,226. W. P. Thompson.—From C. L. Coffin, United States. Improvements in the method of and apparatus for welding or heating metals electrically. Complete Specification. September 27.

17,227. W. P. Thompson.—From C. L. Coffin, United States. Improvements in or relating to electrically welding or heating metals. Complete Specification. September 27.

17,246. T. J. D. Rawlins. Improvements in or connected with electric primary batteries. September 27.

17,348. R. J. Crowley. Improvements in or relating to batteries. September 28.

17,466. H. C. Bull and Gustavus, Baron de Overbeck. An improved electro-metallurgical process. September 30.

17,922. F. King and E. Clark. Improvements in secondary batteries. October 7.

17,930. J. Hirshfeld, W. Morison, A. P. Morison, and W. Wright. Improvements in secondary batteries. October 7.

17,931. J. Hirshfeld, W. Morison, A. P. Morison, and W. Wright. Improvements in battery compounds. October 7.

18,037. W. C. Mountain. Improvements in electric welding apparatus. October 10.

18,039. J. Hargreaves and T. Bird. Improvements in electrolytic cells and diaphragms. October 10.

18,215. J. Muter. Electro-plating ceramic, vitreous, and similar non-conducting substances. October 12.

18,280. H. Gardnep.—From E. Francke, Germany. Improved construction of grid plates for holding the active material in secondary batteries. October 12.

18,516. E. N. A. Picard and J. A. Tanière. Improvements in and relating to the electro-deposition of metals. Complete Specification. October 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

16,934. H. H. Lake.—From P. Kennedy and C. J. Diss. Secondary or storage batteries. October 5.

16,938. H. H. Lake.—From P. Kennedy and C. J. Diss. Secondary or storage batteries. October 5.

18,256. A. S. Ford.—From H. Pottier. Process for the electro-deposition of metal upon the surface of glass, porcelain, china, earthenware, and other materials. October 12.

19,704. J. C. Richardson. Application of depolarisers in electrolysis. October 19.

19,775. A. Breuer. Diaphragms for electrolytic decomposing apparatus. October 5.

20,312. J. M. Moffat. Form of electrical battery cells, boxes, or vessels. September 28.

1892.

14,089. C. C. Lesenberg and J. von der Poppenburg. Dry galvanic batteries. October 5.

14,814. E. P. Usher. Storage batteries. October 5.

14,816. E. P. Usher. Electric battery plates. October 5.

15,477. A. F. W. Kreinsen. Means for and method of melting metals and other materials by electricity. October 19.

15,799. E. Nunan and J. W. Nelson. Galvanic batteries. October 9.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

16,767. W. Mills. Improvements in and relating to the recovery of soap and suint from wool-grease. September 20.

16,827. W. R. Lake.—From W. T. Cutter, United States. Improvements relating to the cleansing of or extraction of

fatty substances from wool and the like, and to a method of clarifying the solvent used therefor. Complete Specification. September 20.

16,954. A. G. Petty. Improvements in the steam treatment of oils and fats for purifying or distilling purposes. September 22.

17,230. J. C. Lahusen. Improvements in or relating to the production of a neutral wool-grease from suint or wool washings. September 27.

17,478. J. C. Fell.—From H. Heller, Austria. See Class XVIII.—C.

18,086. E. Hill, F. W. J. Webb, A. W. Machouachie, and S. Roper. Improvements in cleaning and renovating compositions. October 10.

18,451. M. Perls. An improved manufacture of soap. October 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

18,224. W. Mills. Bleaching, deodorising, and purifying fats and oils, and apparatus therefor. September 24.

20,590. E. J. T. Digby. Manufacture of soap. October 5.

1892.

14,405. H. H. Lake.—From O. P. Amend and J. H. Macy. Desulphuration of oils. October 5.

15,012. J. Trent and G. Henderson. Process of extracting, purifying, and saving the fat or grease from wool, and for cleaning the wool by the use of benzole (benzene) or any other spirituous liquid suitable for dissolving the fat or grease. September 28.

15,899. J. C. Decker. Oil for general painting. October 12.

16,018. W. H. Horton and E. M. Taylor. Dry soap or soap powder for use for certain purposes. October 12.

XIII.—PAINTS, PIGMENTS VARNISHES, AND RESINS.

APPLICATIONS.

17,739. R. Hutchison. Improvements in treating or preparing gutta-percha and rubber for various purposes. October 5.

17,808. M. N. d'Andria. Improvements in the manufacture of pigments. October 6.

17,872. R. J. White and J. C. Martin. Improvements in oil and water colour paints. October 7.

18,346. H. C. Standage and C. Smith. Improvements in the manufacture of pigments. October 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

17,050. J. U. Robertson.—From C. W. Kennedy. Processes for making plastic compounds or compositions. October 19.

18,693. W. Smith. Preparation of acetate of ammonia for use in the manufacture of white lead by the acetate of ammonia process. October 12.

18,709. T. H. Cobley. Treatment of lead ores and the production therefrom of white lead, salts of and colours of lead, as also simultaneously zinc white. October 5.

18,895. C. H. Matthews.—From E. S. Matthews. Compound for coating ships' bottoms, piles, and structures subject to the influence of sea-water. October 5.

21,203. J. C. Chapman.—From J. M. James. A process of and materials for coating metallic surfaces for the prevention of fouling and corrosion, and reducing surface friction. October 19.

1892.

14,656. A. J. Smith. Manufacture of white lead. October 12.

14,794. G. D. Coleman. Process and apparatus for the manufacture of white lead and other lead pigments. September 28.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATION.

18,143. C. A. Jensen.—From W. M. Walters. A new or improved putty or marine glue. October 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

20,755. W. P. Thompson.—From F. Kranseder and A. Lentsch. Apparatus or appliances for use in drying sheets of glue, gelatin, and the like. September 28.

21,774. G. van Haecht and C. Obozinski. A new process for tanning, and apparatus relating thereto. October 19.

1892.

15,630. E. Brand. Manufacture of animal glue. Oct. 5.

XV.—AGRICULTURE AND MANURES.

APPLICATION.

18,129. A. Macarthur. An improved fertiliser. Oct. 11.

XVI.—SUGARS, STARCHES, GUMS, ETC.

APPLICATION.

16,810. G. J. Epstein. The treatment of residue from breweries, distilleries, or starch factories, or of grain, flour, or other matter containing gluten or albuminates or gluten or albumen and starch for the obtainment of useful products therefrom. September 20.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

20,142. J. C. Mewburn.—From The Maschinenfabrik, Grevenbroich. Centrifugal machines or hydro-extractors for extracting sugar juice from crystals, and for other purposes. September 28.

22,089. P. Labrie. Apparatus for evaporating saccharine or other solutions or liquids. October 19.

1892.

15,897. A. Rümpler. Process and apparatus for the production of invert sugar and dextrose. October 12.

XVII.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

16,810. G. J. Epstein. See Class XVI.

16,896. F. E. V. Baines. Improvements in the treatment of rice or other grain for the obtainment of a product suitable for use in brewing and distilling, and for other purposes. September 21.

17,258. E. Adam. Improvements in malt beverages. Complete Specification. September 27.

17,927. R. Hges. Improvements in the method of and apparatus for distilling mash for the purpose of obtaining highly concentrated fusel oil and purified alcohol. Complete Specification. October 7.

18,332. W. H. Willis. An improved apparatus for taking samples of beer from fermenting vessels. October 13.

18,370. A. T. Harris. Harris's patent rectifier. October 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

17,374. J. Takamine. Production of alcoholic ferments, and of fermented liquors thereby. October 19.

17,395. J. Hillyard and E. Dugdale. Manufacture of beer and porter or like beverages. October 12.

18,488. J. Sutton. Process for filtering beer and other liquids, and apparatus therefor. October 19.

25,566. W. P. Thompson.—From O. E. Nycander and G. Francke. Process for the production of yeast and spirit by the employment of ozonised air, or oxygen. October 19.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

18,064. J. Berlit. New or improved manufacture of a substance or composition suitable for use as a substitute for cocoa. October 10.

B.—Sanitary Chemistry.

16,838. J. Burton. Improvements in the means for drying, burning, and consuming the refuse and garbage of towns usually burnt in destructor furnaces. September 21.

17,006. W. D. Scott-Moncrieff. Improvements in or relating to the treatment of sewage. September 23.

17,255. C. G. Matthews and F. E. Lott. Improvements in or relating to the treatment of sewage. September 27.

17,302. A. P. I. Cotterell. An appliance for facilitating withdrawal of sludge or deposit in sewage tanks, applicable also to clarifying water and other liquids. September 28.

17,815. V. J. C. Boulengier. Improvements relating to the disinfection of cesspools and the utilisation of the disinfected matter. Complete Specification. October 6.

18,317. J. Watts. Improvements in apparatus for generating and applying fumes, smoke, or vapours for disinfecting, deodorising, or fumigating purposes, or for the testing of pipes or passages by what is known as the smoke test, or for analogous purposes. October 13.

C.—Disinfectants.

16,807. W. Cooper. An improved disinfectant, insect destroyer, and deodoriser combined. September 21.

17,178. J. C. Fell.—From H. Heller, Austria. An improved disinfecting soap. September 30.

18,198. J. McHardy and M. E. A. Wallis. Improved disinfecting toilet-paper. October 15.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1891.

21,706. O. Imray.—From The Farbwerke vormals Meister, Lucius, und Brünig. Process for preserving organic substances and for disinfection. October 19.

1892.

14,349. G. Barker.—From R. B. Beaumont. Gelatinous food products. October 19.

B.—Sanitary Chemistry.

1891.

17,769. E. Grimshaw. A new or improved compound for the precipitation and purification of sewage and other waste water, and drinking water. October 5.

19,157. E. Grimshaw and H. Grimshaw. The purification of waste effluent waters from manufacturing processes. October 12.

19,739. T. Wardle. Wardle's patent process for the treatment of sewage and other refuse matters. October 19.

22,442. J. Hanson. Treatment of sewage and other foul liquid or semi-liquid matters for the clarification, disinfection, and deodorisation thereof. October 19.

1892.

9685. C. H. G. Harvey. Manufacture of a porous magnetic ferric oxide filtering medium. September 28.

C.—Disinfectants.

1891.

21,706. O. Imray.—From The Farbwerke vormals Meister, Lucius, und Brünig. See Class XVIII.—(C.)

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATION.

18,498. J. McHardy and M. E. A. Wallis. See Class XVIII.—(C.)

COMPLETE SPECIFICATION ACCEPTED.

1891.

17,536. S. Edwards. Manufacture of corrugated paper. October 12.

XX.—FINE CHEMICALS, ALKALOIDS ESSENCES, AND EXTRACTS.

APPLICATION.

16,942. W. P. Thompson.—From R. Campani, Italy. Improved process for extracting iodine from natural saline waters, mother-liquids, or other liquids containing iodine. Complete Specification. September 22.

COMPLETE SPECIFICATION ACCEPTED.

1891.

22,787. C. Fahlberg. Production of pure saccharine. October 12.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

16,778. D. McNae. An improved process of colouring pictures, especially applicable to photographs. September 20.

17,723. A. Radcliffe and the Sun Camera Co., Limited. Improvements in print washers used by photographers. October 5.

17,766. R. G. Williams. Improvements in photographic developing solutions. October 5.

17,767. R. G. Williams. Improved method of and apparatus for developing exposed photographic plates in day-light. October 5.

17,768. R. G. Williams. Improved solutions for toning photographic prints. October 5.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

16,993. G. C. Baker. Improvements in and relating to ammunition. September 23.

17,305. T. P. Palmer. An improvement in matches. September 28.

17,525. G. Gersersdorfer. Manufacture of composition to be used in substitution for wood for match sticks for fire-lighters and torches. October 1.

18,183. A. V. Newton.—From A. Nobel, France. Improvements in the production of nitrogen compounds. October 11.

18,277. H. J. Haddan.—From The American Carrier Rocket Co., United States. An improved dynamite rocket. Complete Specification. October 12.

18,488. R. T. Plimpton and M. W. Travers. An improved manufacture of detonating compound. October 15.

COMPLETE SPECIFICATION ACCEPTED.

1891.

19,267. W. P. Thompson.—From E. Landauer. Manufacture of explosive substances. September 28.

XXIII.—ANALYTICAL CHEMISTRY.

COMPLETE SPECIFICATION ACCEPTED.

1891.

20,956. W. Johnstone. Detection of foreign fats in butter. October 12.

THE JOURNAL OF THE Society of Chemical Industry:

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Post Office Orders should be made payable at the General Post Office, London, to the Honorary Treasurer, E. Rider Cook, and should be forwarded to him at Bow, unless it be desired to notify a change of address.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is prepared to offer 5s. apiece for copies of the Society's Journals for January 1883 in saleable condition.

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SESSION 1892-93.

Meeting held Monday, 7th November 1892.

MR. WM. THORP IN THE CHAIR.

IN opening the proceedings, the CHAIRMAN said that he would like to give a word of explanation as to why they had met there. The Chemical Society had (not a moment too soon) taken in hand the re-decoration and re-arrangement of its rooms. The work had been in hand for some months, and was now in a forward state, but the electric light had not been connected, and, consequently, they could not occupy their old quarters. The theatre in Jermyn Street and that of the Royal Institution being already occupied, they had, by the kind influence of the President, obtained the use of the rooms where they now met.

THE FORMATION OF NITROUS OXIDE AND A NEW METHOD OF PREPARATION.

BY WATSON SMITH.

Lecturer in Chemical Technology in University College, London.

NITROUS oxide has been, until within the last few years, chiefly a curiosity, because of its chemical and physiological properties. It is only comparatively recently that it has assumed distinct importance as an anæsthetic. Nitrous oxide was discovered by Priestley in 1776, and called by him "dephlogisticated nitrous gas." The associated Dutch chemists examined it in 1793, and proved that it was a compound of nitrogen and oxygen. For a full investigation of its properties we are indebted to Sir H. Davy, who published a full series of experiments on it in 1800, and he gave it its present name, "nitrous oxide." It appears that both Priestley and the Dutch chemists jumped to the conclusion that nitrous oxide was irrespirable, but it was Davy who, with characteristic boldness, inspired a quantity of it and showed that it possessed the peculiar physiological properties now so familiar to all chemists. I have spoken of Davy's characteristic boldness; it would have inevitably cost him his life, as the late Professor Thomas Thomson pointed out in his excellent, but now old, system of chemistry, on a subsequent occasion,—when he essayed to inhale nitric oxide gas, by first emptying his lungs of air, and then calmly attempting to inspire the colourless nitric oxide direct from a gas-receiver. Davy's rash desire was anticipated by a spasm of the epiglottis, which, whilst very painful, still effectually prevented the entrance of the gas into the lungs, and so saved Davy from otherwise inevitable asphyxia.

The two old methods for the production of nitrous oxide depend upon two reactions: the *first*, the reduction or deoxidation of nitric acid and other higher oxygen compounds, the *second*, by the decomposition of nitrate of ammonium by heat, where a complete resolution of the compound takes place, with formation of water (steam), and nitrous oxide. A *third*, not a success, was by the decomposition of a mixture of salts.

DEOXIDATION OF NITRIC ACID.—The deoxidation process, so far as I can make out, was the first one known, and was effected by treatment of nitric acid diluted with five or six times its weight of water, with such metals as copper, zinc, or tin. The gas obtained was not pure. Another deoxidant proposed was ammonium chloride, according to Miller (*Elements Inorganic*, 1864, 97). This is L. Smith's process, and it is said that the gas is contaminated with small quantities of chlorine and nitrogen.

Another deoxidant is stannous chloride dissolved in hydrochloric acid. Campari (*Comptes rend.* 1888, 1569) deoxidises nitric acid as follows:—A mixture of 5 parts of stannous chloride, 10 parts hydrochloric acid (sp. gr. 1.21) and 0.9 parts of nitric acid (sp. gr. 1.38) is heated to boiling, when it is claimed pure nitrous oxide is evolved in a regular stream. Any alterations in the proportions may cause explosions. The last statement spoils that of the "evolution of the pure gas in a regular stream!" Millon states that copper treated with nitric acid of sp. gr. 1.217 yields nitrous oxide mixed with a small quantity of NO, if the temperature be kept below -10° .

METHODS OF PREPARATION DEPENDING UPON THE DEOXIDATION OF LOWER OXIDES OF NITROGEN.

DEOXIDATION OF NITROGEN TRIOXIDE, N_2O_3 .—Sir H. Davy exposed "common nitrous gas"—I presume, N_2O_3 —for a few days to the action of iron filings, or to that of various other deoxidising agents. He adds the caution that "some nicety and experience are necessary, that the decomposition may be suspended before it has gone too far, when nitrogen gas will be obtained, and he recommends the use of potassium sulphite, which is incapable of decomposing nitrous oxide.

DEOXIDATION OF NITRIC OXIDE.—Nitric oxide gas is mixed with sulphuretted hydrogen, dry or moist "liver of sulphur" (mainly K_2S_3), moistened iron or zinc filings, hydrated ferrous sulphide, solutions of alkaline or earthy sulphites, or stannous chloride. By passing NO through a solution of sulphurous acid or an acid sulphite.

DECOMPOSITION OF HYDROXYLAMINE.—Silver nitrate ($AgNO_3$) with $NH_2OH + aq.$ forms metallic silver, nitrous oxide, and nitrogen. Iodine quickly decomposes NH_2OH and its salts to N_2O and H_2O , with collateral formation of HI.

Ferric sulphate is reduced to $FeSO_4$ with evolution of N_2O .

Sodium nitrate causes evolution of N_2O from—
 $2 NH_2OH \cdot H_2SO_4$ hydroxylamine sulphate.

DECOMPOSITION OF SALTS.

DECOMPOSITION OF NITRO-SULPHATE OF AMMONIA BY HOT WATER.—The most remarkable and probably least known decomposition of a salt which yields pure nitrous oxide is that of Pelouze's so-called *Nitrosulphate of Ammonia*, or, as Gmelin has it, "Sulphite of nitric oxide and ammonia." This salt is prepared by mixing a concentrated solution of ammonium sulphite with five times its volume of aqueous ammonia, cooling with ice, and then passing nitric oxide gas through the liquid. Crystals of the "nitrosulphate" are deposited. These are collected, washed with aqueous ammonia, and dried between folds of blotting paper. The salt is soluble in cold water, but on heating the solution decomposition sets in with brisk evolution of pure N_2O .

Decomposition of Nitrate of Ammonium by Heat.—This is the process known, I may now say, to every school boy, though I do well recollect a time, about 1857, when sundry play-books for boys recommended as a process for the preparation of "laughing-gas" the treatment of copper turnings with dilute nitric acid and collecting the gas in a

bladder. Then whilst closing the nostrils with the fingers of one hand, and holding the bladder with the other, the gas was to be inhaled. The books in question contained no record of any names with addresses of boys who had tried the experiment, and had really laughed in accordance with the description of pleasing symptoms which were to follow the inhalation; but I anticipate more wry faces and choking sensations were the leading features of such perilous experiments. I have no doubt our friend Dr. Alder Wright could tell us something on this subject, for he has been re-writing and rehabilitating a science play-book, and has now presented to the public one which is doubtless the best of the kind ever written.

The mode of decomposition of nitrate of ammonium by heat has become a matter of great interest recently, since that salt is now so much used in explosives. With regard to the melting point, this is stated in Watts' Dictionary to be about 152°C ., decomposition commencing at 210°C ., and becoming explosive about 300°C . According to Pleischl (Gmelin's Handbook, Vol. II. 490) the salt fuses imperfectly at 56° , perfectly at 108°C .; at 150° it evolves white fumes condensing in drops; at 175° it effervesces slightly; at 225° rapidly; at 238° it begins to evolve nitrous oxide and at 250° the gas is evolved in abundance. According to Legrand, at 180°C . the salt "bails" without being decomposed, decomposition not beginning until between 190° and 200° . Dr. Henry, in his Elements of Chemistry of 1810, states, on the authority of Davy, that at 316°C . (600°F .) the salt explodes and is entirely decomposed, and hence was formerly called "*Nitrum flammans*." It was Berthollet who first examined the nature of this decomposition.

According to Miller (Elements Inorganic, 1864, 459) the salt melts at 108°C ., and at 249° undergoes complete decomposition. We have thus rather a variety of melting and decomposition points.

	Melting Point.	Incipient Decomposition.
	$^{\circ}\text{C}$.	
Watts' Dictionary (Morley and Muir).....	152	210°C .
Pleischl (Gmelin).....	108	175° (begins to effervesce), at 225° (effervescence rapid), at 238° (begins to evolve N_2O).
Legrand.....	..	180° (bails without decomposition). Between 190° and 200° decomposition begins.
Watson Smith.....	153	Between 170° and 180° ; 205° N_2O first evolved distinctly over water; freely at 215° ; on cooling then continues at 180° , though slowly.
Biedermann's Chemiker-Kalendar.	..	At 170° begins to decompose.

On heating pure ammonium nitrate in a bulb apparatus, such as is used in distillations, the salt was found by me to soften at 145° and fuse at 160°C . mean = 152°C . Decomposition with slight effervescence began at about 170°C ., and nitrous oxide gas first came off over water at 205°C . I observed no such phenomenon as Pleischl describes of effervescence or boiling, without evolution of nitrous oxide. At 215°C . the evolution was tolerably active. On dropping the temperature to 180°C . it was found possible to continue the decomposition with slow evolution over water even at this temperature, though of course very slowly, yet undoubtedly with evolution of nitrous oxide. The water was cold. The bulb apparatus used was heated in a paraffin bath, and with thermometers in the fused salt and in the oil-bath as well. The decomposition of the salt at 215°C . was not accompanied by such exothermic effect as tended to cause the reaction to become self-accelerating or to "run away with one," if I may use the expression, but at 240°C . the evolution became vigorous and decidedly strong exothermic action was so manifested as soon to become uncontrollable, the thermometer rising rapidly towards 300°C . There thus appears to be a kind of equilibrium below which a slower evolution can be maintained, but over which it is upset, and the increments of exothermic force

are added in rapid progression, no doubt ever tending to the explosion point, which means an ultimate point of another and more drastic and complete reaction, in which oxygen, nitrogen, and steam are formed. So much for the ammonium nitrate method.

DECOMPOSITION OF MIXED SALTS.

Sal-ammoniac and Nitre.—The only method I know of in the text books is that of Grouvelle (*Ann. Chim. Phys.* 17, 351), who proposed to prepare nitrous oxide by heating a mixture of three parts of nitrate of potassium with one part of ammonium chloride. Pleischl states that by this means a mixture of chlorine, nitrogen, and nitric oxide is evolved, containing a small quantity of nitrous oxide. Soubeiran (*J. Pharm.* 13, 321, and *Pogg.* 13, 282) states that not a trace is formed. I have tried the method, and can testify to the abundance of chlorine and nitric oxide, but I could detect no nitrous oxide, though I will not say that absolutely none was formed.

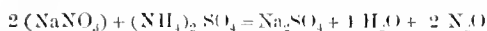
Ammonium Sulphate and Nitre.—I will now pass on to the results of some attempts of my own to prepare nitrous oxide. About a year and a half ago it occurred to me to try if it was possible to ignite sulphate of ammonium or sal-ammoniac by dropping small pinches of it in the dry state into fused sodium nitrate, the hydrogen of the ammonia forming the combustible material, and being directly fired by the loosely combined oxygen of the nitrate. This was easily done. When, however, the sulphate was damp, the steam developed produced such local cooling effect that another phenomenon appeared instead of the flashes of fire, viz., evolution of red nitrous fumes. The experiment is easily shown in an iron or platinum dish, the crystals of $(\text{NH}_4)_2\text{SO}_4$ floating about in a blazing condition, just like bits of sodium burning upon water. On heating a mixture in equivalent proportions of the dry salts in a pulverised condition, viz., sulphate of ammonium and nitrate of soda, it was found that it was possible to obtain a large yield of very pure nitrous oxide gas. The reaction proceeded very smoothly and without tendency to any danger of explosive action, even on reaching higher temperatures at the close of the experiment.

The yield of nitrous oxide was slightly behind that obtained from an equivalent amount of nitrate of ammonium, in the proportion of about 2.6 : 3 by volume, but to set against this, besides the residue of sodium sulphate, is the convenience of safety in the moderate action that goes on in the retort, and the fact that the average cost of raw materials employed in the mixture is about 9l. to 10l. per ton to day, as against about 40l. per ton for ammonium nitrate.

In an American Specification, No. 173,961, February 22, 1876, relating to explosives, a certain Mr. Johnston states that he has actually formed some nitrate of ammonium by fusing together dry nitrate of soda and sulphate of ammonia, but he does not say that he ever extracted the nitrate of ammonia, or how he did so, or how demonstrated its presence. One thing is certain, you cannot properly fuse the mixture without evolution of N_2O , and another thing equally certain is you cannot get both N_2O and also nitrate of ammonium.

We have seen that the melting point of nitrate of ammonium is about 153°C ., and that incipient decomposition is observed at about 180°C ., and that at 205° nitrous oxide is first distinctly evolved and may be collected over water. Now, the melting point of nitrate of soda is close upon 316° (Carnelly), whilst that of sulphate of ammonium is decidedly not 140°C ., as stated in Gmelin, Vol. 2, 462, and all the text-books; also in Biedermann's Chemiker-Kalendar. Sulphate of ammonium softens and finally melts when considerably decomposed by heating up at nearly 330°C . That is the plain fact. Now the mixture of the two salts softens, it is true, below 300°C . indeed a partial softening commences about 200°C ., but even at 240°C . this fusion is only semi-fusion. Incipient decomposition manifests itself in the semi-fused mixture, at about 230°C ., but the gas is only evolved at what I might term a moderate speed at 240°C . and at fair speed at 250°C . On lowering the temperature from this higher point gradually to 200°

at this temperature only a very faint and slight evolution of gas occurred, in fact, evolution was only just perceptible, and after a short time ceased. But 240° , the point at which the mixture shows but a reasonable speed of evolution of nitrous oxide, is one at which the nitrate of ammonium itself has overstepped its equilibrium of stability, and tended to violent evolution. Meantime it was ascertained that nitrate of ammonium begins to evolve nitrous oxide between 170° and 180° , and that the rapidity of evolution of the gas at 215° was fully as great as that from the mixture at 240° or 250° C. The trials were made in the paraffin bath in perfectly similar bulb tubes, and with thermometers in the bath and in the salts. Thus, to get the mixed salts so to mutually decompose as to yield nitrous oxide with reasonable rapidity it is necessary to acquire a temperature at which nitrate of ammonium cannot exist. There is a kind of critical point for ammonium nitrate, and that point is rough below 240° C.; it is even below 200° C. The way of representing the change which takes place on heating the mixture of equivalent weights of nitrate of sodium and sulphate of ammonium for the production of nitrous oxide, is to the best of my belief best represented as follows—



No doubt, when a portion of $(\text{NH}_4)_2\text{SO}_4$ is formed we have present the nascent elements of ammonia and nitric acid, but unite to form nitrate of ammonia at 240° or 250° C. they cannot. We have seen, moreover, that both NO and N_2O , by reducing agents form nitrous oxide, so that were these gases present momentarily in the passing reaction referred to, the change to the final nitrous oxide is perfectly natural and intelligible. This only indicates, I think, the ease and readiness with which the gaseous elements of nitrate of ammonium under a variety of conditions of temperature can adapt themselves in a variety of changes.

NITRATE OF LEAD AND SULPHATE OF AMMONIUM.—By heating nitrate of lead, PbN_2O_6 , alone we adopt the tolerably ancient and classical method for producing nitrogen peroxide, NO_2 , along with oxygen and oxide of lead. On heating a mixture of nitrate of lead with its equivalent of sulphate of ammonium, however, I find that instead of the red fumes of NO_2 the colourless gas N_2O is evolved. This experiment, along with that of heating lead nitrate alone, I would suggest as a pair of instructive lecture experiments to show side by side in illustration of the degree of stability or instability of the N_2O_3 molecule under the influence of heat, alone, and in presence of such a reducing agent as NH_3 .

SODIUM NITRATE AND AMMONIUM OXALATE.—This mixture did not yield nitrous oxide, the decomposition of the ammonium oxalate apparently occurring at a temperature below that at which the necessary decomposition of the sodium nitrate occurred. Such a result might be expected, since oxalic acid decomposes just above 160° .

SODIUM NITRATE AND AMMONIUM PHOSPHATE.—The dry mixture, on heating, evolves nitrous oxide, but not so effectively as the ammonium sulphate mixture.

BARIUM NITRATE AND AMMONIUM SULPHATE, also yield nitrous oxide on heating, but with much more difficulty than lead nitrate and ammonium sulphate.

I desire to express my best thanks to Messrs. S. Ernest Linder and H. Pietou, formerly students of University College, and especially to my late assistant, Mr. Hamilton, for their assistance in carrying out several of the details of this experimental inquiry with me.

I am continuing the investigation of this subject, and more particularly of the intermediate reactions, and hope shortly to publish more details.

SCHÜRMANN'S REACTIONS.

BY WATSON SMITH,

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This paper deals with reactions which are the outcome of an investigation forming the subject of an Inaugural Dissertation conducted by Ernst Schürmann in the laboratory of Professor Lothar Meyer of Tübingen, the details appearing in Liebig's *Annalen*, **249—250**, 1888—89. 326—350.

For some time past in a somewhat desultory way I have been examining sundry of these reactions to see if any, and how many, are capable of any more practical application. In this inquiry I have been greatly aided by my late assistant Mr. Hamilton, as well as more recently by my present assistant Mr. J. C. Chorley. The original title of this investigation is, "Die Verwandtschaft der Schwermetalle zum Schwefel," and it seems that the first man who experimented as to the action of various solutions of metallic salts on the insoluble sulphides of the silver, copper, and iron groups, was E. F. Anthon in the year 1837, the results appearing in the *J. für prakt. Chemie*, **10**, 353. In this direction he investigated the metals Pb, Cd, Cu, Ag, Co, Ni, Mn, and Fe. He caused, for example, silver nitrate to react upon CuS, and realised the following equation:—



Thus he succeeded in arranging the metals referred to, in a series such that the salt of any one of these is capable of decomposing the sulphide of the metal following it, or the sulphide by the saline solution of the metal preceding it. His arrangement was Ag, Cu, Pb, Cd, Fe, Ni, Co, and Mn. Schürmann extended the investigation to the following metals, Sb, As, Pb, Cd, Fe, Co, Cu, Mn, Ni, Pd, Hg, Ag, Ti, Bi, Zn, and Sn.

As regards the salts used, the sulphates of Cu, Cd, Zn, Ni, Fe, and Mn, the nitrates of Pb, Co, Bi, Ag, and Ti, and the chlorides of Sn, Pd, and Hg, were used. Besides these, tartar emetic for Sb, and arsenious acid were employed.

In the experiments, so as to effect fairer comparison, equivalent weights of such salts, &c., were taken, as produced no precipitates in the solutions. One or two specially striking reactions are worthy of note in founding the table to be given. These are: (1.) That, between lead nitrate with two equivalents of sulphide of zinc, lead sulphide and zinc nitrate being very quickly formed, so that in less than two hours the whole of the lead will be in the precipitate and one equivalent of Zn in solution; also (2.) Those between arsenic trisulphide and tartar emetic, stannous chloride and zinc sulphate, which latter completely decompose the arsenic trisulphide.

I ought perhaps to mention that the sulphides experimented upon in this research were not natural sulphides, but sulphides obtained by precipitation. The total results are collected together in a table in which the salts marked with an *asterisk* only acted upon the adjacent sulphides in sealed tubes under pressure.

Sulphides.	Completely decomposed.	Partially decomposed.	Not decomposed.
Ag_2S	$\text{Hg(NO}_3)_2$	..	\text{CuSO_4
As_2S_3	HgCl_2 CuSO_4	FeSO_4	..
..	$\text{C}_6\text{H}_5\text{O}_2\text{SbK}^*$ $\text{Pb(NO}_3)_2^*$ ZnSO_4^* NiSO_4^*	..	..
Bi_2S_3	CuSO_4	..	CuSO_4 $\text{Pb(NO}_3)_2$ $\text{C}_6\text{H}_5\text{O}_2\text{SbK}$
CdS	CuSO_4	$[\text{SnCl}_2]$	$\text{Pb(CH}_3\text{COO)}_2$ ZnSO_4 NiSO_4 $\text{C}_6\text{H}_5\text{O}_2\text{SbK}$

Sulphides.	Completely decomposed.	Partially decomposed.	Not decomposed.
CoS.....	CuSO ₄ Pb(NO ₃) ₂	ZnSO ₄ NiSO ₄ FeSO ₄	MnSO ₄
CuS.....	HgCl ₂ AgNO ₃ PdCl ₂	..	..
FeS.....	ZnSO ₄ NiSO ₄ Co(NO ₃) ₂	TiNO ₃	MnSO ₄
HgS.....	PdCl ₂	..	CuSO ₄ AgNO ₃
MnS.....	NiSO ₄ Co(NO ₃) ₂ FeSO ₄ TiNO ₃	..	..
NiS.....	CdSO ₄ Pb(NO ₃) ₂	ZnSO ₄ Co(NO ₃) ₂ FeSO ₄	TiNO ₃ [As ₂ O ₃]
PbS.....	Cu(NO ₃) ₂ Cd(CH ₃ CO ₂) ₂ * SnCl ₂	..	Co(NO ₃) ₂ FeCl ₃ TiNO ₃
PdS.....	..	..	HgCl ₂ AgNO ₃
Sb ₂ S ₃	HgCl ₂ CuSO ₄	..	[CdSO ₄] SnCl ₂ ZnSO ₄
SuS.....	CuSO ₄ [CdSO ₄]	..	C ₂ H ₅ O ₂ SbK Pb(NO ₃) ₂ ZnSO ₄
Tl ₂ S.....	Pb(NO ₃) ₂ ZnSO ₄ NiSO ₄	FeSO ₄	..
ZnS.....	CuSO ₄ Pb(NO ₃) ₂ CdSO ₄ SnCl ₂	NiSO ₄) But little Co(NO ₃) ₂) action.	FeSO ₄ TiNO ₃

The conclusion drawn as to the affinity of the metals referred to for sulphur is that this affinity continually diminishes from palladium to manganese in the following series:—

Pd, Hg, Ag, Cu, Bi, Cd, Sb, Sn, Pb, Zn, Ni, Co, Fe.
106 209 198 63 208 112 122 118 207 65 59 59 56
As, Ti, and Mn.
75 204 55

The author endeavours to show how by means of the knowledge of relative affinities thus portrayed, certain useful results may be attained, for example, in separating a metal from a large excess of another metal, and even going a step farther than this by means of fractional precipitation with sulphuretted hydrogen. Take one case, 6.3 cc. HgCl₂ were mixed with 6.3 cc. CuSO₄, diluted to 50 cc., and when the solution was brought to boiling, 20 cc. of sulphuretted hydrogen solution were added. The solution was kept boiling for a quarter of an hour, and filtered. Mercury alone remained in the precipitate, and copper in solution.

In this way Schürmann completely separated from each other the following:—

Hg from Cd, Pb, Sb, and Ag.
Pd from Hg and Ag.
Cu from Sn and Cd.
Ag from Cu.

It was also shown that thus in neutral solution nickel is precipitated before cobalt.

Schürmann has lastly arranged the metals according to their greater or less affinity for sulphur in the *periodic system*, and he expresses, by the sign >, which of two

neighbouring elements has the greater inclination to form sulphides, thus:—

VII.	VIII.	I.	II.	III.	IV.	V.
Mn < Fe < Co < Ni < Cu > Zn > As						
55 56 59 59 63 65 75						
	Pd > Ag > Cd > .. Sn < Sb					
	106 108 112 118 122					
		Hg > Tl < Pb < Bi				
		200 204 207 208				

Regarding the elements belonging to each family alone, if his reasoning be correct, we see that those with the largest affinity for sulphur also possess the largest atomic weights. Group IV. forms an exception, for Sn is precipitated before Pb. A few other remarkable relationships are referred to, though to these several exceptions have to be added.

Now, with regard to my own experiments, these were, as I have already said, with the object of testing these reactions to some extent to discover if any of them were likely to be of industrial use, for I must add that several trials in the use of the list given only brought failures.

For industrial purposes I desired to experiment not upon precipitated sulphides alone, but upon mineral sulphides. One of the first of these I tried was *galena*. Looking at Schürmann's table, we see that copper nitrate is set down as a salt, the solution of which should effect a complete decomposition of lead sulphide. On sealing up a quantity of galena with a trifle less than its equivalent of copper acetate in a strong glass tube, and heating up to 130° C. for about a couple of days, the blue colour had quite disappeared. A black precipitate truly remained, but it was no longer one of lead sulphide but of cupric sulphide, whilst the solution was one of pure lead acetate, on evaporating which the beautiful specimen of pure lead acetate I now pass round was obtained. On exposing the precipitate in a damp state on the filter to the air, and occasionally moistening, and finally washing with a little hot water, this solution of copper sulphate was obtained.

Here is a possible useful application arising from a study of such reactions. Now, suppose silver was present in the galena, let us see what should happen. On referring to the table we observe that when using silver nitrate, silver appears to have a greater affinity for sulphur than copper has, and hence must remain as sulphide with the sulphide of copper, or if the sulphide of copper be oxidised to sulphate, the silver will remain in the residue.

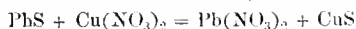
The other double decompositions I have attempted and effected are as follows:—

In Aqueous Solution.	Results.
Copper sulphate with slight excess of CoS, heated 120° for 20 hours.	Complete decomposition.
Copper sulphate with slight excess of NiS, heated 130° for 4 days.	" "
Copper sulphate with slight excess of MnS, heated 130° for 6 days.	" "
Copper chloride with slight excess of As ₂ S ₃ , heated 120° for 20 hours.	" "
Lead chloride with slight excess of As ₂ S ₃ , heated 150° for 60 hours.	Partial decomposition.
Copper chloride with slight excess of Sb ₂ S ₃ , heated 130° for 4 days.	" "
Zinc chloride <i>in excess</i> , with As ₂ S ₃ , heated 115° and 165° for 25 hours.	Very little decomposition.
Antimony trichloride <i>in excess</i> , with dry As ₂ S ₃ , fused together at 170° for 3-4 days.	Little decomposition.

With the remark that an inspection of the tabulated reactions of Schürmann will show that copper as nitrate, chloride, or acetate furnishes at once the cheapest, the most far-reaching reagents (salts) of any; also with the suggestion that metallurgical chemists may yet find considerable value in Schürmann's table of double decompositions both analytically and industrially, I will conclude with a few critical remarks as to Schürmann's scientific attitude in viewing such reactions as these as due to the affinity of

the sulphur of the sulphides for the metals of the salts presented to them. Though I had in my experiments noted what Schürmann might have regarded as differences of affinity of the sulphur (*vide* my results as given where Pb, Cu, Zn, and Sb, as chlorides, though sufficiently far removed in Schürmann's list from the metals whose sulphides they are set to decompose, exert but little action), yet I had not at first the intention of applying any general criticism to Schürmann's standpoint, but of limiting myself to the bare experimental facts elicited for the sole purpose of application, technologically, to the treatment of mineral sulphides. My friend Dr. C. R. A. Wright, however, thinks the opportunity should not be lost of demonstrating a certain fundamental fallacy which lurks in Schürmann's generalisation, and which leads him to attempt definite scientific classification of the metals referred to. It was, perhaps, another thing had such classification been put forward as a rough technical guide with reference to the results of the special reactions examined, but I thoroughly agree with Dr. Wright that, since the attempt has gone further than this, correction should be applied. Dr. Alder Wright's views are as follows:—

The interesting cases of double decomposition between insoluble sulphides and soluble salts described by Schürmann are apparently due as much to the difference in affinity of the two metals present for the *acid radical of the soluble salt*, as to the difference in their affinities for sulphur; and hence the experiments hardly warrant any classification of metals based on their relative affinities for sulphur as thus deduced. For instance, when lead sulphide and copper nitrate solutions act on one another, copper sulphide and lead nitrate are formed; thus—



But it does not therefore follow that copper has a higher affinity for sulphur than lead; in point of fact the reverse is the case, for according to Julius Thomsen's thermochemical affinity values, the heat of formation of copper sulphide is *less* than of lead sulphide, *viz.* (using Thomsen's notation).

	Calories.
Pb, S.....	20,430
Cu, S.....	9,760
Difference.....	10,670

If therefore lead could react on copper sulphide at the ordinary temperature, it is to be expected that lead sulphide would be found and copper liberated; at any rate this change should be brought about more readily than the converse change, since the former would be accompanied by a considerable heat evolution (10,670 calories), and the latter would require an equal heat absorption.

The heat of formation of lead nitrate solution (from lead, oxygen, and dilute nitric acid) is considerably greater than the heat of formation of copper nitrate solution (from copper, oxygen, and dilute nitric acid); hence a Daniell cell may readily be obtained by placing lead in lead nitrate solution, and copper in copper nitrate solution,* the energy exhibited by the current being due to the displacement of copper from nitrate by lead, just as in the ordinary Daniell cell it is gained by the displacement of copper from sulphate by zinc. Thomson's values are—

	Calories.
Pb, O, 2 HNO ₃ aq.....	68,070
Cu, O, 2 HNO ₃ aq.....	52,410
Difference.....	15,660

Hence it results that when lead sulphide and copper nitrate solution act on one another producing copper sulphide and lead nitrate, the action as a whole is accompanied by heat evolution to the extent of 15,660—10,670 = 4,990 calories. Hence the reaction takes place, notwithstanding that the affinity of copper for sulphur is *less* than that of lead for sulphur.

* I have also used thin, clean sheet lead, and still better spongy lead, to precipitate small quantities of copper from solutions of ammonium acetate slightly acid with acetic acid.—W. S.

Since the heat of solutions of metallic oxides in dilute nitric, hydrochloric, sulphuric, or acetic acids, &c., in many cases differ but little, it follows that in such cases the difference in heat of formation of a given pair of salts containing different metals, but the same acid radical is practically the same as the difference between the heats of formation of the oxides of the two metals. Hence the question as to whether the sulphide of a metal A will or will not be decomposed by a soluble salt of another metal B, will in such cases depend on whether the sum of the heats of formation of the oxide of A, and the sulphide of B is or is not greater than the corresponding sum in the case of the oxide of B and sulphide of A.

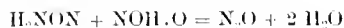
DISCUSSION.

The CHAIRMAN said that, for himself, he was not quite convinced by the argument used as to the course of the reaction with the sodium nitrate and ammonium sulphate. It seemed to him that the argument from temperature still left it ambiguous as to whether nitrate of ammonium was not formed and immediately decomposed, the fact that it could not exist at such temperatures being no argument to that end. He had nevertheless a strong suspicion about these reactions that were said to occur in two stages. He had always held the opinion that they were simultaneous.

Mr. OSCAR GUTTMANN said that it might be of interest to hear, in addition to Professor Watson Smith's highly interesting experiments, that a friend of his had prepared nitrate of ammonium by mixing solutions of nitrate of soda and sulphate of ammonium, and exposing the mixture to a temperature of -15°C . He had seen a sample of this nitrate of ammonium, about a year ago, after it had been lying open on a writing table for several days. He saw the same sample again about four weeks ago, and it was upon both occasions perfectly dry. His friend preferred this way of making nitrate of ammonium to that of absorbing ammonia gas by nitric acid, as he thereby avoided the impurities contained in the nitrate of soda; and it was to these impurities that he attributed the hygroscopic qualities of nitrate of ammonia, whilst the sample mentioned above was evidently free from that defect. There was still some doubt whether this process could be worked on a large scale, as the investigations were not yet completed.

Mr. C. F. CROSS remarked that the author had omitted mention of Ackworth and Armstrong's researches on the reduction of nitric acid by metals (Chem. Soc. J. 1877, 32, 54—90), in which these authors showed that nitrous oxide was formed to the extent of from 1 to 85 per cent. of the total gaseous products ($\text{NO}, \text{N}_2\text{O}, \text{N}$) according to the conditions of the action.

The equation proposed to account for the production of N_2O under the conditions described in the paper did not attempt any explanation of the reaction. It appeared probable that in the molecular re-arrangement which took place ammonia was oxidised to hydroxylamine concurrently with the reduction of the nitric to the nitrous group, and it might be possible to prove the occurrence of this reaction as the intermediate stage of the decomposition. Hydroxylamine salts and nitrites reacted quantitatively in aqueous solution according to the equation—



and the decomposition appeared to be realisable under a wide range of conditions.

Mr. CRESSWELL asked whether anything had been done with Schürmann's reactions in respect of the two metals, magnesium and aluminium, the symbols of which he did not see on the board. The main reaction of the Schaffner and Helbig process depended entirely upon the want of affinity of magnesium for sulphur. A patent had recently been taken out—or rather an investigation had taken place—as to the possibility of manufacturing aluminium from aluminium sulphide because of the amenity of that body to treatment by electrolysis.

MR. WATSON SMITH, in reply to the observations made about the nitrous oxide process, said that it appeared to him to be a matter of logic,—that if only partial fusion, amounting to mere softening, could take place at certain temperatures very high up in the scale, and if no proper fusion took place, then there was no real chemical contact. He could not understand in such a case that a chemical change would entirely occur: it might, however, do so to a certain extent. It appeared to him to be an extremely interesting thing that the aqueous solution of these two salts should decompose at the low temperature referred to. From the dry mixture at 240° nitrous oxide came off somewhat slowly; but if nitrate of ammonia were there it would come off vigorously, tending to explosion. But that was not the case. In point of fact, if nitrate of ammonium were heated by itself at 215°, the evolution was as rapid as from the mixture heated to 240°. With regard to the hydroxylamine reaction suggested by Mr. Cross, he did not think that hydroxylamine itself would resist that temperature. If these things did not exist at the temperature given, he could not see that such a change would take place as one could reasonably show by an equation. It would certainly be a mixture of the elements of the substance; but he did not regard that as the substance itself, especially when one considered Berthelot's investigations on the seven different reactions possible on heating nitrate of ammonium. Referring to Mr. Cresswell's question, he believed that Schürmann had omitted aluminium and magnesium because they did not form sulphides under the same conditions as the other metals which he had included.

The results are as follow:—

JUTE.						
	I.		II.		Mean.	
Carbon	46.18		45.12		45.65	
Hydrogen	5.83		6.33		6.08	
Oxygen	47.99		48.27		48.27	

COTTON-WOOL.						
	A. and C.			B.		
	I.	II.	Mean.	I.	II.	Mean.
Carbon	42.66	42.16	42.41	42.93	42.47	42.70
Hydrogen	6.25	6.16	6.20	6.33	6.07	6.20
Oxygen	51.09	51.68	51.39	50.74	51.56	51.10

The jute contained 11.35 per cent. of moisture; samples A and C, 5.34; and sample B, 5.83 per cent. The moisture was estimated by drying over sulphuric acid for four weeks in a vacuum.

Although these bodies cannot be regarded as pure chemical individuals, it is interesting to compare the results of certain definite compounds with the results of their analysis. Those which most nearly approach the above composition are:—

	C.	H.	O.
Pentosane or xylene ($C_5H_8O_4$) ¹⁰	45.45	6.06	48.48
Cellulose ($C_6H_{10}O_5$)	44.44	6.17	49.38
Grape-sugar, $C_6H_{12}O_6$	40.00	6.66	53.33
Starch (probably) $C_6H_{10}O_5$	43.63	6.26	50.10

These samples were distilled in the manner described in our first paper (this Journal, 1892, p. 395). As before, the gas was collected and analysed; and the distillate was separated into three portions, viz., weak acetic acid, crude methyl alcohol and tar.

The results are as follow:—

THE DESTRUCTIVE DISTILLATION OF WOOD.

BY JNO. C. CHORLEY AND WM. RAMSAY, PH.D., F.R.S.

LAST May we brought before the Society the results of some experiments on the distillation of wood. We have followed up these researches by investigating the behaviour of compounds which have a greater claim to be considered definite. These are jute and cotton-wool.

The sample of jute was purified by boiling it in a dilute solution of caustic soda; the cotton-wool was of two qualities; the samples A and C consisted of crude wadding, while the sample B was purified wool, and is sold under the name of medicated cotton.

These substances were analysed without having been dried; they were afterwards dried and the analyses calculated on the dry material.

	Jute.				Cotton-Wool.		
	I.	II.	AI.	A2.	B1.	B2.	C.
Weight in grams	71	73	45	60	67	45	50
Charcoal, per cent.	28.71	32.87	33.33	30.00	34.33	3.44	33.00
Distillate	57.70	43.15	53.33	50.00	43.32	51.11	46.00
Carbon dioxide	Lost	12.33	6.66	9.53	5.22	7.77	11.00
Other gases .....	..	11.45	6.68	10.47	17.13	6.68	10.00
Vol. of gas, cc.	3,000	2,500	2,000	2,700	1,500	1,000	3,500
Vol. of gas from 100 grams	4,220	3,420	4,000	4,500	2,240	2,200	7,000
Composition of gas per cent.:							
Carbon monoxide	78.80	85.29	76.92	85.74	54.14	52.46	76.20
Oxygen	3.01	1.73	3.06	2.80	8.50	4.73	3.34
Residual gas	18.19	12.95	19.12	11.46	37.36	43.11	20.46
Tar, per cent.	14.78	6.85	..	8.33	9.70	13.33	12.00
Acetic acid	0.10	1.40	..	2.44	1.75	2.11	1.31
Methyl spirit .....	..	10.08	..	..	3.94	10.24	7.07

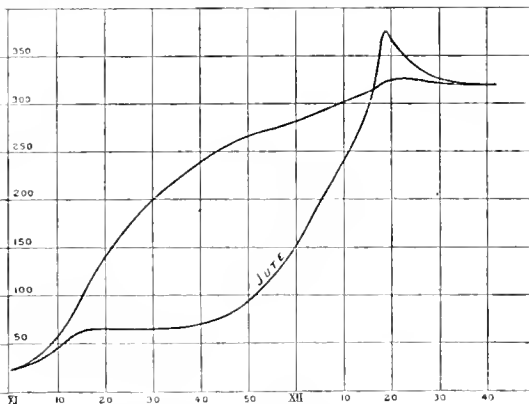
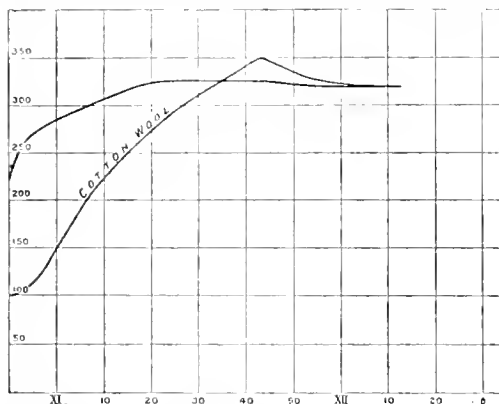
In contrasting these numbers with those obtained in distilling wood, it is to be remarked that the percentage of charcoal is considerably smaller than with such fibres; that of distillate smaller, and that of carbon dioxide larger than with wood. The acetic acid is very much less; and that of the impure mixture counted as methyl-spirit is particularly high, in almost every case.

In comparing jute with cotton wadding and with cotton wool, it appears that the chief difference between them lies in the amount of carbon monoxide which they yield. While jute and impure cotton wool give a gas containing as much

as 70 to 80 per cent. of this constituent, the pure cotton wool yields only a little over 50 per cent., the nitrogen and residual gas being correspondingly increased. We do not think that all of this increase can be accounted for by ascribing it to air present in the retort, though there is no doubt that some may thus be accounted for.

We next pass to the thermal behaviour of the fibres.

The best idea of the changes of temperature distillation is gained by a graphic representation of the temperatures of the bath, contrasted with those of the substance being distilled, time being taken as ordinates.



We give tables, however, showing the actual temperatures in the air-bath (outside temperatures), and of the fibre (inside temperatures), at different intervals of time during distillation, for crude cotton-wool, and for jute; the curves are a graphic representation of these numbers.

Cotton-wool.			Jute.		
Time.	Outside.	Inside.	Time.	Outside.	Inside.
10.50	250	100	11.15	100	63
55	270	115	30	200	63
11.00	285	150	45	255	80
05	295	190	12.00	278	150
20	323	275	05	292	240
25	324	295	10	302	249
30	324	310	15	312	295
35	324	323	17	317	328
49	325	340	18	321	375
43	325	348	19	323	372
45	324	345	20	323	365
50	322	333	25	322	340
55	320	326	1.00	317	320
12.00	319	322	..	..	..
05	319	319	..	..	..
1.45	325	324	..	..	..

With cotton-wool the temperatures are practically equal at 11.35. Eight minutes later the wool is 13° higher than the bath. In 17 minutes the temperatures are again practically equal. The whole rise and fall took place in 25 minutes.

With jute the temperatures may be considered equal at 12.16; at 12.18, the jute had a temperature no less than 54° higher than that of the bath; but the fall of temperature in this case was much more gradual; it was not until 1.00 that the temperatures were practically equalised

Hence the rise is a very sudden one, occupying only two minutes, and I think that it will be allowed that this approximates to an explosion. Gas was evolved with great rapidity during this sudden rise of temperature, and it is perfectly evident that the exothermic reaction is a violent one.

With purified cotton-wool, there were no signs of an exothermic reaction. The whole operation appeared to be of the nature of an ordinary distillation.

The conclusion is therefore forced upon us that the substance which decomposes in this manner is not cellulose, but some substance which may be removed from woody fibre by solvents. It appears not to be the same substance as the one which yields acetic acid on distillation, for jute, which decomposes with such sudden evolution of heat, gives a minimum percentage of acid. Nor does it appear to accompany the mixture reckoned as methyl spirit in our table, for both jute and pure cotton-wool yield this distillate in considerable quantity.

Oak and beech wood therefore must contain some substances which yield acetic acid on distillation, and which is not (at least not wholly) the cause of the exothermic reaction which accompanies their decomposition. That substance has been removed in the purified wool, which yields a minimum quantity of acid; and with it the body which causes the exothermic reaction has also been removed.

The direction of further research is obvious; but circumstances have prevented the authors of this paper from continuing the investigation; moreover, the problem is in the hands of others. Messrs. Cross and Bevan are working with matters extracted from wood fibre by solvents, and Herrn Flint and Tollens are engaged in determining the nature of the decomposition products of fibre (Berichte, 1892, 2316). From the labours of these chemists we may hope soon to obtain a satisfactory idea of the real constitution of different varieties of woods; and we are content to leave the subject in such competent hands, resting satisfied that if our experiments have contributed even a little towards the solution of such a complicated problem.

Only two points remain for mention. One is the striking circumstance that the percentage composition of xylene and jute are the same, viz., $(C_8H_8O_4)_n$. The other is the fact that products removed from cotton-wool during its purification appear to be the cause of the large amount of carbonic oxide in the gases evolved. For, while jute and impure cotton-wool yield amounts of gas varying from 3,420 to

7,000 cc. per 100 grms., purified wool yields only 2,200 cc. Moreover, the former yields gases consisting mainly of carbonic oxide (76 to 85 per cent.), while the gases from the latter contain little over 50 per cent. It is possible that some clue may be given by these observations to the particular mode of decomposition of the chemical constituents of the fibre.

DISCUSSION.

Mr. A. H. MAYSON wished to know whether the medicated cotton was pure cotton, as the substance was sometimes rendered impure in the process of manufacture by other combinations.

Mr. C. F. CROSS said that he had been engaged on this subject some years, and knowing that it was to fall into his hands, he had been fortunate in obtaining a gentleman to undertake the prosecution of this question of determining the reactionary agents, and also the variations in the products themselves. As they had been asked to place the subject before the Society at an early date they would endeavour to do so.

Professor RAMSAY said that he believed that what was known as medicated wool was practically pure cellulose, being cotton wool denuded of soda, acetic acid, &c.

Professor FOSTER said it was quite possible to get pure cellulose in the form of cotton wool. He had been surprised at its purity, for it burned clean away and left no acid residue.

The CHAIRMAN said that it was a matter of regret that Professor Ramsay and Mr. Chorley's paper was in a certain sense the final paper on the subject. While he was very glad to hear that Messrs. Cross and Bevan promised a contribution on the same subject, it did seem a pity that Professor Ramsay should drop it, as it seemed to him to provide an ample field for both, from which useful results might have been expected.

Liverpool Section.

UNIVERSITY COLLEGE, BROWNLOW STREET.

Chairman : H. Brunner.

Vice-Chairman : E. Carey.

Committee :

J. Campbell Brown.

E. Carey.

V. C. Driffield.

Jos. C. Gamble.

C. L. Higgins.

P. Harter.

W. Norris Jones.

A. H. Knight.

E. K. Muspratt.

G. Schaack-Sommer.

A. Watt.

Hon. Treasurer : W. P. Thompson.

Hon. Local Secretary :

Dr. Chas. A. Kohn, University College, Liverpool

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892-93.

Wednesday, December 7th. — Mr. Hubert L. Terry, F.I.C.
"Critical Notes on the Chemical Technology of India-Rubber."

Meeting held Wednesday, November 2nd, 1892.

MR. HENRY BRUNNER IN THE CHAIR.

CHAIRMAN'S ADDRESS ON ARTIFICIAL MANURES FOR FRUIT CULTURE.

(ABSTRACT.)

THE subject of fruit-growing for profit is one that has during the last few years had increasing attention drawn to it, partly owing to the hope that it may prove a means of bettering the condition of the land cultivator, and partly due to the growing demand for fruit as an article of food. From figures kindly supplied by Sir James Whitehead, Master of the Fruiterers' Company of London, it appears that the total area devoted to fruit culture in this country in 1891 was 268,700 acres. This would represent a value of 9,000,000*l.*, taking 30*l.* per acre as a low average value of the produce. In fruit-growing it may be taken that, roughly, one-fourth of the cost of production is due to the necessary supply of manure, and therefore it is evident that if a large proportion of the natural manure used be replaced by chemical manures, a considerable benefit to the chemical industry of the country will accrue. It appears that to-day the balance of opinion is against the total replacement of natural manures by artificial, but there is no doubt that a large proportion may be so substituted with advantage to the crop and with economy to the cultivator. The author's own experiments made with strawberries show that by employing chemical manures far less potash, phosphoric acid, and nitrogen is required per acre than is the case with ordinary farmyard manure, as owing to their soluble form they penetrate the soil more rapidly and deeply.

The requirement of an acre of land planted with apple trees would amount to about 20 tons of farmyard manure once in three years, whilst the necessary ingredients contained therein would be supplied by the yearly use of 500 lb. of kainit (at 13.5 per cent. K_2O), 120 lb. of superphosphate (at 16 per cent. soluble P_2O_5), and 360 lb. nitrate of soda, or a total for the three years of 26 cwt. of material. From the above it is evident that in certainty of effect, in convenience of handling, and in distribution over the soil, chemical manures possess distinct advantages. The author does not recommend the complete discarding of farmyard manures, but rather the adoption of some system of rotation of manures such as that recommended by Wagner of Darmstadt for the cultivation of vines, in which farmyard manure is supplied in the first year and supplemented by chemical manures only in the second, third, and fourth years. It has been urged against chemical manures that they render the soil poorer in organic matter, whilst farmyard manure has the reverse effect, but it has been shown by Joulie that the more abundant harvests produced by the use of chemical manures leave a larger proportion of residues in roots and otherwise in the soil, and consequently that there is no impoverishment, but an increase in the quantity of organic matter in the soil.* By the use of chemical manures each ingredient can be adjusted to the requirements of the crops, which is obviously not the case with natural manures, whilst Ville has shown that more than one-third of the nitrogen contained in the latter is lost to the soil on account of the decomposition which the manure must first undergo before it can exercise its action.† The cost of carriage is also favourable to the employment of chemical manures. Superphosphate is the most suitable form of phosphoric acid for the fruit-grower, and it has the further advantage of supplying a considerable quantity of a soluble lime salt necessary for the building

* *Mercurie Scientifique*, Supplément du *Moniteur Scientifique* June 1892.

† Ville on "Artificial Manures," trans. by W. Crookes, p. 105.

up of healthy trees. Finely-ground basic slag is also likely to prove of great value since it contains 18 per cent. of phosphoric acid combined with lime in a fairly soluble form. The latter should be applied in larger proportionate quantity than the former, and will be found specially useful in preparing the ground before planting young fruit trees. Kainit affords the cheapest form of easily soluble potash, but contains only 13 per cent. of potash and as much as 40 per cent. of sodium chloride. The composition of the soil and the requirements of the crops must, to a large extent, determine the best form of potash salt to employ.

Taking into consideration their relative price, one of the following will be found most useful:—

(1.) "Pure sulphate of potash, magnesia, calcined. Guaranteed minimum 48 per cent. sulphate of potash, maximum, $2\frac{1}{2}$ per cent. chlorine." It contains usually about—

	Per Cent.
K ₂ SO ₄	50
MgSO ₄	41
NaCl.....	3

(2.) "Ground calcined manure salts. Guaranteed minimum 31.5 per cent. potash," containing usually—

	Per Cent.
KCl.....	51
MgSO ₄	17
MgCl ₂	7
NaCl.....	14

It must be borne in mind that potassium chloride tends to decrease the calcium carbonate of the soil. Nitrate of soda is the best and most economical nitrogen manure for fruit cultivation; sulphate of ammonia is less suitable.

Manchester Section.

Chairman: Ivan Levinstein.

Vice-Chairman: Edw. Schunck.

Committee:

J. Angell.	J. Grossmann.
G. H. Bailey.	P. Hart.
F. H. Bowman.	J. M. Irving.
R. F. Carpenter.	E. Knecht.
G. E. Davis.	Sir H. E. Roscoe, M.P.
H. Grimshaw.	C. Truby.

Hon. Local Secretary:

J. Carter Bell.

Bank House, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892.

Friday, 2nd December.—Dr. Carl Otto Weber. "Cop Dyeing."

Meeting held Friday, 4th November 1892.

MR. I. LEVINSTEIN IN THE CHAIR.

CHAIRMAN'S ADDRESS.

ADDRESS DELIVERED AT THE OPENING OF THE SESSION (NOVEMBER 1892) OF THE MANCHESTER SECTION OF THE SOCIETY OF CHEMICAL INDUSTRY.

TEN years have now elapsed since the establishment of the Manchester Section of the Society of Chemical Industry,

and the results achieved have fully justified its formation. Many interesting papers have been brought before us, and their number, as well as the number of our members, has been steadily increasing; it has, moreover, brought together and united in intimate association those engaged and interested in the development of our industries. To the action of this Section is due the fact that we are now represented in the Manchester Chamber of Commerce, an association which, until this took place, had been almost exclusively occupied in the consideration of questions relating to the cotton industry; the formation of the Chemical Section in the Chamber was the means of breaking down this barrier of exclusiveness, and extending the scope of its usefulness. That the principle of forming special sections for special trades or industries was a sound one is clear from the fact that the example set by the establishment of the Chemical Section has been followed by other trades. That section, although comparatively young, has already had to deal with a number of subjects which concern our industries, such, for instance, as the French and Spanish Tariffs; Patent Laws; Smoke Nuisance; Building Bye-Laws; Weights and Measures Act; Stills in Chemical Works, &c. Some time ago you referred to that section certain clauses of the Building Bye-Laws of the Manchester Corporation which you considered as injuriously affecting our industries, and, as you have already heard from the letter read by our secretary, bye-law 31, the building committee of the Corporation has promised the Council to recommend the amendment of this bye-law in accordance with your representations and suggestions. As far back as 1890 that section furnished the Board of Directors with a report on patent law amendment, as far as the regulations of those laws concerned our industries; this report has been approved by our Society, and support has been promised by other Chambers of Commerce. After repeated discussions it has, however, been thought that the question of further amendment is one which naturally concerns the interests of all trades and industries, and that any representations with regard to such amendment should be on broader lines and not confined to one particular industry, and for this reason the Board of Directors has recently decided to form a special committee, consisting of the chairmen of the various sections, with power to add to their number, for the purpose of devoting its attention in the first instance to the consideration of the advisability of amendment, and if necessary to the eventual recommendation of such steps as may be thought requisite. That there is really need for amendment will scarcely be disputed by those who have any acquaintance with the subject; difference of opinion may, however, exist as to what reforms should be made. The Patent Law Reform Association in Liverpool, for instance, is agitating for the substitution *en bloc* of the American patent system; how far such a proposition is wise I am not prepared to say, but one thing appears to me of paramount importance, and that is a painstaking examination of the subject-matter and of the specification of every patent before it is granted, as is the case in America and Germany. Such an examination would at once protect genuine and honest inventors, and by giving a valuable title benefit both them and our trades and industries, and would remove the large number of bogus and "bluff" patents now in existence taken out by unscrupulous patentees for the sole purpose of blocking *bonâ fide* inventions, thereby interfering with the legitimate development of our industries. As far as chemical patents are concerned, I hope that this committee will recommend the suggestion also made in the report furnished to the Board by the Chemical Section, viz., the necessity of distinguishing, in the application of the law, between chemical and mechanical patents. The present and past years have been productive in the passing of certain Acts more or less concerning our industries, such as the Building Bye-Laws; Weights and Measures; Extension of the Alkali Act (Noxious Trades); Smoke Prevention; Rivers Pollution, &c.; all enacted for the protection of common interests, and I believe that I am only expressing the views held by the majority of our members in stating that we by no means look upon the establishment of these Acts with any dislike; on the contrary, most of us have by

now found out that the enforcement of some of them, if carried out with discrimination by competent and experienced men, may be of great advantage. Take, for instance, the old Alkali Act; this Act has been and still is a blessing to manufacturers, its enforcement being in the hands of accomplished and properly qualified experts, whose advice and suggestions have been of the greatest benefit to manufacturers, and moreover, in no instance have those gentlemen lodged a complaint without at the same time suggesting practical means for avoiding and preventing the alleged nuisance, and if all these Acts are only carried out in a similar spirit and by men at once competent and experienced, I have no hesitation in saying that we shall give them a hearty welcome. No chemical manufacturer endowed with ordinary common sense is desirous of creating a nuisance; more than this, he is thankful to those who can point out to him a way by which he may prevent the emission or discharge of matters which are almost invariably of value to him. On the other hand, no Act for suppression, mitigation, or prevention of any alleged evil arising from the carrying on of trades and industries can be enforced without serious injury to them, unless practical means are available for such prevention. If I may be allowed to advise our trades on this point, I would suggest that we use our utmost endeavours to prevent, as far as is practically possible, the discharge of any thing that is hurtful or annoying to others; that we consult and discuss together and advise each other with regard not only to any grievance under which we may be labouring, but also to the method and means for its removal, and for that purpose there is no better opportunity than those provided by the meetings of this Section. On the other hand, I trust that the authorities in whose hands lies the enforcement of these various Acts will remember the words of Professor Huxley, uttered before a large audience some years ago in the Town Hall when the question of technical education was coming to the front:—"We are at present in the swim of one of those vast movements in which, with a population far in excess of that we can feed, we are saved from a catastrophe through the impossibility of feeding them solely by our possession of a fair share of the markets of the world; and in order that that fair share may be retained, it is absolutely necessary that we should be able to produce commodities which we can exchange with food-growing people, and which they will take rather than those of our rivals on the ground of their greater cheapness or their greater excellence." These words struck me at the time as an admirable description of our present position and of what our aims ought to be in the effort to retain it. Manchester and its trade and commerce depend upon its industries, and its present and future prosperity depend upon their extension and development. Now one of the Acts, the Rivers Pollutions Act, does not quite as much concern ourselves, and as long as sewage is discharged into our rivers and their tributaries, the liquid discharges from chemical works will, if anything, in some instances lessen the evils caused by sewage pollution, but the purification of this sewage has afforded some of our members an opportunity of showing what can be done by chemical means to effect that object. A number of interesting papers and discussions have been before us during the past session, by which the fact was established that if iron salts are added in sufficient quantity and time be allowed for settling, an effluent is produced of sufficient purity to allow of its discharge into any river. The use of iron in one form or another is by no means new, but the difficulty which is involved in this question is one not only of efficiency, but also of economy, and this latter is now in a fair way of being overcome. We have in our immediate neighbourhood a number of works in which iron, in some form or another, and also the acids necessary for its conversion into the requisite soluble salts, are obtained as waste products, and for the utilisation of these waste products a number of patents have been taken out, and I hope that the outcome may be helpful in solving a problem which has puzzled many corporations and rural authorities.

Now, gentlemen, taking a general and brief review of the position of our trades, I regret to say that, with but few exceptions, manufacturers will have a hard struggle to

maintain their position and to make their business pay. Outsiders generally think that anything chemical means piling up money, but this is a complete fallacy. Our industries are not in a flourishing condition, and more than this, our prospects are in no way encouraging, and if, with the disadvantages under which we are at present labouring, any undue pressure or harassing policy is adopted, the consequences will be keenly felt.

There exist in our immediate neighbourhood many branches of these industries, and if none of these individually is so important as the cotton industry, yet taken together they find employment for a large number of hands and contribute considerably to the maintenance of the commercial greatness of our city. Some of our traders and manufacturers have been adversely affected by the great fall in the values of half-manufactured articles obtained from the by-products of gasworks; 90 per cent. benzol, for example, which last year was quoted at 3s. 6d. and 3s. 9d. per gallon, is worth to-day only about 1s. 5d., and there is every likelihood not only that this low figure may be maintained for some time, but that prices may fall even lower. We had, until lately, the poor consolation, so far as the coal-tar colour industry was concerned, of knowing that if Germany had outstripped us in the production of coal-tar colours, we at least held the key of the situation in supplying the principal raw materials, such as benzol, toluol, carbolic acid, ammonia, &c., but those days are now gone by. As a consequence of further improvements in the recovery of these materials from the gases of combustion produced in the conversion of coal into coke, Germany is now already in a position to obtain these articles as a by-product in quantities almost sufficient to meet her own requirements; and with a more extended application of the improved process to the coke ovens, she will be able to supply the whole of the benzol required at a much lower price than tar distillers and carbonisers could accept at the present market price for the crude material, and thus we shall most likely lose an important article of export. The consequences of this improvement will also be seriously felt by our corporation and the rate-paying community; considerably lower prices will have to be accepted by the gasworks for their tar and ammonia waters, and there appears little chance now of a reduction in the price of gas for manufacturing and lighting purposes, for not only has attention been directed to the regeneration of benzol, but considerable quantities of ammonia are also being obtained as by-products from the same source; indeed the consequence has already been that some of our carbonising works have had to suspend operations. It is, however, not only the coal-tar industry which has recently received a severe shock, but it may be said, without fear of contradiction, that the whole of the chemical industries of this country are in a certain state of stagnation; their progress and development are undoubtedly most unsatisfactory when compared with those of our great rival, and this state of things is perhaps not altogether confined to chemicals but extends also to other articles of manufacture. Who would ever have thought, say 20 years ago, that we were going to import cotton goods, or cotton machinery, or perhaps still less alkalis? At that time anything appertaining to cotton was of English origin; when we spoke of an alkali industry we had only England in our minds; and even then, though Germany was already making rapid progress in wresting from us a large portion of the coal-tar industry, she at least had then to depend to a large extent on us for the supply, not only of benzol and other crude tar products, but also for the alkalis required in the production of colouring matters. To-day the unexpected has become a fact; we are importing some kinds of cotton goods and certain cotton machinery, and we are importing alkalis; it is true the quantities are not as yet large, but who shall say that they may not rapidly increase, and that before we are fully aware of the fact? I cannot give a better example of the unsatisfactory progress of our industries than by selecting an article of very large consumption which enters into use in multitudes of branches of industry, and which may be taken as a fair test of the expansion or otherwise of other industries. I will refer you to a few comparative figures relating to the export of alkali.

EXPORTS OF ALKALI FROM ENGLAND TO GERMANY.

1881.	1891.
Cwt. 928,900	Cwt. 143,700

EXPORTS OF ALKALI FROM GERMANY.

1884.	For the half-year ended 30th June 1892.
Cwt. 351,402	Cwt. 433,824

without including potash. Assuming that Germany will export only a like quantity in the current half-year, we find that she has increased her exports, within a period of eight years, from 351,402 to 433,824 cwt., an increase of more than 20 per cent. Now, looking at the exports of alkalis from this country to all countries, say in 1883, and comparing the figures with those for 1891, we shall see that our total exports of alkalis, instead of having increased, have decreased by more than 10 per cent. during a similar period of eight years.

EXPORTS OF ALKALI.

1883.	1891.
Cwt. 6,947,000	Cwt. 6,225,953

These figures do not require elaborating, they tell their own tale; the only redeeming feature in this case is that the decrease is due not so much to inferior skill on our part as to the want of foresight on the part of our manufacturers, who would stick to antiquated processes, trusting to combinations and artificial raising of prices, which, as experience has taught us over and over again, could only result, as they have resulted, in failure. The high prices ruling for alkali during the last few years have not only reduced our exports of the article, but also injuriously affected other trades, especially those of paper-makers, dyers, calico-printers, bleachers, soap-makers, and chemical manufacturers, and with the small margins at which these trades are and have been working of late they can ill afford to pay more for an article largely used in their respective trades than is paid by other countries with which they have to compete in the world's market. New works have been started during the present year for the manufacture of ammonia-soda, and another new undertaking is shortly to commence operations, and it may be assumed that the price for this important article will by and by be reduced to a figure which will leave a fair working margin to the manufacturer, and compensate him for the difference in price by an increased consumption. Gentlemen, German producers can purchase to-day some of the principal raw materials, such as alkalis, sulphuric acid, benzol, and other products, at prices at least as low as those we have to pay; we have, therefore, in the future to reckon with a new factor, and one that may have a material and important bearing on the development of our industries. The battle for supremacy will have to be fought henceforth with equal arms, and with no advantage, such as we formerly had, on our side, and the victory will rest with the nation that turns to best account the materials at its disposal. Our whole aim must therefore be to concentrate our thought, skill, and energy on the conversion of crude and half-finished materials into products of the highest excellence and perfection, and in order to do so, we must give to the people in this country similar, or even greater facilities for acquiring the requisite scientific and technical knowledge as are enjoyed by our rivals. As one for some years

connected with the former management of the Manchester Technical School, I have regarded with great satisfaction the acquisition of this school by our corporation, and under the guidance of the able and energetic chairman of the Technical Instruction Committee, seconded by the eminent services of my friend, Mr. J. H. Reynolds, its director, it may be expected that we shall, before long, possess a technical school worthy of this great centre of industry, affording opportunities for acquiring technical knowledge as good as, or better than those at the command of the people with whom we have to compete. A special feature in the new school will be the silk-spinning, weaving, dyeing, and finishing department, and the school for bleaching, dyeing, printing, and finishing of all kinds of fabrics. So far, the teaching of the tinctorial arts, especially the application of chemistry to colouring fibres, has in all our colleges and schools been only very partially successful. No doubt students, on leaving, possess a fair amount of knowledge, but of a kind a great deal of which is never required in practice, and much that is required they have never been taught. The reason for such a failure is very evident. Success in dyeing, printing, and the accessory arts does not depend solely upon a sound knowledge of chemistry, but to a large extent, just the same as applied chemistry in general, upon chemical engineering. Hitherto, however, the student, after having gone through a science, and a so-called experimental course, in which no opportunity is afforded of becoming acquainted with the engineering part of his profession—his experience principally extending to the handling of beakers, glass cylinders, china basins, a few grains or grammes of drugs and colouring matters, and correspondingly small quantities of yarn or cloth—has found himself, on entering a dye or print works, in a similar position to a cow before a turnstile, not knowing where to turn or how to move: he feels that every ordinary workman in the place knows more about the complicated machinery and other appliances before him than he does. The consequence is that the foreman or manager looks over his shoulder, and the principal soon gets disgusted with his new acquisition from which he had been promising himself so much, and puts him down as a noodle only fit for testing a few drugs and nothing else, and in this opinion he shortly after becomes fully confirmed. Work is going wrong, goods are being spoiled, they are either spotted, or streaky, or "off shade," or have other possible defects attached to them. For the time the foreman is puzzled, he cannot account for the defect, and now here presents itself a glorious opportunity for our friend from the technical school or college. The principal consults him, and requests his advice as to how to get over the difficulty. The fact however, is, that in ninety out of a hundred cases this scholar makes a fool of himself, and ultimately the comparatively ignorant foreman solves the problem, and our student, carefully trained at the college, is sent back to the laboratory, apparently the only suitable place for him. Now, what is the cause of this, and how can such an ignominious failure be avoided? The reason is that the student has never, during the whole course of his training, met with any such or similar problems, and to solve these when met with one must possess, in addition to scientific knowledge, a thorough knowledge of the entire plant and machinery of a dye or print works, as the causes of these difficulties are frequently of a purely technical character, or of a chemical and technical nature combined. If, therefore, we want to train in our schools day-students destined to become foremen, or managers, or masters of such works, we must teach them the application of science to these industries with the appliances and apparatus which they will actually meet with in practice. We must have the school workshops equipped with the very latest and most modern machinery of this or any other country, which must be kept on a level with the progress of discovery and invention; we must have a model bleach, dye, print, and finishing works, of course on a small scale—but yet large enough to allow the yarns in our spinning department to be made up, bleached, prepared, dyed, &c., and the cloth woven in our weaving school to be bleached, printed, and finished; and the work turned

out must not be schoolboys' work, but equal to the best to be found in the trade. Only thus shall we be able to put our students in a position at once to confront and solve all the difficulties and problems which he may encounter in practice, and only thus will his scientific knowledge be of real advantage to himself and the trade. Such a student will at once command a higher salary, for he will, frequently from the very commencement, be in a position to point out to his employers any likely improvement, because his knowledge of a varied class of appliances may often be superior to theirs. A number of men thus trained will soon produce a marked effect on the goods turned out in our dye, print, and a finishing works.

That this view is practical one, is proved by the Dyeing School at Crefeld—the only school, in my opinion, worthy of the name—which has produced results so highly appreciated by the community and the trade generally, that the municipal authorities, supported by the Government, have resolved to remove the already large dyeing department from the school, and to erect a special building to carry out the work on a still more extended scale.

We are exporting annually more than twenty millions' worth of dyed and printed cotton goods, the largest portion of which comes from Lancashire; improved methods for cheaper production, and still greater excellence would, we may fairly take it, materially increase our exports of these goods, and find increased employment for our working classes, and towards accomplishing this important object such a school would render invaluable assistance.

DISCUSSION.

M. CRIPPIN said he felt very keenly the remarks made by the Chairman upon the Patent Laws, inasmuch as he had a patent which, had it not been that he had means wherewith to fight, would probably have never come to the front. He hoped that the Chairman as a member of the Chamber of Commerce would obtain its influence in securing Government protection, and reducing the Patent Law fees as in America and Germany. With regard to technical education, while he did not wish to discourage the Chairman and those associated with him in their endeavours to bring about a better state of efficiency, still he thought that the laboratory work done in the technical schools of this country was not brought to a practical issue. Unfortunately the men who worked by rule of thumb knew a great deal more than the student who had passed through a course of study at these schools, and this was mainly due to the deficiency of the teaching staff, and pupils not being in touch with practical work, as was the case in Germany.

Dr. HEWITT said he appreciated most strongly the Chairman's remarks on technical education, and he enforced them all the more, inasmuch as the previous speaker appeared not to fully comprehend them. The Chairman had pointed out the defects of the British system of technical training, and called attention to the fact that most students were quite unfit to guide men who had had a life-long experience, and who had acquired a certain amount of practical knowledge by observation. What was required was a system of technical education which would give students an opportunity of seeing a piece of cloth pass through the various processes of spinning, weaving, dyeing, and finishing, and of learning something with regard to the laws of motion and physics.

Students were admitted into technical schools without their having first of all received a preparatory training, and regardless of their fitness to take up any particular class of work; and another defect was mainly due to the common notion that a student after three years' experience at Owens College was competent to undertake practical work. Under these conditions the great wonder was that British manufacturers had maintained their supremacy as long as they had, and the only reason he could assign for it was the abundance and cheapness of coal and iron. What was required in England was something between the elementary school and the university, and the university and the works. With regard to the Rivers Pollution Act, he hoped the chemical manufacturers in that district would not depend upon the sort of defence set forth in the Chairman's address. He should be sorry to think that it could be argued that two

blacks made one white, and that because towns sent sewage into the streams and rivers chemical manufacturers ought not to do their utmost to prevent pollution. With reference to the alkali trade, he did not think they had much to fear from German competition; still it would be necessary to march with the times and abandon antiquated processes.

Mr. PHILIP HARTOG said they had heard a good deal of the ridicule cast by manufacturers on the system of teaching as carried out in university laboratories, but it seemed to him that it was not so much the fault of the system as the fact that manufacturers expected too much. They expected that a student should not only know, but that he should understand technical processes which could only be learnt in modern works. After an engineering student at Owens College had served three years as a student, he was supposed to have at least three years' training in a civil engineer's office before he was competent to fill any position requiring a knowledge of that profession; and it was the same with a chemical student, who, before he was called upon to take a responsible position, should be taught the technical part of his profession.

Dr. DREYFUS quite agreed with all that Dr. Hewitt had said with regard to students receiving a secondary education before passing into technical schools, and he thought one of the greatest defects in the present system of technical instruction was the inefficiency of the teaching staff which was principally owing to the small salaries offered.

Mr. J. H. REYNOLDS (director of the Manchester Technical School) said he endorsed all that had been said by Dr. Hewitt with regard to the defects of the present system of technical education. His experience proved to him that the system of education as carried out in elementary schools was such that the majority of pupils were quite unfit to receive instruction in any particular branch of technical knowledge; and moreover students seemed to expect to attain proficiency in the course of a short session or two, sufficient to earn money. So long as that spirit prevailed it was hopeless to expect anything like success in technical education. Dr. Hewitt had referred to the students in Switzerland who had served three years in the works, and who were the very ideal of what students should be, inasmuch as they had experienced the difficulties they had to contend against, and had voluntarily gone back to school to acquire the scientific knowledge they knew the school was capable of imparting to them. Until a system of secondary education was established in England which would reach every child in the kingdom, both rich and poor, the technical schools would be a failure. In Zurich the pupils passed from school to school and were afterwards drafted into industrial works. The Chairman had referred to the proposed Manchester municipal technical scheme, which could only be made successful by allowing properly trained students to enter, and by securing their attendance for a sufficiently long time to get thoroughly well grounded in laboratory work before passing into the dyeing department, where they could have an opportunity of seeing work carried on in a practical manner. If technical education in England was to be brought to a successful issue, we must be prepared to spend money lavishly as in Switzerland, and if the German Government could spend such large sums of money, why could not Manchester if it were necessary? He was afraid that manufacturers did not realise the importance of this, and it was only when trade was bad that any effort was made to alter this state of things. The only note of opposition he wished to raise against Dr. Hewitt's remarks was that to multiply technical schools, having regard to the lack of teaching power in the country, would only end in a considerable waste of money. They could only increase their number in proportion as well-organised secondary schools were established, and when they had achieved this he had sufficient faith in the intelligence of the people not to lag behind in the race of industry.

Dr. HEWITT was entirely at one with Mr. Reynolds as to the danger of increasing the number of technical schools. One of the practical difficulties was that every township wanted a fair proportion of the money set apart for technical education, and this might tend to multiply inefficient schools.

The CHAIRMAN, in reply, said the opinions expressed by Dr. Hewitt and Mr. Reynolds were quite in accord with his own. With regard to the pollution of rivers, he did not wish to set up any defence on behalf of chemical manufacturers, as they were bound to do all they possibly could to prevent the pollution of streams.

THE RECOVERY OF BY-PRODUCTS FROM COKE OVENS.

BY CHARLES DREYFUS, PH.D.

WITHIN the last twelve or eighteen months there has been a gradual fall in the prices of tar products, and specially of those used in the colour industry, such as benzenes and anthracene.

	Prices.			
	90s Benzene.	50s. Benzene.	Anthracene.	Sulphate.
1891.	s. d.	s. d.	s. d.	£ s. d.
January	4 8	3 6	1 4	10 10 0
December	3 0	2 0	1 2	10 5 0
1892.				
January	2 0	1 8	1 0	10 10 0
July	1 8	1 3½	0 9	10 0 0
September	1 7½	1 3½	0 9	10 0 0
November 1st	1 6½	1 3½	0 9	10 0 0

Most people in this country have been at a loss to account for this shrinkage in values, and various causes have been given as the reasons for it; our old friend, depression in trade, and bad trade in the foreign colour works have been trotted out by even responsible people; but the real reason of such depression—namely, a larger production—has been overlooked. It is to give the real reasons of this great shrinkage in values that I have prepared this paper, and in order that I may not be accused of over-stating the case, I will give you the sources from which my information is drawn: the principal sources of my information are the papers published by my friend Mr. Fritz W. Lürmann, engineer, of Osnabrück, in *Stahl und Eisen*, 4, 1892, and 18, 1892; also a pamphlet published by Mr. Ch. Demanet, C.E., manager of the Havré Colliery, near Mons, and which I owe to the kindness of Messrs. Semet-Solvay, and finally, private information obtained from friends in England and abroad, and which I have the right to use here to-night by permission of such friends.

The real reason of the depression in prices of benzene and anthracene is the large production of tar from the coke ovens abroad, the production of large quantities of benzene from such tar, and more especially from the gas of such coke ovens, and though England has been up to now the greatest producer and exporter of *Benzenes* and *Anthracene*, in the future I fear this will not be the case unless the English coke oven proprietors follow the example set to them by their colleagues abroad, and carbonise the whole or part of the "15,000,000 tons* of coal annually coked for the use of our ironworks" in ovens specially constructed for the recovery of the valuable by-products: tar, benzene, and ammonia.

HISTORICAL: PART.—I.

"More than one hundred years ago 'Stauf,' called the 'Kohlenphilosoph,' made a successful attempt to recover

the tar formed in the coking of coal." The ironmasters, engineers, and chemists all over the world have given much time and great attention to the question of coke-oven progress, with special regard to obtain by-products, and their experimental work in this direction extends back 35 years (this Journal, 1884, 601—606; also 1835, 451—452.) "Appolt, Semet, Coppée, and others have constructed ovens which have been for 30 years in very general use in Germany, Belgium, and France, whilst in Great Britain nothing seemed to shake the belief of iron-smelters in the infallibility of the bee-hive ovens. But even on the Continent it was thought that any attempt at condensing tar and ammonia must necessarily be fatal to the quality of the coke. Only quite recently has this belief been thoroughly shaken."

Thus, said Lunge, in his second edition of "Coal Tar and Ammonia," edition of 1887, and I can only add my testimony to his, that the coke produced in the ovens where by-products are recovered is now declared to be equal in quality to the coke from bee-hive ovens.

The French first, and the Germans afterwards, took up this question, and it has made slow but sure progress with them. The plant for the recovery of tar, benzenes, and sulphate of ammonia is not simple, and requires the greatest attention. The fear was entertained that by the introduction of these methods the coalowners would have to add chemical works to their mines; this plant increases considerably the primary cost of the coke ovens; then again, the coal-mine owners did not know what a ready market existed for the disposal of the by-products. The value of the recovery of the by-products has become clearer and clearer within the last 10 years, and the greatest praises are due to Mr. Hässener and Dr. Otto for their efforts in that direction. This latter gentleman has erected, for account of his own firm, as well as for others, a great number of Hoffmann-Otto ovens. These ovens are now at work over seven years, and the installation is so carefully planned that they give everywhere the greatest satisfaction.

II.—PROGRESS MADE IN THE DIRECTION OF SUCH OVENS.

The Hoffmann-Otto coke ovens exist now in the greatest number in Germany; they are the ovens worked in connection with Siemens regenerators. The following figures will show how this extension has taken place:—

	Ovens at Work.	Ovens in Construction.
1884	40	120
1885	210	140
1889	605	..
1892	1,205	..

Of these 1,205 ovens there are at work:—

	Ovens.
1. In the Ruhr district	470
2. In Upper Silesia	705
3. In the Saar district	30
	1,205

The firm of Dr. C. Otto and Co., of Dahlhausen, undertakes the construction of a group of 60 Hoffmann-Otto ovens with the necessary machinery and appliances for the recovery of the by-products (of which steam engines, gas exhausters, ventilators, and pumps are in duplicate) for the sum of 700,000 marks (about 36,000*l.*), of which about 15,000*l.* are for the ovens themselves, and 21,000*l.* for the condensation plant of by-products.

One Hoffmann-Otto oven can be charged with 6½ tons of coal, and requires 48 hours to work off; therefore in one

* See Lecture by Sir Lowthian Bell delivered at the Autumn meeting of the Iron and Steel Institute this year.

year the following amount of coal is coked, and by-products recovered :—

	One Hoffmann-Otto Oven.	A Group of 60 Ovens.
	Tons.	Tons.
1. In the Ruhr district	1,125	67,500
2. In Upper Silesia	1,170	70,200
3. In the Saar district	960	57,600

The yield from the dry coal is :—

	Coke.	Tar.	Sulphate of Ammonia.
	Per Cent.	Per Cent.	Per Cent.
1. In the Ruhr district	75-77	2.3-3	1.1-1.2
2. In Upper Silesia	65-70	4-4.5	1.0-1.15
3. In the Saar district	68-72	4-4.3	0.8-0.9

One ton of dry coal yields therefore an average of about $14\frac{1}{4}$ cwt. of coke, 10 gallons of tar, and 25 lb. of sulphate of ammonia.

One Otto oven produces, therefore, per annum an average of 820 tons of coke, 44 tons of tar, and $13\frac{1}{2}$ tons sulphate of ammonia.

The production, use, and surplus gas is per day and per oven :—

	Production.	Use.	Surplus.
	Cub. M.	Cub. M.	Cub. M.
1. In the Ruhr district	1,000	600	400
2. In Upper Silesia	1,150	650	500
3. In the Saar district	1,000	600	400

It is reckoned that every 100 cubic metres of this surplus gas replaces 87.5 kilos. (about $1\frac{3}{4}$ cwt.) of coal in the heating of boilers. The saving in coal by the surplus gas for a group of 60 Hoffmann-Otto ovens is :—

	Per Day.	Per Annum.
	Tons.	Tons.
1. In the Ruhr district	21	7,560
2. In Upper Silesia	26 $\frac{1}{2}$	9,458
3. In the Saar district	21	7,560

Of this surplus must be deducted one-third for use by the condensing plant.

II.—SEMET-SOLVAY COKE OVENS.

I come now to another system of coke ovens, which are in use in Belgium, in France, in Germany, and in one works only in England.

The first ovens of this system were built in 1882 by Mr. Semet, at the Bellevue Pit, No. 2, belonging to the Ouest Mons Colliery Co., with a small set of six ovens, which were worked on trial for about one year. Since then the experiments have been carried out by the Solvay Co., with a set of 25 ovens erected close to the Havré Colliery. Finally, the Bois du Lac Co. have taken up on their own account the working of this plant, which has now been greatly enlarged; the Semet-Solvay system has thus entered definitely into industrial practice. The following are the ovens at work of this system :—

100 ovens at Havré, near Mons.
26 " Seraing (Société John Cockerill).
25 " Ghlin (Société des Charbonnages du Nord du Flemin).
24 " Ruhrort (Société Phoenix).
39 " Northwich (Brunner, Mond, and Co.)
205 ovens.

There are in construction this year the following ovens of this system :—

50 ovens at Drocourt (at Henin Lietaud, France).
15 " Syracuse (Solvay Process Co.).
24 " Ruhrort (Société Phoenix).
26 " Seraing (Société John Cockerill).
25 " Jemeppe, near Liège (Charbonnages des Kussales).
140 ovens.

From the fact that the Phoenix Co. and the Société John Cockerill are erecting a second set of these ovens, I would conclude that the system gives full satisfaction. The construction of the Semet-Solvay ovens permits of a stronger formation of the covering masonry, a very high temperature can be attained, and good coke can be obtained from poor coal.

The cost of the oven itself, with fittings, steam ram, rails for the same, &c., can be estimated at 160*l.* per oven. This figure is not high, considering the large production of coke, which amounts to 100 tons per month per oven. To this estimate must be added the cost of the apparatus for the recovery of the by-products, which is about 100*l.* per oven. Each oven takes a charge of 4 tons of coal, and the coking is finished in 22 hours; the yield of coke is a maximum, and corresponds to the theoretical yield owing to the air tightness of the ovens.

At the Havré works, with coal containing 16 to 17 per cent. of volatile matter, the yield of coke averages 81 per cent.; in this figure are not included small coke and breeze. The coke is absolutely the same as that produced in ovens of the ordinary type; the by-products vary in quantity, according to the nature of the coal used. At Havré, where poor coal is used, the average yields are :—sulphate of ammonia, $13\frac{1}{2}$ lb. per ton of coal used, and 31 lb. of tar. Through the kindness of Mr. Mond, Mr. Gustav Jarmay, managing director of the Northwich works, has communicated to me the following figures of the average yield of by-products obtained in the Semet-Solvay ovens in use at Northwich :—"For the last half-year we have recovered ammonia equal to 12 kilos. (27 lb.) sulphate per ton of coal, and 40 kilos. (88 lb.) of tar per ton. Our ovens are the oldest type of Semet-Solvay, and at present are out of repair, as we intend to replace them by the new type of Semet-Solvay ovens, and we quite expect that the yield of ammonia and tar will be better after the alterations."

III.—EXTRACTION OF BENZENE FROM THE GAS OF COKE OVENS.

It is now about three years ago, that besides tar and ammonia, benzole was directly recovered from the gas of these ovens. The plant for this process has been devised by Mr. Frank Brunk, C.E., of Dortmund. The process is kept a secret, but my friend, Mr. George E. Davis, and others who have studied this question years ago, will know probably what that secret consists of. So much, however, is known that between 3 kilos. (7 lb.) and 7 kilos. (16 lb.) of 90 per cent. benzene are recovered from the gas of one ton of coal coked. The quantity varies, of course, according to the nature of the coal; these figures offer nothing abnormal when it is known that $12\frac{1}{2}$ kilos. (27 $\frac{1}{2}$ lb.) of 90s benzene can easily be obtained from the gas of one ton of good coal, distilled in an ordinary gasworks retort. (See Lunge, page 31.)

It is stated that the cost of erecting the benzene recovery plant is 250*l.* per oven (the Brunk system). Taking the present coke ovens as 1,205 (I have been informed there are now 1,350 Hoffmann-Otto ovens at work in Germany only, and that more are in course of construction). The quantity of coal these 1,205 ovens

can coke per annum is 1,382,400 tons: taking only the minimum yield of 3 kilos. of benzene per ton of coal, the yield in benzene, from the gas alone, would be 4,147,200 kilos., or over 1,000,000 gallons. I do not think there is quite as much as this quantity produced in Germany from coke ovens as yet; all the ovens not being arranged to recover the benzene from the gas, but I believe if we take Belgium and Germany together, there is not less than 1,000,000 gallons of benzene, and principally 90s quality, produced at present already from coke ovens alone; there is no doubt that this production of by-products is on the increase, because the Semet-Solvay system of ovens can be put down at a moderate figure, including the recovery of all by-products, tar, ammonia, and the extraction of the benzene from the gas. The cost of an oven, including all, would be about 260*l.*; the by-products, after deducting supplementary costs, yield 72*l.* per annum as net profit (this does not include the extra profit from the extraction of the benzene from the gas).

The recovery of by-products is not only of importance to the tar and colour industries, but it is of enormous value to agriculture. If we take into consideration the great profits realised in this industry (notwithstanding the lower prices now ruling), and which on tar and ammonia alone are over 40 per cent. on the cost of the plant, as we will show later on; if we add to this the profits on the benzene from the gas, we come to the conclusion that this recovery of by-products from coke ovens must go on increasingly. The demand for sulphate of ammonia and for tar is such that all the coke ovens in Germany, and even in England, if they were to recover their products, would find a ready sale for them. The actual daily consumption of pitch in Westphalia alone is 150 tons, which would take already the tar of 3,000 ovens.

Sulphate of ammonia is a valuable manure; in Germany the consumption of nitrogen containing manures has been as follows:—

	1887.	1888.	1889.	1890.
	Tons.	Tons.	Tons.	Tons.
Sulphate of ammonia ...	33,865	35,564	35,555	33,788
Nitrate of soda.....	194,619	259,482	320,820	330,366
Guano.....	71,880	58,261	54,062	46,444

If all the nitrogen in the above manures could be replaced by sulphate of ammonia it would mean that 285,000 tons of sulphate of ammonia would be required. The total quantity of sulphate of ammonia produced till now per annum from coke ovens is only 17,500 tons, and if all existing ovens in Germany were to recover by-products, the total annual production of sulphate of ammonia would only be 120,000 tons.

If we take the price of tar at 10*s.* per ton; of sulphate of ammonia at 10*s.* per cwt.; then the yearly income from a group of 60 Otto ovens would be:—

	For Tar.	For Sulphate.	Total.
	£	£	£
1. In the Ruhr district.	990	7,800	8,790
2. In Upper Silesia	1,500	8,000	9,500
3. In the Saar district .	1,200	4,920	6,120

This would give for one Otto oven a gross income of:—

	£
1. In the Ruhr district.....	115
2. In Upper Silesia.....	165
3. In the Saar district.....	102

From the above have to be deducted general expenses and sulphuric acid used for sulphate making, which are estimated at 50*l.* per oven, leaving therefore a net profit of over 100*l.* for by-products per oven, not including benzene.

There existed in 1892 in Germany, 16,947 coke ovens, of which 15,726 were at work; there are, therefore, at present barely 10 per cent. fitted up for the recovery of

by-products. It is estimated that the production of coke in Germany was, in 1891, 7,700,000 tons; if the whole of this coke had been produced in ovens fitted up for the recovery of by-products, Mr. Lürmann estimates the net profit from tar and ammonia alone (without taking into account either the benzene or the extra gas useful for other heating purposes) at 1,440,000*l.*

I would put the matter in a different way to prove how profitable this industry would be to this country. The best coke ovens without recovery of by-products give 60 tons of coke per month, according to information which I consider reliable. Suppose that the construction of such an oven costs 80*l.*; therefore the capital required for putting up ordinary ovens producing 100 tons of coke per month, would be, without recovery of by-products, 133*l.* 6*s.* 5*d.* for the Semet-Solvay oven, with recovery of by-products, the cost is 260*l.* for 100 tons coke produced per month, 126*l.* 13*s.* 7*d.* more capital is expended; these 100 tons of coke yield in by-products, after deducting supplementary cost, 6*l.* per month, or 72*l.* per annum, which is 57 per cent. of the additional capital spent for the same production. If to this we were to add the extra available gas of which one-half is sufficient for heating the ovens, and the benzene contained in the gas which can be extracted at very small cost, then these figures would come out still more favourably.

These figures apply to the poor coal used at Havré; in England, where better coal is available, better results are obtained, which can be tabulated as follows:—

	Sulphate of Ammonia.	Tar.
	Lb.	Lb.
Per ton of coal in England	27	88
" " Belgium	13½	31

The available gas in England would be larger also than in Belgium, our coal being so much richer in volatile matter.

Let us suppose that the 15,000,000 tons of coal which are coked per annum in England were treated in ovens of the Semet-Solvay type for recovery of by-products, we should obtain sulphate of ammonia, 180,000 tons, and in tar, 130,000,000 gallons; we should have surplus gas available, equivalent to one-fifth of the total coal consumed, and benzene from gas in such quantity that I fear to mention the figure.

The Board of Trade returns for 1890 (the last issued), give the quantity of coal used for gas making as 10,242,317 tons. This applies to authorised companies, but as there still are a large number of others, it is probable that the above total would reach 11,000,000 tons. If instead of the present system of working, gas were produced for sale by Semet-Solvay ovens, the coke could be used for metallurgical purposes, and the gas could be produced much cheaper than at present. If, finally, all the coal used in factories, works, and houses for heating purposes, and for the production of power, were coked, the gas and the coke produced would be available for heating and lighting purposes; we would do away with fogs and smoky towns, and the cost would be less than at present. I throw these suggestions out and they merit the consideration of all thinking men whether politicians, sanitarians, engineers, chemists, or manufacturers.

If we in England, using annually such an enormous amount of coal, were to recover the by-products, our profits would be great, our agriculture and industry would greatly benefit by the progress, and our towns would have a bright and clear atmosphere, where it would be a pleasure to live, and I hope the time will come when this progress which I foresee will be an accomplished fact.

Newcastle Section.

Chairman: A. Allhusen.

Vice-Chairman: John Pattinson.

Committee:

P. P. Bedson.	W. W. Proctor.
G. T. France.	W. L. Remoldson.
G. Gathral.	W. A. Rowell.
T. W. Hogg.	T. W. Stuart.
John Morrison.	John Watson.
B. S. Proctor.	

Hon. Local Secretary and Treasurer:
Dr. J. T. Dunn, The School, Gateshead.

SESSION 1892—93.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held in the Durham College of Science,
Newcastle, on Thursday, November 10th, 1892.

MR. ALFRED ALLHUSEN IN THE CHAIR.

Professor BEDSON made an informal communication, giving an account of some work undertaken by Mr. W. McConnell and himself on the gases enclosed in coal and coal-dust. The coal broken up into small pieces, and enclosed in an exhausted vessel, was heated to 100° C. for over 100 hours, and gave off gases amounting to 10 or 11 times its volume (about 300 cubic feet per ton), of which about one-sixth was marsh-gas. After this treatment the coal, crushed to dust, was similarly heated for 26 hours, and gave off more gas (nearly 20 cubic feet per ton), of which 18 per cent. consisted of marsh-gas and its homologues; analysis showed that members of the series at least as high as propane, $C_3H_{8.0}$, were present. The experiments seem to show that the coal parts more easily with the lighter hydrocarbons than with the higher homologues.

ON THE PART PLAYED BY CALCIUM CHLORIDE IN THE WELDON PROCESS.

BY G. LUNGE.

THE late Walter Weldon knew very well that the presence of considerable quantities of calcium chloride is essential to the recovery of manganese peroxide by his celebrated process. No doubt a good many observations had been made on that point in various works with which he was in communication, and probably many others have been made since his time, but they seem to have remained buried in the works' note books, and never to have been utilised for deriving distinct quantitative rules therefrom. The only quantitative statement on the amount of calcium chloride required for the Weldon process which I know of is that which I have received from Mr. Schaffner, of Aussig, and which is found in my "Sulphuric Acid and Alkali," viz., that there ought to be from 2 to $2\frac{1}{2}$ molecules of calcium chloride present for each molecule of $MnCl_2$. I thought it therefore advisable to investigate this question as far as possible, and this I have done with the assistance of Mr. B. Zahorsky. I shall now give a short description of our results.

The most natural explanation of the auxiliary part of calcium chloride is this, that it serves as a solvent for the

lime, which is so essential for the Weldon process. It is well known that lime is more soluble in hot chloride of calcium solution than in water, undoubtedly owing to the formation of an oxychloride. Crystallised calcium oxychloride has the formula $3CaO, CaCl_2, 15H_2O$, recently confirmed by Mr. Zahorsky, who found that no other crystallised oxychloride can be obtained. Quantitative statements on the solubility of lime in $CaCl_2$ solution have only once been published (by Post, in "Berichte," 1879, 1541), but they are extremely fragmentary, since only four observations were made, and the concentration of the solution was merely established by the hydrometer. We therefore commenced by making more complete observations on the solubility of CaO in $CaCl_2$ solutions of various strengths and at different temperatures, of which the following is a synopsis:—

SOLUBILITY OF LIME in Solutions of Calcium Chloride (expressed in grammes of CaO per 100 cc. of $CaCl_2$ solution).

Liquid.	Temperature in Degrees C.				
	20°	40°	60°	80°	100°
Pure water,	0.1374	0.1162	0.1026	0.0845	0.0664
5 per cent. $CaCl_2$	0.1370	0.1160	0.1020	0.0936	0.0906
10 " "	0.1661	0.1419	0.1313	0.1328	0.1389
15 " "	0.1963	0.1781	0.1706	0.1736	0.1842
20 " "	0.1857*	0.2243	0.2204	0.2295	0.2325
25 " "	0.1661*	0.3020*	0.2989	0.3261	0.3714
30 " "	0.1630*	0.3681*	0.3664	0.4112	0.4922

In the cases marked with an asterisk a precipitate of calcium oxychloride was formed which removed some $CaCl_2$ from the solution.

We notice that the solubility of CaO in solutions containing up to 10 per cent. $CaCl_2$ at the ordinary or a slightly raised temperature does not differ very much from that in pure water, no doubt because no oxychloride is formed up to that point. At higher temperatures the presence of $CaCl_2$ increases the solubility of CaO , and this takes place proportionately with the quantity of $CaCl_2$, except where the phenomenon is complicated by a precipitation of solid oxychloride. Otherwise from 40° C. upwards the concentration of the solution has more effect than a rise of the temperature.

Apart from CaO , a solution of calcium chloride can also dissolve protoxide and peroxide of manganese, and we shall have to refer to this later on.

After this preliminary work it was our task to construct an apparatus in which the part played by calcium chloride in the Weldon process might be experimentally studied in the laboratory under conditions sufficiently resembling those of actual practice. That this is no easy task is best proved by the fact that Weldon himself did not succeed in getting any satisfactory results so long as he worked on a laboratory or even on a semi-grand scale; and it is also proved by the complete failure of Post to establish a process even remotely similar to that carried on on the large scale. The task was, however, successfully accomplished, as we shall see, by means of the resources of our technical laboratory, which has indeed been expressly constructed with a view to similar investigations.

We possess a blowing-engine driven by steam-power, with a network of pipes and taps for distributing the compressed air in the laboratory. With one of these taps I connected a circular iron vessel, from which three vertical glass tubes carried the air to the bottom of tall glass cylinders (40 cm. high) placed in a large common water-bath, heated to 55°—60° C. The ends of the glass tubes were provided with many small perforations in order to divide the stream of air into many bubbles, and at the same time to thoroughly stir the mass, just as in a Weldon oxidiser. As it was important

to ascertain that exactly the same quantity of air passed through each of the three pipes, several check experiments were made with exactly equal quantities of manganese liquor and lime, keeping all other conditions as similar as possible, and the product was tested for MnO_2 in the usual manner. The result of three such experiments, carried on at the same time by means of the three branch tubes, was as follows:—66.14, 65.90, 65.90 per cent. MnO_2 . This very slight difference, which is no greater than in the case of very good analyses, proved that my apparatus fulfilled its purpose in this respect, viz., that tests made with it at the same time are really comparable with one another.

The material employed for our experiments was ordinary "still liquor" obtained from a works where chlorine is made in the old style from native manganese ore and hydrochloric acid. This liquor was neutralised with an excess of chalk and filtered; it then contained MnCl_2 corresponding to 114.84 grms. per litre. For each test 800 cc. of this liquor was in the end diluted to 2,000 cc., so that it now contained manganese corresponding to 45.93 grms. MnO_2 per litre, which is very nearly the concentration usual on the large scale. The 800 cc. of liquor was mixed with the exactly necessary quantity of milk of lime for precipitating all the manganese as Mn(OH)_2 , and then tested for CaCl_2 , whereupon the liquor was made to contain a certain proportion of the latter by either taking away some of the clear solution or else adding solid CaCl_2 . Lastly, exactly 1 mol.

of CaO to 2 mols. of Mn(OH)_2 was added, and the mixture was made up to 2,000 cc. It stood at the same height in all three cylinders. During the experiments the water carried away as steam was replaced, and the same level of liquid always kept up. When the temperature of the bath had reached 55° or 60° C., the air-blast was started, and continued for 10 hours. This is certainly much longer than is ever done in practice, but it was necessary in consequence of the low depth of the magma as compared with a Weldon oxidiser, and the best proof that, in spite of this unavoidable difference, our conditions of working sufficiently resembled those of manufacturing practice, is given by the excellent results reported below.

I do not quote several experiments made with turbid liquors, which exhibit irregularities on the small scale similar to those experienced in large work. The others are summarised in the following tables, where I give the average results of two parallel experiments for each single case. In every case the same quantities of manganese (= 45.93 grms. per litre) and of free lime (= 14.78 grms. = $\frac{1}{2}$ mol.) CaO to 1 mol. Mn(OH)_2 and of water were used, but the quantity of CaCl_2 was varied from 1 to 6 mols. to 1 mol. Mn(OH)_2 , and tests were taken every hour. The table shows the percentage oxidation of MnO to MnO_2 , giving always the average of two experiments, which never differed more than is unavoidable both on the small and the large scale (at most 3 per cent. MnO_2).

Molecules.	Hours.										
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	12.
1. $\text{Mn(OH)}_2, \frac{1}{2} \text{CaO}$:											
+ 1 CaCl_2	56.91	66.14	67.71	69.84	70.60	72.49	73.78	75.23	76.11	77.25	..
+ 1½ CaCl_2	54.95	60.68	65.82	69.22	71.41	73.81	75.00	77.20	78.30	79.24	..
+ 2 CaCl_2	50.56	58.23	64.31	69.93	73.89	76.59	78.52	79.60	80.21	80.97	..
+ 3 CaCl_2	42.23	53.13	61.78	70.06	76.17	79.05	80.45	81.62	82.53	83.92	..
+ 4 CaCl_2	38.53	48.70	57.86	68.35	76.02	79.68	80.94	81.75	83.27	84.75	..
+ 5 CaCl_2	29.43	37.50	44.37	49.77	52.32	65.36	75.14	81.08	84.11	85.20	87.79
+ 6 CaCl_2	19.74	26.47	41.37	51.18	65.71	73.14	79.77	82.36	83.75	85.51	89.13

It is evident that in the first stages of the process the oxidation of MnO and MnO_2 , or more correctly speaking the formation of calcium manganite, is the more retarded the more calcium chloride is present; with 1 mol. CaCl_2 it is nearly three times as quick as with 6 mols. But this proportion steadily changes with the duration of the blowing process; after six hours there is an equilibrium among all various proportions of CaCl_2 , and further on the degree of oxidation rises quite regularly in proportion to the quantity of CaCl_2 present. With 1 mol. CaCl_2 we find, after 10 hours' blowing, 77.25 per cent., with 3 mols. 83.3 per cent., with 6 mols. 85.5 per cent. Two experiments were continued for 12 hours in order to reach the maximum of oxidation, which was found = 89.13 per cent. with 6 mols. CaCl_2 .

In actual practice the oxidation at this stage (previous to the addition of the "final liquor" which we did not make, not to complicate the conditions) rarely exceeds 79 or 80 per cent. This is attained in very large oxidisers in two hours, in smaller ones in three hours, and in our small apparatus in six hours. It will be conceded that this is an exceedingly good result and entitles us to draw conclusions not merely for our small experiments but for actual practice. My conclusion is: that 3 mols. of calcium chloride to each mol. Mn is the most suitable proportion for the oxidising process. Below 3 mols. the process is essentially retarded, an addition of more than 3 mols. is more difficult to manage, and does not give a very large gain. Still there is no doubt that the operation ends all the more favourably, the more CaCl_2 is present.

The next question is, what is the cause of this favourable action of calcium chloride? The explanation which suggests itself from the first, and which was also given by Weldon himself, rests on the fact that CaO is more soluble in hot CaCl_2 liquor than in water, and that the oxidation must be all the more facilitated the more CaO there is in solution. If this is the only and all-sufficient explanation, then other similar solvents for CaO must act in a similar way. We cannot employ the best solvent for lime, viz., cane sugar, which, of course, entirely prevents the oxidation of MnO and MnO_2 ; the only substances which I found applicable here are the chlorides of sodium and potassium. Solutions of these, if not containing more than 5 or 10 per cent. KCl or NaCl , dissolve at 50° C. about 30 or 40 per cent. more lime than pure water, or almost exactly as much as a 10 per cent. solution of CaCl_2 , as proved by a number of special determinations which I leave out here. We now made three parallel tests, charging our three cylinders with the same quantities of manganese and lime as before, but adding to No. 1, 100 grms. CaCl_2 ; to No. 2, 100 grms. NaCl ; to No. 3, 100 grms. KCl per litre, which solutions would dissolve almost exactly equal quantities of lime. The three cylinders were heated in the same bath to 55° C.; air was blown through for eight hours, and the product analysed with the following results:—No. 1, 77.2 per cent.; No. 2, 69.41 per cent.; No. 3, 69.02 per cent. MnO_2 .

Although the same quantity of CaO was dissolved in all three cases, the advantage shown by the CaCl_2 in comparison with KCl and NaCl is much too large to be ascribable to an accident, looking at the absolute uniformity of all other

experimental conditions. This makes the assumption that the calcium chloride acts exclusively as a solvent for CaO very improbable; nor would this in any way explain the delay of the oxidation produced in the initial stage by an increased quantity of CaCl_2 .

We must therefore look for something else, and we naturally turn at once to the oxides of manganese themselves, whose solubility in CaCl_2 solutions was very early observed by Weldon (Chem. News, 20, 109). We have confirmed this; we have, moreover, found that the solubility of Mn(OH)_2 increases with the concentration of the CaCl_2 solution. The solution formed is colourless and turns brown on addition of chloride of lime. Weldon has noticed that any manganous salt, whether MnCl_2 or the solution of MnO in CaCl_2 solution, retards the oxidation of the Mn(OH)_2 suspended in the liquid, but that the simultaneous presence of lime quickens the oxidising process, by which a "port wine" coloured liquid is formed which Weldon took for a solution of calcium manganite in calcium oxychloride solution.

We have prepared that port-wine solution directly from the materials. In the case of a concentrated CaCl_2 solution it is amber-coloured, and there is no precipitate formed on boiling. Exposed to the daylight the clear liquid becomes gradually turbid and deposits a large quantity of MnO_2 (or calcium manganite). By the addition of water the colour is changed into dark brown, and it now yields a precipitate when heated. Hydrogen peroxide produces an evolution of gas and a vermilion-coloured precipitate. Ammonia gives no precipitate. Hydrochloric acid gives first a brown liquor, with evolution of chlorine, then the colour turns lighter, a green colour being temporarily formed. Sulphuric acid produces a precipitate of calcium sulphate, which also shows a transient green colour. Sodium sulphate produces a black precipitate.

Some of these reactions, especially the decomposition in daylight, seem to show that we have not to deal with a simple solution of manganese dioxide or calcium manganite in calcium chloride, but with a manganese dioxychloride, perhaps of the formula $\text{Cl-Mn-O}_2\text{-OCl}$.

The just-mentioned opposite behaviour of solutions of manganese, monoxide, and dioxide in calcium chloride during the oxidation of manganous oxide by oxygen seems to permit us to give the following explanation of the retarding action of an excess of calcium chloride in the commencement of the operation. Calcium chloride dissolves some Mn(OH)_2 , and this solution acts in a retarding way upon the oxidation of the suspended Mn(OH)_2 by atmospheric oxygen. The more CaCl_2 there is present the more Mn(OH)_2 is dissolved, and the more the retarding action of this solution is exercised. But as the oxidation is merely retarded, not stopped, gradually more and more MnO_2 (or rather CaMnO_3) is formed, which is also partly dissolved in the CaCl_2 solution, and yields the "port-wine solution" in which the oxidising action is accelerated. Thus, after a certain time, the retarding action of the MnO solution is compensated by the accelerating action of the MnO_2 solution, and later on the latter becomes prevalent. But at this point the circumstance comes into play that the quantity of MnO_2 entering into solution is also increased in proportion to the quantity of CaCl_2 present; therefore, in the latter stages the acceleration of the oxidation must increase with the quantity of CaCl_2 .

Several attempts were also made to clear up the nature of the "stiff batches" which used to occur frequently years ago, but are rare now, since it has been recognised that their formation can be prevented by keeping a proper quantity of calcium chloride in the mass, and by good blowing. The idea (suggested by Post) that thick batches were caused by the formation of solid oxychlorides is utterly untenable. Oxychloride does not separate out when calcium chloride is deficient, but only when it is present in excess, and even then only in far more concentrated solutions (as shown in the first of our tables) than ever occur in the Weldon process. Moreover, we found by filtering a "stiff batch," accidentally obtained, that the filtrate contained the full proportion of CaCl_2 , but a deficiency of CaO ; hence any separation of oxychloride was out of the question. We obtained even a stiff batch

by blowing air through a mixture of pure Mn(OH)_2 , free from calcium chloride, with a little more than its equivalent of Ca(OH)_2 . The analysis of a filtered sample showed 30.12 per cent. CaO , 11.11 Mn as MnO_2 , 41.32 total Mn, calculated as MnO_2 . There was thus more than 3 CaO present to 1 real MnO_2 . It seems that a combination of lime is formed with manganese protoxide, or else a very basic manganite, but we do not venture to pronounce a positive opinion on this question, which will probably be further investigated in the Zurich laboratory.

DISCUSSION.

Mr. STUART said that many years ago at Hebburn they made careful tests of batches worked on the manufacturing scale with varying amounts of calcium chloride, and had come to the conclusion that from 1.7 to 2 equivalents of calcium chloride to one of manganese chloride was the most suitable proportion. Thick batches arose when the proportion of calcium chloride was too small.

Mr. MARTEN pointed out that two equivalents of calcium chloride to one of manganese chloride was 3 of calcium chloride to 1 of manganese hydrate, as the decomposition of manganese chloride formed calcium chloride.

The CHAIRMAN said that excess of air appeared to act in the way of preventing thick batches, and thus counteracting the effect of a deficiency of calcium chloride.

Mr. RENNOLDSON thought the concentration of the solution would probably have some influence on the result.

Further discussion was adjourned until next meeting.

Nottingham Section.

UNIVERSITY COLLEGE, NOTTINGHAM.

Chairman: A. Archbutt.

Vice-Chairman: F. Clowes.

Committee:

F. J. R. Canulla,
J. B. Coleman,
C. H. Field,
H. Forth,
F. D. Mordle,
S. J. Pentecost.

H. J. Staples,
C. Taylor,
Sir John Turney,
G. J. Ward,
J. T. Wood.

Treasurer: J. M. C. Palon.

Hon. Local Secretary:

R. L. Whiteley, University College, Nottingham.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892-93.

Wednesday, Dec. 14th.—Mr. F. J. R. Canulla. "The Use of Chemical Lead."

Yorkshire Section.

Chairman: Sir James Kitson, Bart., M.P.

Vice-Chairman: Dr. F. H. Bowman.

Committee:

A. H. Allen.
J. B. Cohen.
T. Fairley.
A. Hess.
R. Holliday.
J. J. Hummel.

J. Lewkowitsch.
F. W. Richardson.
Jas. Sharp.
G. W. Slatter.
G. Ward.
F. B. Wilkinson.

Hon. Local Secretary:

H. R. Procter, Yorkshire College, Leeds.

Notices of Papers and Communications should be addressed to the Hon. Local Secretary.

A PAPER was read by Dr. Julius B. Cohen and G. Hefford, A.I.C., entitled "A Preliminary Note on the Products of Combustion of Coal," which will appear, together with report of discussion, in a future number of the Journal. The next meeting of the Section will be held at the Yorkshire College, Leeds, on Monday, December 5th, when Professor J. J. Hummel will describe some primitive modes of dyeing, and exhibit specimens, and various recent forms of apparatus will be shown.

Glasgow and Scottish Section.

Chairman: C. A. Fawsitt.

Vice-Chairman: E. J. Mills.

Committee:

G. Beilby.
W. J. Chrystal.
C. J. Ellis.
Wm. Foulis.
J. Gibson.
R. A. Inglis.
R. Irvine.
J. Falconer Kinz.

J. S. Macarthur.
T. P. Miller.
T. L. Patterson.
J. Pattison.
J. B. Readman.
E. C. C. Stanford.
E. R. Tatlock.
G. Watson.

Hon. Secretary and Treasurer:

J. Stanley Muir, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892-93.

Tuesday, Dec. 6th (Edinburgh):—Discussion on Mr. D. R. Stewart's paper, "The Flash-point and Heat of Burning of Mineral Oil."

Meeting held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, November 1st, 1892.

MR. CHAS. A. FAWSITT IN THE CHAIR.

THE FLASH-POINT AND HEAT OF BURNING OF MINERAL OILS.

BY D. R. STEWART.

In examining a burning oil, the first thing to investigate is whether the oil is safe to handle and to burn in ordinary lamps, and after that, what light it gives, &c. The safety of an oil is determined by taking its flash-point as it is called. What the flash-point is meant to be is the lowest temperature at which an explosion of the vapours given off can take place when a light is applied to the mixture

of air and vapour. At this temperature there is a flash of flame going immediately out. A somewhat higher temperature is required to evolve vapour sufficiently fast to keep up a constant flame. The lowest temperature for this is sometimes called the firing-point. The old method of taking the flash-point, fixed by Act of Parliament, was by gradually heating the oil in an open cup, partly screened from draughts, and applying a light at intervals. During the experiment, the vapours first given off diffused away into the atmosphere, and a point far above the true flash-point was got, and this, of course, gave a false impression as to the safety of the oil. This method was not rejected on this account however, but because different experimenters could not or did not strike the same point. I do not know the origin of this test, but if it was not designedly invented to deceive the public and let dangerous low-flashing oil into the market, that at any rate was the result of its adoption. The present method fixed by Parliament is the close test of Sir Frederick Abel. In this case the cup is kept covered when being heated, and two little holes are opened for a moment when the light is applied; we get the true flash-point, the lowest temperature at which we may expect an explosion; and different experimenters get the same result.

To fix 100° F. as the minimum safety point for oil in our climate, was, I think, a very reasonable thing; but to change the safety point when the correct method of testing was adopted, was very absurd. 100° in the old test was about 73° in the new, according to certain experimenters, and the minimum for the new test was fixed at 73°; that is, the old test, giving an indication false by 20° or 30°, was used for fixing the new safety point as if it indicated the truth. What naturally fixes the safety point for any country is the highest ordinary temperature of the climate. An oil flashing at or under ordinary summer temperatures is dangerous to handle, let alone to burn. If temperature in houses is for months at 80°, 73° flash-point oil is as dangerous as naphtha. For safety in lamps we have to add the heat developed by burning, and besides that, add a little for safety to put the oils fairly out of the range of possible explosions. The common high temperatures of this country, 70° at least, plus the heat developed in the oil reservoir by ordinary lamps in ordinary dirty order (20° at least if of metal as recommended by Abel and Redwood) plus 10° to put the flash out of danger, gives 100° as the lowest temperature which can be allowed with any security for the flash-point, Abel test, for oils for ordinary household use. This takes it for granted that oils are safe in proportion to their flash-points, which is a matter we must afterward discuss.

The crude oils, whether shale or petroleum, from which our burning oils are manufactured, contain a considerable proportion of volatile oils, called spirit or naphtha, which vaporise or boil at comparatively low temperatures. These have to be separated in the refining of the oils, otherwise burning oils would flash or give off combustible vapours at ordinary temperatures. The separation of this volatile spirit is a simple matter, happening of its own accord in distillation; and in Scotland in the manufacture of paraffin oil from shale there is no temptation to let any pass into the burning oil, for this spirit or naphtha is always in demand, and often commands a better price than burning oil. As far as I know, however, Scotch manufacturers have kept the flash-point about 100° as a minimum, whether naphtha was cheap or dear. Scotch paraffin oil generally flashes between 100° and 125° F. In America and elsewhere matters are different. Foreign petroleum is produced in such quantities that the naphtha production is far beyond what is required. There is therefore a great temptation to put in as much naphtha among the burning oil as possible. A great bulk of American petroleum is sent into this country between 73° and 80° flash-point. The petroleum trade in America has been practically in the hands of one great organisation, which, of course, had no difficulty in believing that what suited it was good for the world. Manufacturers and merchants at home and abroad like to have freedom to sell a low-flash consignment of oil if by any chance it should be made, and the Government does not want to hamper the trade, or do anything that would increase the cost of light unless it sees undoubted danger. There is no great class

whose interest it is to see that the flash is kept high enough, and great and powerful interests are all ranged on the other side, so that the interest and safety of the people are neglected and the safety point fixed far too low.

The temperatures of 73° to 80° are common summer temperatures, and even common winter temperatures in rooms after the lamps are lighted and the doors shut, particularly in the upper strata of the rooms, the position in which lamps are often placed, on the mantelpiece of the poor or the brackets of the rich. At these temperatures there is an explosive mixture over the surface of ordinary petroleum, whether in ship tank, barrel, tin can, or lamp funnel.

For the poor, with the petroleum flashing at 75° or so, there is constantly lying in wait the possibility of an explosion. In hot summer weather it is always there, only waiting for the accidental touch of a light; and throughout the year, summer and winter, with every lamp using these low-flashing oils, as a general rule once every evening, as the oil warms with the burning, the explosive mixture exists for some little time, and often it will exist for hours. The danger is therefore not a rare one; it is a thing of every-day occurrence. So it is not at all surprising that explosions and fires in petroleum ships should not be rare; and that in London and other towns where cheap petroleum is much used, lamp explosions should not be infrequent. The question rather is, why are accidents not more frequent? and the answer, I fear, is that even the most ignorant people are more intelligent than the Government, and have been taught by dire experience to treat ordinary petroleum as a dangerous liquid. The lowest flashing petroleum is in some respects more dangerous than gunpowder, for the powder only ignites on applying a light directly to it, while the petroleum insidiously exhales its vapour all round where no danger could be anticipated. But surely it is something approaching a national crime to put into the hands of the poor, the least intelligent of the people, a liquid which gives off an explosive vapour at ordinary temperatures, and to give it practically a Government certificate of safety. Yet that is exactly what is done. There are many deaths every year from ordinary petroleum, none of which would have happened if the safety flash-point had been left at 100°. Now, who is responsible for these easily preventable deaths, as well as all the destruction of property? You and I, gentlemen, if we don't speak out.

The better brands of petroleum used by the rich, to be got for a trifle more per gallon, are homogeneous in their nature, and their flash-points range from 100° to 125° F. or so. With them, under ordinary circumstances, the explosive mixture is never lying in wait, and there is no danger with them whatever if treated in anything approaching a reasonable manner. Under such circumstances our hope would naturally be in the Government, but unfortunately it is there that the great impediment lies.

From Eyre and Spottiswoode can be got for three halfpence a Report by Abel and Redwood on lamp accidents. How lamps may be modified to prevent accidents is the subject, but they fully discuss the influence of the oil.

They give details of 28 accidents, with flash-point of oil as far as can be ascertained. They found only one high-flashing oil 110°, and the accident was a case of over-setting. The highest flash-point got besides this was 88°. There were 23 cases of lamp explosion all of which, as far as could be ascertained, were from low-flashing oils. So their own table proves that 73 and even 88° are far too low for safety, and that over 100° is safe; yet they do not point this out but talk as if the reverse were proved.

They fail to point out the danger in the ordinary every-day handling of low-flash oils and talk as if the only risk were explosion in the lamps.

They argue that 73°, or a lower point, is safer than anything higher (page 5) and that this safest oil is at its greatest safety when heated far above its flash-point, so that the air is all expelled by the evolved vapours (pages 5 and 9). Now any person of common sense can see that this for common lamps and every-day use is very absurd. I quote their words, "If the flashing-point of the oil used be below the minimum (73° Abel test) fixed by law, and even if it be

about that point or a little above it, vapour will be given off comparatively freely, but the mixture of petroleum vapour and air formed in the upper part of the reservoir of the lamp will probably be feebly explosive in consequence of the presence of an excess of vapour. On the other hand, if the flashing-point of the oil be comparatively high the vapour will be less readily or copiously produced, and the mixture of vapour and air may be more violently explosive, because the proportion of the former to the latter is likely to be lower, and nearer that demanded for the production of a powerfully-explosive mixture." That is, they are of opinion that the lower the flash the safer the oil. If there was anything in the argument, 73° should be fixed as *maximum* and not *minimum*. Their highest flash was only 88°, and consequently the greater violence of their highest flashing oil over their lowest was a matter of no moment, as even 88° is dangerously low; but they make the statement as if it were of great importance, and put it so generally as to give the impression that the higher the flash the greater the danger. Common sense would advise a flash-point high enough to be out of the region of danger altogether. They do the very reverse. They go on to say, "Experiments have demonstrated that the burning of an oil of comparatively high flashing-point is more likely to cause heating of the lamp than the use of an oil of comparatively low flashing-point, in consequence of the higher temperature developed by the former, and of the greater difficulty with which some oils of that description are conveyed to the flame by the wick. It therefore follows that safety in the use of mineral oil lamps is not to be secured simply by the employment of oils of comparatively high flashing-points (or low volatility), and that the use of such oils may even in certain cases give rise to dangers, which are small, if not entirely absent, with oils of comparatively low flashing-point."

I am quite sure that this is a mistake they have made, and that as a general rule the very reverse is the truth. They fail to state the rule it seems to me, and give a rare exception as if it were the rule. Mr. Fox, present chemist to the Petroleum Association, and others, have made experiments proving them to be wrong. In all my experience I never found any corroboration of their statement. I give experiments in the Tables, proving that the law of the matter is that the lower the flash the more danger there is of a high temperature being developed.

In summing up the results of their investigations, Abel and Redwood say, "In one case the oil flashed at 73°, in one at 74°, in one at 77°, in one at 78°, in two at 79°, in one at 82°, in one at 83°, in one at 84°, in one at 86°, in one at 88°, and in one at 110°. Therefore in one half of the cases in which it was possible to determine the flashing-point of the oil, it was about 10° and upwards above the legal standard. In some of these instances the explosion was apparently of a more than ordinarily violent character."

Further on, in advocating metal reservoirs, they say, "Moreover, the heating of the oil does not necessarily increase the probability of the formation of an explosive mixture; on the contrary, any increased volatilisation resulting therefrom would have the effect of increased expulsion of air from the reservoir, so that the vaporous contents would be rendered inflammable instead of explosive. A lamp intended to be used with ordinary petroleum oil, and having an unprotected burner, is in the safest condition when the proportion of vapour to air is considerably in excess of that required to produce an explosion."

They say *safest*, when the oil according to their showing is heated far above its flash-point! But they are wrong in indicating that vapours would under ordinary circumstances be evolved in sufficient quantity to expel the air to such an extent as to prevent explosion. A certain temperature merely demands a certain definite pressure of oil-vapour, and when this is got evolution stops. Even with naphtha, a half-filled oil-can or lamp would not cease to be explosive, unless by the outward application of heat for the purpose. They themselves pointed out that many accidents were from oversetting, or from reservoir breaking. In the case of their so-called safest condition, if such accidents happened, there would be a sudden evolution of vapour all round, an explosion would certainly take place and vigorous combus-

tion ensue. Moreover before this safest condition could be reached by the heating of the lamp, in every case the state of greatest danger must be passed through. In a lamp full of oil the danger of an explosion might not be very great, yet still not insignificant; but when a half-filled lamp is lighted, as is habitually done by many people, the danger remains a long time, probably for hours, and the explosion, if it took place, might be the sharpest possible, whether with 73 flashing oil or 88. This is not a matter in which it is necessary for experts to instruct us.

Now, if a lamp of high-flashing oil were overturned, the lamp would likely go out, or, if the wick continued to burn, it would burn quietly on the pool of oil for some time without inflaming, it would not cause alarm, and would be easily extinguished. That is, unless the oil were highly heated by the lamp, as it was in Lord Romilly's case. His death was caused by a metal lamp without any non-conductor between burner and fount, and evidently intended to heat the oil to make it burn better, which it on that account certainly does. The table was overturned with lamp and papers on it, and the burner was so insecurely fixed that it fell out, allowing the oil to flow over the papers. In Scotland here I have heard of many cases of paraffin lamps oversetting, but I never heard of an explosion or fire resulting.

No doubt oil of 73° flash can be burned in proper lamps with perfect safety, just as naphtha can, but no manipulation of lamps would ever make naphtha or 73° flash petroleum safe for ordinary handling. We need never even talk of such a thing until the working man is able and willing to give a guinea for his lamp instead of a shilling as at present.

Mr. Redwood lately said:—"He had the honour of being associated with Sir Frederick Abel in some of his experimental work, and well remembered his expressing in his report a very distinct opinion that there was no grounds for considering that the minimum legal flash-point was not calculated to afford adequate protection to the public." (*Jour. Soc. Arts*, xl., 217.) I, unfortunately, could not get any such report from Eyre and Spottiswoode, or I would quote from the report itself.

Some time since I wrote to Mr. Gladstone on the subject, and the other day I got an answer from the Home Secretary "That he was advised that there are not sufficient grounds either of safety or convenience for an alteration of the existing flashing-point for mineral oils."

The oil required by the War Office has to be 105° flash-point as a minimum; lighthouse oil, 145°. Now, why does the Government supply its servants with such dangerously high-flashing oil if, according to the teaching of Abel and Redwood, 73°, or something lower, is safer? If our intelligent Government servants are not sufficiently protected unless they have a flash of 105°, how are the ignorant poor sufficiently protected by a flash of 73°? There seems to be something very far wrong somewhere.

Mr. Redwood's remarks to the Society of Arts are well worth reading. He appears to think the experiments made by the million every night are in favour of low-flashing oils, yet, judging from his own report, accidents are practically all from low-flashing oils.

Abel and Redwood are of opinion that metal lamps are best. The problem they set themselves seemingly was—how can ordinary dangerous petroleum be burned safely in lamps? Quite an impossibility. They suggest metal reservoirs strong enough to stand an explosion, and have low-flashing oil, well warmed by the lamp, to drive out the air with oil vapours, as before mentioned. Metal reservoirs are objectionable. You cannot see to fill the lamp without overflowing it. The smear itself is dangerous with low-flashing oils, particularly when it warms. It also causes the oil to syphon out by surface attraction, which it does with more speed than one would believe. Also, if the reservoir is a little too full, warning rapidly as it does in metal, the oil expands and must get out somewhere to produce a blaze, either through some chink of reservoir, or up the burner-tube to cause an alarming flare of light in the chimney that cannot be controlled or extinguished by screwing down the lamp. My opinion is we ought to have high-flashing oil, and we should have a glass reservoir with a non-conductor between it and the burner. Even although

the lamp were smashed, with the oil 20° under the flash-point, as it would naturally be in such a case, the danger of fire would be very small. But the glass reservoir might be protected by metal. Their proposal to protect the filling hole and burner-tube with wire gauze is very good, but it would be difficult to enforce it universally, or prevent it being torn out of cheap lamps. Then with a wick too small, as often happens in places far from the market, or with duplex lamp and one burner left without wick, as is sometimes designedly done, the train is laid for an explosion. The oil must be safe as well as the lamp.

The experiments I give were carried out to see the effect of flash-point on the heat developed in burning, and to get at that with certainty, I tried to make out the effect of other qualities, such as heavy oil being present, chemicals left in the oil, &c. When I commenced my experiments first I wished to investigate the matter very thoroughly, but was prevented. However, I tried a few experiments to satisfy myself, and these are what I have to give.

My aim was to have all the results exactly comparable. I used the same lamp with glass reservoir throughout. The table I give of the oils of different Scotch companies may possibly be an exception as they were tested previously; the lamp even in these cases was the same one, or one exactly similar. I took a new piece of wick for each experiment, clean and dry, and always of the same quality, and in the cases of first division of Table I. and first division of Table II., even from the same coil. Changing the wick each time was the only way to get comparable results, as I could not continue the same oil for a length of time; but by this way we do not get the full difference of good and bad oil, for some bad oils are cumulative in their bad results, as the impurities accumulate in the wick.

I wished to get the highest temperature possible for each oil, so as to get the differences accentuated. I soldered, therefore, a little tube to the metal outside the chimney, at the same level as the burner, put mercury in it, and a thermometer bulb in the mercury. If I took only the temperature of the oil in the reservoir I thought the error of experiment would be great from the effect of difference in draughts on a windy day and a quiet one, &c.

In doing first division of Table I. I did not take temperature of oil left in lamp at all, as I knew it was never high enough to be near the flashing-point of the oil; but having taken this in the case of petroleum, I supplemented these afterwards with the temperature results given in the second division of Table I.

The lamp with glass reservoir is a Young's duplex; and the metal lamp is a duplex exactly similar, I believe, to the one which caused Lord Romilly's death. After adjusting the flame of the lamp at first to its full height we did not touch it afterwards in case one experiment would get more care than another. The experiments and calculations given were made by my assistant, Mr. John Woodrow.

When a lamp burns badly it generally develops more heat than usual, the light is red instead of white, and the combustion is imperfect, producing a bad smell. This may arise from a bad lamp, the air supplied not being sufficient or not properly reverberated on the flame, or from the chimney being too short or so badly shaped as to give a back current inside the widened part; or it may arise from the lamp being dirty and air-holes partly filled; or from the wick being bad, damp, or dirty; or from the oil being polluted with a trace of vegetable or animal oil in the dishes used for measuring or filling; or from the oil itself being bad from refining chemicals being retained or heavy oil being present.

In the tables, I give the lamps burned with the air-holes free and also with the air-holes partly filled with candle-wick, so as to imitate the effect of a lamp in bad order. The result was often to decrease the light and always to increase the heat.

I give also the specific gravity of the oil, and the flash-point. The flash-point does not always rise in proportion to the specific gravity, comparing paraffin oils by themselves, or petroleum by themselves; for an oil of 800 sp. gr. say, may be either a comparatively homogeneous oil of that gravity, or it may be a mixture of lighter and heavier oils, with 800 as the average. The structure of the oils tested

is given in the columns for fractionation. My rule for fractionating is to make cuts with intervals of 25° or 50° C., but working with Fahrenheit thermometers my assistants erred from this a little, for which I am sorry; but all are done comparatively with each other. It is much better to fractionate in this way than to cut into equal measures, say 10 per cent. fractions, as one sees at a glance the structure of the oil. The effect of oil being not homogeneous in structure is shown in (7) where light special oil 782 is mixed with heavy marine sperm 830. The light was pretty well kept up, but the heat developed was much greater than with either oil separate. If the wick had been of poor quality the result would have been far more striking. A closely-woven wick fractionates the oil to some extent, and the residue in the wick and lamp tends to get heavier; so that an oil containing heavy oil with such a wick burns very badly after an hour or two, while a homogeneous oil burns well throughout. With a very good loose wick, the heavy oil rises pretty well, and the burning of badly-fractionated oil approximates to the well-fractionated. A well-fractionated oil is nearly independent of wick, one with heavy residue does not burn well unless the wick is very good. The burning oils (8—13) of first division of Table I. are all of similar quality, with fractionation similar to the two given.

In testing an oil in the laboratory all that boils over above 300° C. (572° F.) is looked on as hurtful to the burning in ordinary lamps. Ordinary paraffin oil has sp. gr. 808 to 815, but special lamps can burn oil of 830 or 840 quite well, and the flash of these is 220° or 230° F. They contain a considerable residue boiling over 572° (See (3).)

The expression "treated" and "untreated" which I have used refer to whether or not the oils were treated with acid and soda after the last distillation. Burning oils are greatly influenced by a finishing treatment. It gives them a pale colour and improves the smell. The oil settles quite clear, but retains sulpho-compounds of soda, and these have to be washed out as thoroughly as possible. Whether thoroughly washed or not the burning of the oil is always somewhat harmed by the treatment, and if much soda-compound is left in the oil, the oil is much the worse. The sulpho-compound decomposes in the burner, giving free sulphuric acid, which chars the wick, sometimes for an inch down the burner-tube. The wick at the top becomes quite acid to litmus. But sometimes the wicks are acid of themselves to begin, and acidity in the burner is not always from the oil. As a rough and rapid test for the amount of this decomposable sulpho-compound, I heat the oil rapidly to 330° , cool rapidly, and titrate the acidity. With care in doing the experiments all alike, the results are comparable. If left in the heat any time, the acid is given off as SO_2 , and disappears. I take 2,000 fl. gr. of oil and wash it afterwards with 200 fl. gr. of water. I titrate the water with centinormal soda, using methyl-orange as indicator, and the figures I give are the number of fl. gr. used. Experiment No. 11 was made for the purpose of testing the effect of much chemical retained. It was settled clear without further washing. The average C.P. is reduced from 19.6 to 14.6 .

Carefully fractionated homogeneous oils are low or high in flash in proportion to specific gravity and boiling point. To get at the influence of flash-point free from any confusing element I tried paraffin oil of similar quality, but varying in specific gravity, flash, and boiling point, and therefore exactly comparable. Nos. 1, 2, and 3 of Table I., first division, have flashes respectively 100° , 155° , and 230° . Burned with free burner the temperature was practically the same in all, being at burner 102° , 103° , and 104° respectively, giving the higher flash with the higher temperature. Even this little difference, I concluded, was from error of experiment, as I always got higher temperature with the lower flash afterwards, as in Tables below. One degree at the burner would only be a very small fraction of a degree when conducted to the oil, and diffused over it. When I tried similar oils with the air-holes partly filled, as lamps generally are, I was much astonished to find the lowest flashing oil give by far the highest temperatures.

The experiments being carried on at intervals as we happened to have time, the circumstances as to the weather, &c., varied, and the results vary a little one with another. I tried my very best to invent means of getting a high

temperature with high-flashing oils, as Abel and Redwood got for one experiment at any rate, but I failed. I wrote to Sir Frederick Abel, giving my experience, and asking him to give me a hint as to how I could repeat his experiments; but he answered that "he was altogether precluded at the present time to give any attention to the subject," and that he had forwarded my letter to Mr. Redwood. Mr. Redwood did not write in answer to my question, and I did not trouble him with another letter.

I thought if the oil were supplied freely to a lamp burning well, that the higher temperature should be got from the higher specific gravity and flashing-point, so I burned comparable oils with oil supplied at constant level, $2\frac{1}{2}$ in. below burner against 5 in., which is common enough in lamps, and I got the old result, highest temperature from lowest flash.

I tried American and Russian oils with the results shown on Table II. I tried the crucial experiment given in the last division of the Table. I distilled a sample of petroleum all over, and added naphtha from one half to the other half with the naphtha, and thus got comparable oils, such as I had of the Scotch, differing only in flash, we may say, with the result again of getting highest temperature with lowest flash-point.

I tried many experiments which I have not recorded, as each would have had to have been detailed separately; but all accorded with the results given.

My experiments leave no doubt on my own mind that Abel and Redwood's observations of a higher temperature from higher flashing oil was a mistake, and that the oils they compared had not been comparable. However high a temperature their high-flashing oil gave, I have no doubt a really comparable oil of low flash would have given a still higher temperature in similar circumstances. To render an oil flashing at 100° as dangerous as an oil flashing at 73° , it would have to produce a temperature in the oil vessel of 27° higher.

I have no doubt if all our oils, home and foreign, were made with high flash-point, it would render them safer in every respect. I have little doubt that to make all oils safe in this way would be a blessing to manufacturers, as well as to sellers and consumers. A demand for naphtha for enriching gas, or some other purpose, would soon be created; and, with ensured safety in use, the consumption of paraffin oil and petroleum would, I have no doubt, increase enormously. We will soon have factories driven by oil engines, working at the top of Highland mountains, and other out-of-the-way places, where coal as fuel is impossible. To give petroleum a chance of taking its natural place in the world, freedom from explosive vapour ought to be ensured, and I hope the manufacturers will soon see that this is to their own advantage.

I think myself it is an immoral thing for either individual or company to make or sell oil that gives off explosive vapours at ordinary temperature of house or lamps without labelling it as dangerous. If it were not for that report of Abel and Redwood, I would think that no sane man could look on 73° flashing oil as anything else but extremely dangerous.

It is a fact, of course, that high-flashing oils, which naturally burn cooler than low-flashing ones, can be contaminated (see 13 of Table I.) or burned in dirty lamps, so as to produce a dangerously high temperature; but with ordinary care of oil and lamps, I look on the 105° flashing oil of the War Office practically as safe as colza, or any other combustible oil.

More than a year since I tried to get samples of as many Scotch oils as I could. I give the results of my tests, showing all were of safe flash-point. Some, however, retained too much chemical, and would tend to char the wick and heat the lamp, but the experiments were carried out before the question of temperature was suggested to me. They should have the oils better refined before giving the final treatment, and be able to finish with less sulphuric acid.

I have not been able to carry out the series of experiments I originally planned, but I will continue to experiment as I have opportunity. But others should experiment also, and publish their results. It is a matter of too much importance to leave to the proclivities of a few individuals. Many

thoughts are suggested by my little array of experiments. These or a better planned series should be carried out by every oil chemist, so that the laws of the matter might be made quite definite and beyond dispute, and out of the region of mere opinion. Even educated persons have great diffidence in forming an opinion where scientific questions are involved, for although they are as capable of judging as experts, they do not know it, and this is a question on which they have been confused and misled. I have been greatly oppressed by my own responsibility in the matter—a responsibility brought painfully home to me by every death from lamp accident—and I had resolved to speak out my mind whether

I was opposed or supported by the Scotch oil trade. I think this Society should appoint a committee to draw up a series of experiments to be carried out by each member of the committee independently.

We should get from Parliament reliable and full returns as to deaths and fires from mineral oil, with origin of oil and flash-point as far as possible. I have no doubt whatever that all facts and experiments when collected and interpreted aright will further prove what I hold is proved already, that other things being equal, the higher the flash-point the safer the oil, and that 100° F. is the lowest flash-point that could with any confidence be adopted.

TABLE I,
SCOTCH PARAFFIN OILS.

	Oil Tested.	Air-Holes of Lamp.	Specific Gravity.	Flash-Point.	Candle Power.			Temperature of Burner.				
					After Burning.		Mean.					
					$\frac{1}{2}$ Hour.	7 $\frac{1}{2}$ Hours.		$\frac{1}{2}$ Hour.	3 $\frac{1}{2}$ Hours.	7 $\frac{1}{2}$ Hours.	Mean.	
				$^{\circ}$ F.			$^{\circ}$ F.	$^{\circ}$ F.	$^{\circ}$ F.	$^{\circ}$ F.		
1	Special oil	Free	782	100	25.9	19.0	22.45	102	104	101	102.0	
2	Lighthouse oil.....	Free	800	155	22.5	19.0	20.75	100	105	106	103.0	
3	Marine sperm, untreated	Free	832	230	20.7	10.2	15.45	104	103	103	101.0	
4	Special oil	Clogged	782	100	21.0	17.8	19.4	130	130	130	130.0	
5	Marine sperm, treated	Free	830	230	21.1	9.3	15.2	108	105	102	105.0	
6	Marine sperm, treated.....	Clogged	830	230	17.4	7.9	12.65	122	123	124	123.0	
7	Special and marine sperm, half and half.....	Free	808	114	22.2	18.2	20.2	110	115	111	112.0	
8	Burning oil, untreated	Free	799	94	21.5	18.2	19.85	112	115	109	112.0	
9	Burning oil, treated.....	Free	797	..	22.8	17.8	20.3	115	119	114	116.0	
10	Burning oil, treated.....	Free	799	104	21.2	18.0	19.6	114	115	112	113.6	
11	Burning oil (extra O. V.), treated	Free	802	..	22.0	7.2	14.6	119	115	110	114.6	
12	Burning oil, treated.....	Clogged	799	..	18.4	10.2	14.3	124	127	127	126.0	
13	Burning oil, treated, and $\frac{1}{2}$ per cent. boiled linseed oil.	Free	800	..	18.2	2.8	10.5	124	140	160	141.3	

	Oil Tested.	Oil consumed in Lamp in 7 $\frac{1}{2}$ Hours.			Specific Gravity of Residue Left in Lamp.	First Drop Distilled.	Fractionation of Oil Burned.					
		Fluid Grains.	Grains.	Grains per Hour per C.P.			Up to 450 $^{\circ}$ F.		450 $^{\circ}$ –572 $^{\circ}$ F.		Residue.	
							Per Cent.	Specific Gravity.	Per Cent.	Specific Gravity.	Per Cent.	Specific Gravity.
					$^{\circ}$ F.							
1	Special oil	9,850	7,703	45.7	783	..	..	..	..	..	..
2	Lighthouse oil	9,260	7,413	47.8	809	380	37.0	798	61.5	816	1.5	842
3	Marine sperm, untreated.....	8,000	6,556	57.4	832	510	..	..	81.5	830	18.5	842
4	Special oil.....	8,200	6,412	44.1	782	..	..	..	..	..	..	..
5	Marine sperm, treated.....	7,820	6,474	56.8	830	..	..	..	..	..	..	..
6	Marine sperm, treated.....	6,000	4,980	52.5	830	..	..	..	..	..	..	..
7	Special and marine sperm, half and half.....	9,550	7,716	50.9	809	..	..	..	..	..	..	..
8	Burning oil, untreated	10,020	8,006	53.8	801	..	..	..	..	..	..	..
9	Burning oil, treated.....	10,200	8,129	53.4	798	290	56.0	777	38.5	819	5.5	85
10	Burning oil, treated.....	9,200	7,351	50.0	799	310	54.0	779	41.5	820	4.5	852
11	Burning oil (extra O. V.), treated	7,750	6,215	56.8	803	..	..	..	..	..	..	..
12	Burning oil, treated	6,600	5,273	49.2	799	..	..	..	..	..	..	..
13	Burning oil, treated, and $\frac{1}{2}$ per cent. boiled linseed oil.	5,400	4,320	54.8	801	..	..	..	..	..	..	..

Flash point of samples of burning oil was about 100° F. Acidity after heating to 330°—Untreated oils, 0; burning oils treated, 2; No. 11, extra O. V. treatment, over 200.

SCOTCH PARAFFIN OILS—*continued*.

Oil tested.	Temperature of Room.	Temperature after burning Four Hours.					
		Glass Fount Lamp.			Metal Fount Lamp.		
		Burner.	Oil in Lamp.		Burner.	Oil in Lamp.	
			Increase.	Increase.		Increase.	Increase.
	F.	° F.	° F.	F.	° F.	° F.	° F.
SPECIAL 792, untreated.....	52	128	72	20	150	86	34
Lighthouse oil 810, untreated.....	50	121	61	11	148	83	33
Marine sperm 830, untreated.....	51	112	58	7	132	78	27
Burning oil 800, treated.....	52	124	69	17	144	81	29
Lighthouse oil 809, flash 145° F.....	56	116	63	7	136	72	16
Lighthouse and naphtha 738, mixture 807, flash 73° F.	56	119	64	8	138	72	16
American petroleum "Tea Rose," for comparison, 792, flash 75° F.	60	120	68	8	141	80	20

SCOTCH PARAFFIN OIL OF DIFFERENT COMPANIES.

—	Oil Tested,	Specific Gravity,	Height of Burner above Oil, Inches.	Candle Power,				Chimney,	Crust on Wick,	Notes.
				After Burning,			Average.			
				$\frac{1}{2}$ Hour.	4 Hours.	7 Hours.				
1	A.a.....	803	2 $\frac{1}{2}$	22'4	21'5	21'5	21'8	Clean.....	.. ..	.. ..
2	A.a.....	803	5	18'5	13'5	11'0	14'33	Clean.....	.. ..	.. ..
3	A.a., excessive (3 $\frac{1}{2}$ O.V.) treatment.	806	5	21'2	12'5	6'3	13'33	Dim, with white deposit opposite flame.	.. ..	.. ..
4	A.a., unwashed..	804 $\frac{1}{2}$	2 $\frac{1}{2}$	24'0	21'0	22'8	23'6	Clean.....	.. ..	Had to be turned down several times.
5	A.a.....	804 $\frac{1}{2}$	5	21'8	19'0	18'4	19'73	Clean.....	.. ..	.. ..
6	B.a.....	805 $\frac{1}{2}$	5	21'6	16'8	12'0	16'8	Very dim	Very hard crust..	.. ..
7	B.b.....	806	5	22'0	20'6	19'0	20'53	Clean.....	.. ..	.. ..
8	B.c.....	818	5	18'8	17'4	11'5	16'9	Slight deposit....	.. ..	.. ..
9	C.b.....	802	5	22'0	19'8	8'0	16'6	Clean.....	.. ..	.. ..
10	D.a.....	798	5	21'5	18'0	13'8	17'7	Dim	A good deal of crust, not so hard as B.a.	.. ..
11	D.b.....	802 $\frac{1}{2}$	5	21'6	18'8	16'8	19'06	Scarcely dimmed.	Crust, soft, little of it.	.. ..
12	D.c.....	809	5	19'8	14'8	11'2	15'27	Slight deposit....	Crust consider- able, soft.	.. ..
13	E.a.....	798	5	21'5	18'1	15'4	18'33	A little dim.....	Crust consider- able, hard.	.. ..
14	E.b.....	805	5	20'0	13'5	12'1	15'2	A little dim.....	Crust hardish.	.. ..
15	E.c.....	809	5	19'5	8'3	7'4	11'73	Very dim	Much hard crust.	.. ..
16	F.....	843	5	21'2	18'0	13'8	17'7	A little dim.....	Crust consider- able, soft.	.. ..
17	G.a.....	805	5	21'0	9'6	6'1	12'23	Very dim, worse than any above.	Crust much and hard, worse than any above.	.. ..
18	G.b.....	805	5	19'5	9'2	5'8	11'5	Very dirty	Great deal of crust, soft.	.. ..
19	G.c.....	810	5	20'0	10'1	6'5	12'2	Brownish deposit, worst of all.	Great deal of crust, hard.	.. ..

SCOTCH PARAFFIN OIL OF DIFFERENT COMPANIES—continued.

Fractional Distillation.

—	Oil Tested.	Flash Point.	First Drop over.	Under 450° F.		450°—572° F.		Residue.		Smell on Distilling.		Tintometer.				Acidity Developed on Heating.
				Per Cent.	Specific Gravity.	Per Cent.	Specific Gravity.	Per Cent.	Specific Gravity.			500	52	59	Total.	
1	A.a.....	190	°F.	..	..	..	..	..	..	..	..	..	..	..	..	Fl. Grs.
2	A.a.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3	A.a., excessive (3½% O.V.) treatment.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	285
4	A.a., unwashed ..	106	280	57.0	781	41.0	821	2.0	851	..	..	..	..	..	..	..
5	A.a. „	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
6	E.a.	110	300	45.0	782	47.0	817	8.0	861	..	..	0.375	0.75	..	1.125	38
7	B.b.	128	300	43.5	785	49.5	820	7.0	850	..	..	1.0	7.75	1.0	9.75	3
8	E.c.	119	340	27.0	789	50.8	821	13.2	849	..	..	1.0	7.75	..	8.75	2
9	C.b.	115	300	50.0	799	41.0	820	9.0	849	..	..	2.75	..	..	2.75	2
10	D.a.	112	300	58.8	783	36.5	816	4.7	851	Strong smell SO ₂	0.5	..	..	..	0.5	25
11	D.b.	118	300	50.0	786	45.6	818	1.4	849	No smell SO ₂ ...	0.5	2.0	..	..	2.5	3
12	D.c.	120	310	56.5	781	50.0	819	13.5	841	No smell SO ₂ ...	2.0	1.25	..	..	6.25	3
13	E.a.	108	300	54.0	782	49.0	816	6.0	858	Strong smell SO ₂	0.5	..	..	..	0.5	38
14	E.b.	115	310	40.0	785	52.5	815	7.5	852	Strong smell SO ₂	1.0	..	..	..	1.0	36
15	E.c.	123	320	37.0	786	50.8	817	12.2	851	Smell SO ₂	1.5	..	..	..	1.5	29
16	F.	120	320	42.0	794	56.5	824	1.5	852	No smell SO ₂ ...	1.0	2.25	..	..	3.25	18
17	G.a.	108	310	45.0	788	50.2	815	1.8	860	Strong smell SO ₂	0.5	2.0	..	..	2.5	70
18	G.b.	112	315	50.2	788	45.0	815	1.8	858	Slight smell SO ₂	1.0	4.25	..	..	5.25	33
19	G.c.	117	320	35.5	790	59.0	818	5.5	861	Slight smell SO ₂	1.0	2.25	..	..	3.25	28

Burner 5 Inches above Oil-Level.

Oil Tested.	Air-Holes of Burner.	Specific Gravity.	Flash-Point.	Temperature.												Increase Oil.
				After Burning ½ Hour.				After Burning 3½ Hours.				After Burning 7½ Hours.				
				Room.	Burner.	Oil.		Room.	Burner.	Oil.		Room.	Burner.	Oil.		
			F.	F.	° F.	F.	F.	° F.	° F.	° F.	° F.	F.	F.	° F.		
Special oil.....	Free	792	116	62	114	62	65	118	71	66	111	89	111	23		
Lighthouse oil	Free	808½	158	58	110	58	65	114	70	65	118	73	118	8		
Special oil.....	Clogged	792	116	61	124	61	63	127	68	66	133	74	133	8		
Lighthouse oil	Clogged	808½	158	60	125	60	62	125	69	66	130	75	130	9		

Burner 2½ Inches above Oil-Level.

Oil Tested.	Temperature.									Increase Oil.
	After Burning $\frac{1}{2}$ Hour.			After Burning $3\frac{1}{2}$ Hours.			After Burning $7\frac{1}{2}$ Hours.			
	Room.	Burner.	Oil.	Room.	Burner.	Oil.	Room.	Burner.	Oil.	
	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.
Special oil.....	62	114	62	64	118	74	66	122	90	24
Lighthouse oil	61	114	61	64	120	78	64	114	86	22
Special oil.....	59	112	59	62	123	71	63	125	91	28
Lighthouse oil	63	117	64	64	124	73	64	124	89	15

TABLE II.
AMERICAN PETROLEUM.

Oil Tested,	Air-Holes of Lamp.	Specific Gravity.	Flash Point.	Candle Power.				Temperature.								Oil Left in Lamp.
				After Burning.				Of Burner.				Of Room.				
				Mean.				Mean.				Beginning.	End.			
				$\frac{1}{2}$ Hour.	$3\frac{1}{2}$ Hours.	$7\frac{1}{2}$ Hours.		$\frac{1}{2}$ Hour.	$3\frac{1}{2}$ Hours.	$7\frac{1}{2}$ Hours.						
American petroleum—				F.	F.	F.	F.	F.	F.	F.	F.	F.	F.	F.		
" Tea Rose "	Free	795	78	22½	20½	17½	20½	117	123	118	119½	63	67	70		
"	Clogged	795	78	22½	21½	18½	20½	118	124	120	119½	65	70	73		
"	Free	792	75	21½	18¼	15½	18¼	118	119	119	118½	66	70	72½		
"	Clogged	792	75	17½	15½	13¼	15½	127	127	127	127½	65	68	71		
" Royal Daylight "	Free	793	77	21½	17½	12½	17½	117	117	110	114½	65	68	70½		
"	Clogged	793	77	21½	16½	14½	17½	124	126	123	121½	64	68	70		
" Bear Creek "	Free	796	76	20½	16½	8½	15½	118	118	117	117½	63	68	70½		
"	Clogged	796	76	18½	17½	14½	16½	119	132	128	126½	64	69	73		
American Water-white, High Test Petroleum—																
Strange's A. 1. Crystal Oil.	Free	791	98	21½	21½	13½	18½	121	125	118	121½	63	67	70		
" Snowflake "	Free	788	110	21½	19½	14½	18½	111	116	110	112½	63	66½	69		
"	Clogged	788	110	17½	16½	13½	15½	119	121	119	119½	63	66½	69½		
" Imperial Crown "	Free	791	106	21½	20½	16½	19½	122	123	115	120½	64	69	71		
"	Clogged	791	106	20½	16½	13½	16½	127	126	125	126½	65	68	71		
Russian Petroleum—																
" Lustré "	Free	824	84	23½	19½	17½	20½	115	119	123	120½	63	57	69		
"	Clogged	824	84	16½	15½	14½	15½	119	124	122	121½	63	66	69½		
" Nobel's "	Free	826	86	20½	17½	16½	18½	117	118	117	117½	63	66	68½		
"	Clogged	826	84	13½	12½	10½	12½	121	121	121	121½	65	68	71		

Oil Tested.	Oil Consumed in Lamp in 7 1/2 Hours.			Oil Left in Lamp.			Fraction of Oil Burned.								Acidity of Oil on Heating.
	Fluid Grains.	Grains.	Grains per Hour per C.P.	Specific Gravity.	Flash-Point.	First Drop over.	Up to 450° F.		450—572° F.		Residue.				
							Per Cent.	Specific Gravity.	Per Cent.	Specific Gravity.	Per Cent.	Specific Gravity.			
American petroleum—															
"Tea Rose"	10,200	8,109	52 1/2	..	..	F.	F.	270	46 0	764	33 0	809	21 0	849	6
"	9,500	7,552	47 9	795	79	270		270	46 0	764	33 0	809	21 0	849	6
"	9,900	7,841	56 8	792	..	270		270	49 5	767	31 0	808	19 5	837	4
"	8,600	7,811	59 1	792	..	270		270	49 5	767	31 0	808	19 5	837	4
"Royal Daylight"	9,700	7,692	59 1	793	..	265		265	47 0	768	35 2	807	17 8	838	3
"	9,200	7,246	55 2	793	..	265		265	47 0	768	35 2	807	17 8	838	3
"Bear Creek"	9,800	7,901	69 1	796	..	270		270	43 0	764	31 0	808	26 0	836	10
"	9,400	7,482	59 7	796	..	270		270	43 0	764	31 0	808	26 0	836	10
American Water-white, High Test Petroleum—															
Strange's A. 1. Crystal Oil.	10,600	8,385	59 1	791	98	300		300	57 0	789	36 0	804	7 0	840	5
"Snowflake"	9,900	7,801	59 7	788	..	320		320	63 0	789	32 2	805	1 8	838	8
"	9,000	7,092	59 1	788	..	320		320	63 0	789	32 2	805	1 8	838	8
"Imperial Crown"	10,700	8,464	58 0	791	103	300		300	53 0	779	39 5	803	7 5	831	2
"	8,600	7,893	54 1	791	..	300		300	53 0	779	39 5	803	7 5	831	2
Russian petroleum—															
"Lustré"	9,700	7,828	52 2	824	84	285		285	59 8	807	35 5	846	4 7	873	4
"	7,400	6,098	53 3	..	..	285		285	59 8	807	35 5	846	4 7	873	4
"Nobel's"	8,800	7,269	53 0	826	87	290		290	55 0	806	41 0	845	1 0	869	2
"	5,800	4,791	52 7	826	..	290		290	55 0	806	41 0	845	1 0	869	2

AMERICAN PETROLEUM—continued.

Oil Tested.	Air-Holes of Burner.	Specific Gravity.	Flash-Point.	Lamp with Glass Reservoir.									
				Temperature.									
				After Burning $\frac{1}{2}$ Hour.			After Burning $3\frac{1}{2}$ Hours.			After Burning $7\frac{1}{2}$ Hours.			In-crease Oil.
				Room.	Burner.	Oil.	Room.	Burner.	Oil.	Room.	Burner.	Oil.	

"Tea Rose"	Free	795	° F. 78	F. 55	° F. 110	° F. 58	° F. 60	° F. 109	° F. 64	° F. 61	° F. 110	° F. 65	° F. 4
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Lamp with Metal Reservoir.

Oil Tested.	Temperature.									In-crease Oil.
	After Burning $\frac{1}{2}$ Hour.			After Burning $3\frac{1}{2}$ Hours.			After Burning $7\frac{1}{2}$ Hours.			
	Room.	Burner.	Oil.	Room.	Burner.	Oil.	Room.	Burner.	Oil.	
“ Tea Rose ”	58	139	58	60	133	73	61	132	76	15

"Tea Rose"	F. 58	° F. 139	F. 58	° F. 60	° F. 133	F. 73	° F. 61	° F. 132	F. 76	° F. 15
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AMERICAN PETROLEUM, 789.

Distilled one Lot, keeping separate 5 per cent. Naphtha, which was added to another Lot which was Distilled all over.

Oil Tested.	Air-Holes of Burner.	Specific Gravity.	Flash-Point.	Burner 5 inches above Oil-level.					Burner $2\frac{1}{2}$ inches above Oil-level.				
				Temperature after Burning 3 Hours.					Temperature after Burning 3 Hours.				
				Room.	Burner.	Oil.	Increase Oil.	Power.	Room.	Burner.	Oil.	Increase Oil.	Power.

Without naphtha ...	Free	792	F. 129	F. 61	° F. 109	° F. 71	F. 13	° F. 10	69	° F. 112	° F. 77	° F. 17	18
With naphtha	Free	784	88	60	112	77	17	21	60	114	78	18	24

Obituary.

CHARLES THOMPSON, F.I.C., F.C.S.

A MEMBER OF THE SOCIETY OF CHEMICAL INDUSTRY.

THE subject of this brief memoir received his chemical education in the first instance in the laboratories of the Pharmaceutical Society in Bloomsbury Square, and subsequently, in 1881, became associated with Dr. C. R. Alder Wright, F.R.S., at St. Mary's Hospital, Paddington, firstly as articled pupil, and then as assistant. In 1885 he was appointed Demonstrator of Chemistry in St. Mary's Hospital Medical School, which post he held for nearly five years. During this period of about nine years in all he collaborated extensively with Dr. Alder Wright in several branches of scientific research, as well as various technical inquiries, as the result of which labours 18 memoirs and other papers were communicated by the two authors conjointly to the Royal, Chemical, and Physical Societies, the Societies of Chemical Industry and of Public Analysts, and the British Association, embodying the results of researches in various branches of work, more especially in electro-chemistry, metallurgy (alloys), and the chemistry of the soap manufacture.

These latter researches led in the spring of 1890 to his being offered the general management and scientific supervision of Messrs. Blondeau and Cie.'s factories for the manufacture of "Vinolia" products, a post the somewhat onerous responsibilities of which he ably discharged until shortly before his death, when the state of his health prevented his attending actively to work.

Charles Thompson died on Saturday, October 8th, unmarried, at the early age of thirty-one years, after a somewhat brief but painful illness. He was very successful as a teacher, his genial temperament and patience causing him to be highly esteemed and greatly liked by the students under his care. His energy and capacity for work were remarkable, whilst in private life his pleasing manners and social attainments greatly endeared him to all his friends. The writer especially looks back in memory to the nine years spent in almost daily companionship with him with feelings of pleasure mingled with regret that the career of one so amiable should be thus early and painfully cut short.

—C. R. A. W.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

The Durability of India-Rubber Hot-Water Pipes.
E. Belleruche. Rev. Univ. des Mines, 18, 1892, 25;
Proc. Inst. Civ. Eng. 110 (iv.) 21.

See under XIII., page 929.

PATENTS.

Improvements in Filters. B. M. Santurio, Buenos Ayres.
Eng. Pat. 10,314, June 17, 1891.

This invention relates to what are known as "earthenware" filters, the improvements referring principally to the construction of the permeable cylinder or vessel, which is here surrounded with permeable hollow screw threads leading from one end of the cylinder to the other. The liquid passes through the hollow screw in one direction, and returns by the inner cylinder in the other. There are arrangements for cleaning the filtering surfaces by flushing.—B.

Improvements in Filters. R. C. Sayer, Bristol. Eng. Pat. 14,609, August 29, 1891.

In the improved filter the porous material is placed in an inverted siphon, which may be attached to the bottom of the water reservoir by bolts, so as to be suspended in the filtered water reservoir, or, in large filters, where the weight of the unfiltered water reservoir is considerable, may be bolted to the sides of the reservoirs. By this means it is claimed that the cleansing of the porous materials is facilitated. When upward filtration is not desired, a straight tube is substituted for the siphon. Thus the siphon, or straight chamber, and retaining chamber will be outside both reservoirs, and either may be removed without disturbing the other, or either reservoir.—O. H.

Improvements in Water-Filtering Apparatus. W. C. Henderson, London. Eng. Pat. 14,843, September 2, 1891.

THE inventor claims "the combination, or arrangement and use, of a water-filtering apparatus, comprising means of supply of water, as from the stack pipe from a house roof, a chamber for sediment, divided from the filtered water chamber by sponges, sand, or other suitable filtering material, and reticulate screens through which the water filters by ascension, and means to draw off, overflow, and access for cleansing."—O. H.

Improvements in and in the Construction of Wood Trays for Filter Presses. J. Teggin, Longton, Staff. Eng. Pat. 15,747, September 17, 1891.

THIS invention relates to certain improvements in the details of the construction of wooden trays and grates used with filtering presses, the object being to construct such trays of less bulk and weight than hitherto.—B.

A New or Improved Filter. F. D. Tippetts, Birmingham.
Eng. Pat. 16,234, September 24, 1891.

THE body of the filter consists of two "nearly similar semi-ellipsoidal halves connected together by screwing." The body or case is open at both ends, one end having a funnel-shaped mouthpiece lined with india-rubber so that it can be attached to the nozzle of an ordinary tap; the other end has a short delivery pipe. Each half is charged with animal charcoal supported by layers of felt. For purposes of cleansing the body may be unscrewed and the charcoal replaced, or the rubber mouthpiece and delivery pipe may be reversed and the impurities washed out by a stream of water.—O. H.

Improvements in the Method of and Apparatus for Treating or Drying Artificial Manure, also applicable for Drying Grain, Minerals, and other Substances or Materials. B. L. Fletcher and J. Hoyle, Halifax.
Eng. Pat. 16,281, September 25, 1891.

THE apparatus consists of a vertical cylindrical vessel, containing a series of horizontal hollow plates of different diameters, one set of plates having central openings through which the material drops, whilst the other set of plates permit the material to fall over the outer edges. A central shaft carries scrapers or distributors of bristles, wire, &c. arranged at such angles that on one set of plates the material is worked towards the centre and on the other to the circumference. The plates are heated by steam or other suitable heating medium, and the material is dried during its descent through the apparatus.—O. H.

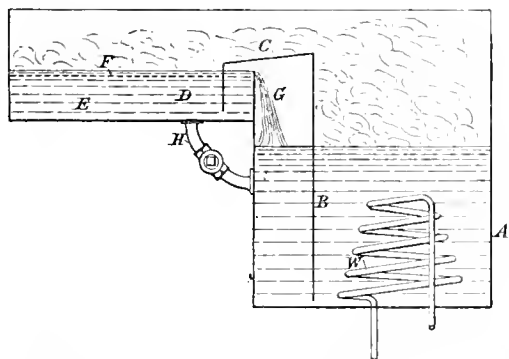
Improvements in the Construction of Vertical Stills for the Distillation of Ammoniacal and other Liquors or Liquids. J. Wright, Stockton-on-Tees. Eng. Pat. 18,533, October 28, 1891.

THIS invention relates to columnar or vertical stills, in which there are superimposed trays or platens with caps, over the edges of which the liquid flows downward, whilst the heated gases or steam rise upward through central openings. The improvement consists principally in making the caps of annular form, either circular or of any other shape, in order to enable the steam to rise on the inner as well as the outer edges of the caps, after forcing its way through the liquid on the trays, thereby considerably increasing the effective working surfaces within the casing.—B.

* Any of these specifications may be obtained by post by remitting sd.—the price now fixed for all specifications, postage included—to Sir Henry Reader Luck, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

Improvements in Apparatus for Separating from Liquors the Scum or Matter which rises to the Surface during Boiling or Heating. A. Chapman, Liverpool. Eng. Pat. 19,364, November 9, 1891.

THE object of this invention is to secure the skimming without loss of boiling liquids, more particularly of saccharine solutions, by means of the interposition of a strainer and a body of quiescent liquid between the scum and the boiling liquid. The inventor endeavours to utilise the fact that when liquids are boiled the scum or "feculencies" retreat from the hotter to the colder parts of the vessel, one of the arrangements being shown in the accompanying illustration.



APPARATUS FOR SEPARATING THE SCUM FROM LIQUIDS DURING BOILING.

A is the boiling vessel, W the heating steam coil, B a partition reaching down within a short distance of the bottom of the vessel, and some distance above the liquid when not boiling. From the top edge a cover plate C extends to another partition D in the skimming pan, reaching down to near the bottom of that pan. The strainer F lies across the pan near the upper part of the partition, and the side G of the pan near the boiling vessel forms a ledge very little higher than the level of the strainer F.

As the liquor in A boils, the froth and scum overflow the partition B on to the strainer F, where the scum is retained, and the purified liquor, becoming nearly quiescent, at E, returns over the ledge G for further boiling.—B.

Improvements in Thermostats or Instruments for Regulating Temperatures. A. Shiels, Glasgow. Eng. Pat. 20,368, November 24, 1891.

THESE improvements relate to the regulation of the steam valves of the refrigerating engines by a thermostat, the upward movement of the piston of the latter opening the steam valve of the engine by means of a slotted and balanced lever, while a spring brings down the piston when contraction takes place in the fluid in the thermostat tubes.

"In cases where the temperature in the refrigerating chamber, through an accident, rises far above the normal, the piston-rod of the thermostat, or a projection on it, may be made to strike a lever and open a valve leading to the sensitive fluid tank, so that the excess of fluid in the pipes may pass into the tank and thus prevent breaking or bursting of the apparatus."—O. H.

An Inexplosible Can for Inflammable Liquids. T. R. Shillito, London. Eng. Pat. 21,086, December 3, 1891.

THE can is so constructed that the neck is sealed by the liquid in use. Within the neck a tube extends downwards, terminating near the bottom of the can in a large mouth. From within the neck also, but lower down than the top of the first tube, a second tube extends obliquely upwards, terminating in a spout. Owing to the relative

position of these, the liquid, when poured from the can, must pass through both tubes, so that when the can is restored to the vertical position, there will always be liquid in the neck. The inventor claims that, in the event of the overflowing liquid taking fire the flame will not be communicated to the interior of the can.—D. A. S.

Improvements in or connected with Furnaces. T. W. Williams, Swansea. Eng. Pat. 2567, February 10, 1892.

THIS invention relates to certain improvements in the furnace described in a former patent (No. 539 of 1878), and its object is to obtain a more perfect combustion of the fuel. This is effected by making an opening near the bottom of the bridge of the furnace, and fitting into this opening a cast-iron tube, which bends upwards at the back of the bridge, and terminates in a somewhat contracted horizontal nozzle. Air, admitted under the ashpit by means of dampers placed at the front of the furnace, passes along the ash-pit, where it becomes heated, and then to the back of the bridge, where it mixes with the smoke and gases and assists combustion.—F. S. K.

Certain Improvements in the Cages of Hydro-Extractors. J. W. Collins and A. Kaye, Marsden. Eng. Pat. 2595, February 10, 1892.

THE patentees propose to make the cages of perforated sheet iron or of wire and cover them with a porcelain enamel.

—O. H.

New or Improved Process and Apparatus for Concreting Sugar or Crystallising Saline or other Solutions. W. P. Thompson, Liverpool. From J. A. Morrell and W. R. Stringfellow, New Orleans, U.S.A. Eng. Pat. 8336, May 3, 1892.

THE process consists in blowing compressed air through a vertical column of the saccharine or saline solution kept in violent agitation by rapidly revolving blades, in order to "economically and quickly convert the solution into a solid crystalline mass without boiling."—O. H.

Improvements relating to Refrigerating Apparatus. H. E. Newton, London. From W. Alsop and W. Blackall, Newcastle, N.S.W. Eng. Pat. 11,250, June 15, 1892.

IN order to dry the compressed air in cold air refrigerating apparatus more efficiently than is usually done by the ordinary coolers, and diminish the amount of snow which is deposited in the expansion chambers and passages, the air, after compression and passage through the coolers, enters a series of tubes so placed that the expanded air, on its way from the expansion chamber to the refrigerating chamber, impinges upon the exterior of the tubes and deposits its moisture upon them. The tubes, being slightly heated by compressed air passing through them, the adherence of the snow or ice is prevented, and the latter melt and drain away. The compressed air, as it passes through the tubes, parts with so much of its heat in the liquefaction of the snow or ice which is deposited on or around the tubes, that it is considerably reduced in temperature (generally below 40° F.).—O. H.

Improvements in Apparatus for Evaporating, Concentrating and Distilling Liquids. W. J. Mirreles and D. Ballinghall, Glasgow. Eng. Pat. 11,296, June 16, 1892.

BY this invention the liquid which it is desired to concentrate, undergoes a preliminary concentration in a steam boiler, in which high-pressure steam is produced for driving a steam engine, and also for heating the liquor as it passes through a tubular or other heater on its way to the boiler.

A blow-off pipe is fitted to the bottom of the boiler to allow the liquor, when sufficiently concentrated, to pass into

a second vessel where the pressure is reduced. More water is here evaporated in consequence of this diminution of pressure, and the steam passes to the first vessel of a multiple effect evaporator. The liquor likewise passes into the evaporator and is then further concentrated by its own steam.—O. H.

Improvements in Apparatus for Distilling Sea Water
S. Smillie, Glasgow. Eng. Pat. 11,787, June 24, 1892.

THE chief feature of this invention is the use of a duplex steam-coil bolted to the removable bottom plate of the distilling vessel, while the top rings of the coils rest on stirrup brackets carried on vertical rods also bolted on the bottom plate.

Both the steam inlet and outlet are flanged to the bottom plate so as to leave "sufficient freedom for vibration of the coils on the admission of steam to ensure dislodgment of salt or scale adhering to them, frequent removal for cleaning being thus avoided."—O. H.

Apparatus for Regulating the Flow of Volatile Liquid in Refrigerating Machines. T. B. Lightfoot, London.
Eng. Pat. 14,047, August 3, 1892.

THIS improvement relates to apparatus under Eng. Pat. No. 7712 of 1892 for regulating the flow of volatile liquid from the condenser to the vaporiser of refrigerating machines, and consists of a cylindrical valve with one opening rotating in a chamber having several lateral outlets, each communicating with a separate vaporiser. On the rotation of the valve each vaporiser is successively put in communication with the condenser through the opening in the valve.

—J.

Improvements in Apparatus for Regulating the Admission of Air and Steam to Furnaces for the Prevention of Smoke. J. K. Broadbent, Salford. Eng. Pat. 15,095, August 22, 1892.

IN order to prevent the emission of black smoke from furnaces immediately after stoking, it is usual to admit air through suitable openings, and also to employ a jet of steam, or "steam-poker," to produce a more rapid current of air. In previous patents (Eng. Pat. 5,927 of 1887, and 19,983 of 1891), apparatus for automatically regulating the admission of air have been described; the present patent refers to the admission of steam to the "steam-poker," which is now regulated, simultaneously and automatically, in the same way as the air supply.—F. S. K.

Improvements in Aerators for Treating Liquids. R. Andrew, London. Eng. Pat. 15,448, August 27, 1892.

THE improved "aerator" described, consists of a cylindrical vessel for containing the liquid, having in its lower part a perforated coil connected with an external vertical pipe, to which a sieve or strainer is attached. On the top of the vessel a steam ejector is placed, and below the outlet to this a conical baffle-plate is suspended. Air, purified by passing through the strainer, is drawn by the ejector through the perforated coil and passes in a continuous stream through the liquid.—J. C. C.

II.—FUEL, GAS, AND LIGHT.

The Manufacture of Oil-Gas. J. B. Ball. Proc. of the Inst. C. E. 1891—1892, 110.

IN this paper the author describes the plant used in the manufacture of oil-gas at the Holloway works of the Great Northern Railway Company, giving the dimensions of the various buildings and apparatus.

Pintseh's system of gas making is employed and the works are designed to produce about 60,000 cub. ft. of gas per day; at present the average make is only 15,000—18,000 cub. ft.

The 10-in. D-retorts are made of 1-in. metal and are 6 ft. in length; they are worked in pairs and are kept as nearly as possible at a cherry-red heat. Each pair will make 300—400 cub. ft. of gas per hour and 600,000 to 700,000 cub. ft. of gas before they require to be renewed. Immediately before the gas enters the hydraulic main, a $\frac{3}{4}$ -in. iron pipe, provided with a stop-cock, is tapped in so that the colour of the gas may be seen, this being the practical test applied to ascertain the quality of the gas and whether the proper quantity of oil is being admitted. Another test for regulating the supply of oil is to drop a small quantity of the tar from the gas main upon a sheet of white paper; if too much oil is being admitted to the retort a greasy ring will be found round the spot of tar, but if the right quantity is being used no greasy ring will appear.

The furnaces consume 160—180 lb. of coke for every 1,000 cub. ft. of gas produced. The oil used is a once-refined shale oil; it runs to the retorts from a galvanised iron cistern, of 50 gallons capacity, through a 1-in. iron pipe, at the end of which is fixed a gun-metal micrometer cock for regulating the supply. From this supply pipe the oil flows into a small funnel attached to a $\frac{3}{4}$ -in. siphon pipe, 12 in. deep, connected to the retort; it then falls on to a loose tray, preferably made of steel, and is instantly converted into a dense brown vapour.

The gas issuing from the retorts passes to the hydraulic main, then through air condensers, washers, and purifiers, into the meters and gas-holders. The purifiers contain a mixture of 2 parts of slaked lime to 1 part of sawdust, placed on wicker trays, and are recharged every week.

The cylindrical steel store-holders are 17 ft. 6 in. in length and 4 ft. 3 in. in diameter; they are tested by hydraulic power to 300 lb. per sq. in. and are provided with a pressure gauge registering up to 200 lb. per sq. in. The gas is forced into the store-holders through a 1-in. extra strong lead pipe by compressing engines; each holder is provided with a cock at the bottom for drawing off the condensed hydrocarbon, of which about a gallon is obtained from every 1,000 cub. ft. of compressed gas.

There are six men engaged at the works and the total cost of buildings and machinery amounted to 11,740*l*.

—F. S. K.

Probable Presence of Iron Carbonyl in Illuminating Gas.
Guntz. Bull. Soc. Chim. 1892, 7—8, 281—282.

IT was noticed that the lamp glasses of gas burners at Nancy, when used for a moderately long time, e.g., 40 to 100 hours without being cleaned, became covered with patches which, at first white, ultimately became red, and were found on analysis to consist of oxide of iron. Similar deposits have been observed on porcelain caps placed over gas burners and on porcelain plates used in regenerative burners. The gas must therefore contain a volatile compound of iron. This becomes more probable having regard to the fact that coal-gas is commonly purified by a mixture of calcium sulphate, oxide of iron, and sawdust, which when it is saturated with sulphur is revived by the addition of iron turnings. The excess of iron is acted on by the carbon monoxide always present in coal-gas and iron carbonyl is formed in small quantity. This hypothesis is borne out by the fact that in a town on the outskirts of Nancy no ferruginous deposits of the kind described were perceptible until the local gas works began to use the iron purifier above mentioned. A few days after the alteration had been made, the lamp glasses became reddened from the deposition of iron oxide upon them.

—B. B.

The Manufacture of Electric Light Carbons at Nürnberg.
Rev. Ind. 23, 384.

REPORT carbon is the material used in the process except in the case of cored carbons, which is manufactured according to the process of Messrs. Siemens Bros., of Berlin. The first operation is to break up the carbon in a mill; the coarser pieces from this process are crushed in a mill with vertical stones, and the finer are passed through a roller mill. The carbon which has been again broken up is sieved to separate the coarse grains from the fine powder, and the former are passed through roller mills. The fine powder so obtained is moistened, and compressed into moulds by hydraulic pressure, and the carbons are then roasted at a very high temperature. In this process great loss occurs, which at present appears unpreventable. The remaining process is to point the carbons. The machines necessary for an installation and their prices are given.

—G. H. R.

Coal Dust Explosions at the Zückerode Colliery. Max Georgi. Jahrb. für das Berg- und Hüttenw. im Königreich Sachsen. 1891, 1: Proc. Inst. Civil Eng. 108, 77.

See under XXII., page 938.

Recent Investigations on the Calorific Value of Coals. Deutecom. Zeits. des Ver. deutsch. Ing. 1891, 1375; Proc. Inst. Civil Eng. 108, 40-44.

On the assumption that the heating power of coals could be determined directly from their elementary chemical composition, the following formula, due to Dulong, has generally been used, the number of calories per unit of fuel burnt being—*

$$8,080 C + 28,800 \left(H - \frac{O}{8} \right) + 2,500 S - 600 W;$$

or, using more exact determinations for hydrogen and sulphur—

$$8,080 C + 29,300 \left(H - \frac{O}{8} \right) + 2,240 S - 600 W.$$

The factor W represents the latent heat of vaporisation from water at the temperature of the air to steam at 100° C., the oxygen in the coal being considered as combined with hydrogen to form water, and only the disposable proportion of the latter to be useful for heating purposes.

This formula would be undoubtedly true if coal were actually a mixture of carbon, gaseous hydrogen, sulphur, and water; but it is not actually so, the ultimate composition being no indication of the combination existing in the fuel. In any case it is abundantly certain that the carbon is not to any great extent present in the free state.

The older form of calorimeters are very delicate pieces of apparatus, in which the quantity of sample experimented on varies from about 0.3 to at most 1 gm.; so that the most scrupulous care is required in order to obtain trustworthy results. This difficulty has been met by the establishment at the experimental station at Munich of a calorimeter of sufficient size to allow the use of several cwt. of fuel in one test. It has a combustion chamber surrounded with water, and the gases are carried through a series of cooling tubes, until their temperature is reduced to that of the surrounding atmosphere. This gives very concordant results.

The conclusion from a great number of different coals tried in the large experiments is that Dulong's formula is practically exact, the variations from the calculated and observed results being at most 2 or 3 per cent., and in a majority of instances about 1 per cent.

The average calorific value of pure coal, i.e., considered free from ash and water, is about 8,000 calories.

* C, H, S, and W representing the respective proportions of carbon, hydrogen, sulphur, and water in a unit of coal.

The loss of heat by evaporation of contained water, and by the heated ashes falling from the grate, is comparatively small. A coal containing a per cent. of pure coal (free from ash and water), b per cent. of ashes falling out at t_b° of temperature, and c per cent. of water leaving the fireplace as steam at temperature t_c° , develops per 100 kilos.—

$$8,000 a - 0.2 (b t_b^\circ) - [620 + 0.4750 (t_c^\circ - 100)] c \text{ calories,}$$

or for—

$$a = 80, b = 15, c = 5, t_b^\circ = 700^\circ, \text{ and } t_c^\circ = 250^\circ \\ (64,000 - 2,100 - 3,456) \text{ calories.}$$

The losses from these sources is therefore less than 1 per cent. of the total available quantity of heat.

The most considerable item of loss in heat is that carried off by the gases which depends upon their composition and temperature. If pure coal be mixed with air in quantity sufficient to give a gas with 21 per cent. of carbon dioxide, 1 kilo. requires 2.66 kilos. of oxygen, giving 3.666 kilos. or 1.865 cubic metre of carbon dioxide, which in the chimney gases will be associated with 8.798 kilos. or 701.5 cubic metres of nitrogen. The heating of these gases to t° C. requires $(3.66 \cdot 0.2164 + 8.798 \cdot 0.244) t = 2.93 t$ calories.

If the gases contain a per cent. less carbon dioxide than 21 per cent., unburnt air is drawn in over the quantity of which x per 100 of coal is, when—

$$a : (100 - a \frac{100}{21}) = 186.5 : x$$

$$x = \left(\frac{18,650}{a} - 888.1 \right) \text{ cubic metres} \\ = \left(\frac{18,650}{a} - 881.1 \right) \cdot 1.2937 \text{ kilos.}$$

To heat this to t° requires—

$$\left(\frac{18,650}{a} - 888.1 \right) 1.2937 \cdot 0.2377 \text{ calories,}$$

and the total heat carried off in the gases is—

$$293 t + \left(\frac{18,650}{a} - 888.1 \right) 1.2937 \cdot 0.2377 t \\ = \left(20 + \frac{5,721}{a} \right) t \text{ calories.}$$

From the above formula the following table has been calculated showing by how much per cent. the heating effect of the coal is diminished per 100° of temperature in the gases, when the proportion of carbon dioxide in the gases is reduced below the theoretical maximum of 21 per cent.

CO ₂ in Gases. Heat Reduction.		CO ₂ in Gases. Heat Reduction.	
Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	71.76	9	8.20
2	34.00	10	7.40
3	24.09	11	6.75
4	18.12	12	6.17
5	14.55	13	5.75
6	12.16	14	5.35
7	10.44	15	5.01
8	9.19		

With the help of these figures it is easy to calculate what quantity of heat is required in the daily working of any industrial heating arrangement.

An interesting branch of the inquiry is the comparison of these figures with those obtained from the thermochemical data corresponding to the reactions going on in the furnace, an example of which is given in the production of salt-cake or sodium sulphate from salt and sulphuric acid in alkali-making as follows:—

a. Chemical reactions :—

	Calories.
2 NaCl + H ₂ SO ₄ = Na ₂ SO ₄ + 2 HCl, this requires, per equivalent 142 kilos., 15,719 calories, or per 100 kilos.,...	11,050
Separation of sulphuric acid from diluting water,	14,000

b. Alteration of state of aggregation :—

Evaporation of 20 kilos. of water	20 × 520 = 10,400
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c. Heating of final products :—

100 kilos. of sodium sulphate to 500°	500 × 100 × 0.232 = 11,600
50 kilos. of hydrochloric acid to 100°	400 × 50 × 0.1832 = 3,704
20 kilos. of water vapour to 100°	100 × 20 × 0.475 = 3,800
350 kilos. of air to 100°	400 × 350 × 0.2377 = 33,278
Total	87,832

In a similar manner the heat requirements for the following chemical operations have been computed :—

	Calories.
Conversion of 100 kilos. of crystallised magnesium chloride into magnesia, hydrochloric acid, and water	116,020
Conversion of 100 kilos. of salt-cake into black ash with coal and limestone	131,453
Production of 100 kilos. of lime from limestone	87,795
Conversion of 100 kilos. of water into steam at 5 atmospheres	62,065
Conversion of 100 kilos. of zinc blende into zinc oxide	52,505

The last of these operations is therefore attended with a development of heat.

Taking into account the temperature and proportion of carbon dioxide in the gases, the effect obtained from the combustion of 100 kilos. of coal in the furnaces used in

these operations may be determined for comparison with that actually obtained in practice, as seen in the following table :—

Furnace.	Working Value of 100 kilos. of Coal in Calories.	Coal required per 100 kilos. of Product.		Difference.
		By Thermo-Chemical Calculation.	In actual Practice.	
Steam boiler	$\left\{ \begin{array}{l} 500,000 \\ 550,000 \end{array} \right.$	$\left\{ \begin{array}{l} \text{Kilos. } 12.5 \\ \text{Kilos. } 11.4 \end{array} \right.$	12-15	0.5-2.5
Lime kiln	$\left\{ \begin{array}{l} 450,000 \\ 575,000 \end{array} \right.$	$\left\{ \begin{array}{l} 19.1 \\ 15.3 \end{array} \right.$	18-30-43	27-11-24
Salt-cake furnace ...	450,000	19.1	35	16
Magnesia furnace ...	450,000	25.8	90-100	64-74
Black-ash furnace ...	350,000	35.6	60	24.4
Zinc-blende calciner	350,000	8.2	18	26

Apart from conduction and small uncalculated losses, the greater part of these differences must be attributed to heat dispersed by radiation from the furnace. The importance of this factor for the different kinds of furnaces is computed as follows :—

Furnace.	Daily Charge or Yield.	Daily Consumption of Coal in Kilos.			Radiating Surface of Furnace.	Daily Radiation per Sq. Metre in Kilog. of Coal.
		Actual.	Computed.	Difference.		
Salt-cake	Kilos. 3,500 sulphate	1,225	668	557	Sq. Metres. 80	6.9
Magnesia	1,120 MgCl ₂	1,060	289	771	80	9.6
Black-ash	5,400 Na ₂ SO ₄	3,240*	1,922	1,318	80	16.5
Blende calciner	7,000 ZnO	1,260	— 574	1,834	120	15.3
Steam boiler, 8.3 fold evaporation	62,500 H ₂ O	7,500	7,125	375	245	1.5
Steam boiler, 6.6 fold evaporation	50,000 H ₂ O	7,500	6,250	1,250	245	5.1
Lime kiln, iron jacketed with gas firing	1,000 CaO	1,736	788	948	210	5.0
Lime kiln with short flue producer	3,700 CaO	1,160	729	431	100	4.3
Lime kiln, Dietzsch's form	20,000 CaO	4,500	3,060	1,440	550	2.5

* 60 per cent. of charge, 42 per cent. of which is burnt, and 18 per cent. mixed for reducing.

—W. S.

PATENTS.

The Utilisation of a certain Waste Oxide of Iron in the Purification of Sewage, and for similar Purposes. H. C. Sacré and H. Grimshaw, Manchester. Eng. Pat. 17,911, October 20, 1891.

See under XVIII., page 933.

Improvements in Apparatus for Carburetting Gas or Air. The Gas Economising and Improved Light Syndicate, Limited, and J. Love, Barking, Essex. Eng. Pat. 18,082, October 21, 1891.

The apparatus to which this patent refers is that described in a previous patent granted to Love (Eng. Pat. 14,031, 1889).

The improvements refer mainly to the carburettor which, instead of being flat-bottomed, is now made curved or hollow, and inclined to one end so as to form a well in which the heavy hydrocarbons will collect; from this well they are drawn off into a closed drum by means of an air-pump, which at the same time forces fresh liquid into the

carburettor from the supply tank. The lower chamber of the carburettor is provided with an overflow pipe which runs to the supply tank; valves for controlling the flow of gas or air, and locking gear for the various cocks or taps, constitute the other improvements.—F. S. K.

Improvements in Apparatus for Washing, Purifying, and Scrubbing Gas. J. C. Chandler, London. Eng. Pat. 7,708, April 23, 1892.

The apparatus described in this patent is a new form of washer. It consists of a vessel, divided into a number of water-tight compartments, in which are placed horizontal perforated plates; tubes are fixed in the perforations, and the lower ends of the tubes dip vertically close to the surface, or beneath the surface, of the water in the compartment, so that as the gas passes from one compartment to another it is caused to impinge on, or to bubble through the water or liquor. Each of the compartments is provided with man-holes so that the perforated plates and tubes can be easily

taken out; each compartment is further provided with overflow pipes, the water or liquor being caused to flow successively through all the compartments.—F. S. K.

Improvements in the Manufacture of Iron and in Fuel, or a Compound suitable therefor. W. A. Sugden, Keighley. From W. R. Sugden, Fall River, Wisconsin, U.S.A. Eng. Pat. 18,442, October 27, 1891.

FOR use in smelting, puddling, or melting iron, the patentee describes a fuel by the employment of which it is claimed that the resulting iron is much improved in quality, chiefly owing to its dephosphorisation.

The fuel is prepared by saturating 2–3 cwt. of slaked lime with creosote or some other suitable oil, and then mixing it with 8–9 cwt. of slack or fine coal. This mixture is then sprinkled with a mixture of 1 lb. of powdered oxide of manganese and one quart of methylated spirit, and the whole thoroughly mixed; fairly good results may, however, be obtained without the addition of oxide of manganese and methylated spirit. One part of the patent fuel is used with 4 parts of ordinary coal or coke.—F. S. K.

Improvements Relating to the Manufacture of Gas, and to Apparatus therefor. H. H. Lake, London. From W. H. Harris, Boston, U.S.A. Eng. Pat. 20,420, November 24, 1891.

THE object of this patent is to generate fuel gas from coal, steam, and air, and then to obtain illuminating gas by the addition of hydrocarbons. The two processes are carried out simultaneously in the usual manner and the gas is then passed through a continuous regenerating chamber, which is filled with balls of silicate of alumina or similar material. For the details of the process and a description of the apparatus the original must be consulted.—F. S. K.

Apparatus for Quenching Coke. T. R. Osbourn, Philadelphia, Penn., U.S.A. Eng. Pat. 4032, March 1, 1892.

A CLOSE chamber adapted for containing coke is constructed with double walls forming a compartment or jacket into which water is introduced. By this means the heat radiated from the coke raises the temperature of the water and generates steam. The steam is led through suitably arranged pipes and discharged into the coke receptacle. The water-jacket may be sub-divided into a series of separate compartments, in each of which a pre-determined quantity of water may be introduced, and each of which may be provided with a separate steam-pipe.—D. A. S.

Apparatus for the Manufacture of Coke. T. R. Osbourn, Philadelphia, Penn., U.S.A. Eng. Pat. 4033, March 1, 1892.

THIS is a coke oven of a beehive pattern in which the hearth is moveable and may be lowered at will. After coking, the hearth is lowered on to a truck and removed, so that the coke can be quenched in a separate receptacle. A special quenching device is also described. It consists of a box-like receptacle of sheet metal mounted on wheels, and is designed to receive the contents of one or any number of coke ovens. Spray pipes are arranged in it so as to distribute water over the mass of coke.

The portable bottom of the oven is raised or lowered by means of a jack mounted on wheels, and adapted to run upon ways extending to or across the top of the oven.—D. A. S.

Improvements in Magnesium Flash-Light Apparatus. H. J. Haddan, London. From E. Beste, Weimar, Germany. Eng. Pat. 5996, March 28, 1892.

THIS is a lamp or device for producing a magnesium flash light, in which the magnesium powder is fed to the charge chamber from a reservoir by means of a spirally fluted shaft, resembling a spiral drill, the forward end of which projects into the base of the powder reservoir. The revolution of the shaft causes the powder to be forwarded along the spiral groove and to fall out at a narrow slit, from

whence it is blown out and propelled through a flame by a blast of gas. This blast is obtained by drawing gas from the pipe by a special valve by use of a piston, which is drawn down by a piston-rod by the operator or by a motor, if the lamp is to act automatically. On releasing it the piston is forced upwards by a spring when the charge of gas passes into the powder chamber, carrying the powder therefrom into the flame.—D. A. S.

Improvements in the Method and Apparatus for Producing Magnesium Flash-light. N. Browne, London. From P. Wunsche, Dresden, Germany. Eng. Pat. 6269, March 31, 1892.

THE object of this invention is to ignite the magnesium powder by means of percussion caps, and so dispense with the use of a flame. Hitherto the ignition by this method has not always been successful. The inventor recommends the substitution for the blow of a hammer at present used, the prick of a needle to perforate the fulminating material. The ignition of the caps in this way ignites only a small portion at first, so that the combustion of the fulminant is comparatively slow, and may be communicated with certainty to the magnesium powder. The percussion cap to be used is placed on a flanged plate and some magnesium strewed beside and upon it. By means of a lever a needle, which is supported perpendicularly to the plate, is forced downwards when desired, thus pricking the cap, igniting it, and thus causing the combustion of the powder.—D. A. S.

Improved Process of and Apparatus for Making Heating- and Illuminating Gas. A. Noteman, Toledo, U.S.A. Eng. Pat. 12,716, July 11, 1892.

FOR the production of illuminating and heating gas from petroleum the following apparatus is employed:—The petroleum is run from a small tank or reservoir by means of a narrow tube provided with a stop-cock, into the lower limb of a U-shaped tube, which is placed nearly horizontally; the petroleum pipe passes some distance into the lower limb of the U-shaped tube, and, as the liquid issues from the pipe, it is partially volatilised by a current of hot air, which is caused by the combustion of a bat-wing flame, burning in a perforated cylindrical vessel, the top of which communicates with the end of the U-tube. The heavier portions of the petroleum flow through a vertical pipe inserted into the lowermost portion of the U-tube, into a reservoir, whilst the gas, hot air, and products of combustion from the bat-wing flame pass along the upper limb of the U-tube into a gas-holder.—F. S. K.

Improvements in Apparatus for the Production of Fuel Gas. J. M. Bailey, Washington, U.S.A. Eng. Pat. 13,339, July 21, 1892.

THIS apparatus for the production of fuel gas is a very simple form of carburettor containing crude petroleum and broken stone, shells, or similar material; it is divided by two incomplete partitions into three chambers, of which the centre one is the smallest. The centre chamber is provided with shelves which extend alternately from opposite sides nearly, but not quite, to the other side; the spaces between the shelves are completely filled with broken stone, &c., and the latter is moistened with crude petroleum whenever necessary. The two lateral chambers are only filled to about one-third or one-half with broken stone, which is then completely covered with crude petroleum. Air, preferably heated a little, is forced into the bottom of one lateral chamber, then over one of the incomplete partitions into the top of the centre chamber, and finally into the bottom of the other lateral chamber. The gas obtained in this way is stated to be so thoroughly carburetted that it will not condense at the ordinary temperature; it is highly inflammable and develops intense heat by its combustion.—F. S. K.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

PATENTS.

Improvements in and Relating to Retorts for Distilling Shale and like Minerals, and for Dealing with the resulting Products. R. Orr and R. MacKay, Sutherland, Lidlithgow. Eng. Pat. 15,552, September 14, 1891. (Second Edition.)

THE improvements consist in a new mode of intermittently discharging the burnt shale from the bottom of the retorts into a lower hopper chamber, from whence it is delivered through the door of a shoot or hopper to the removing and conveying hutches. Two moving organs or apparatus fitted within the lower delivery chamber are arranged so as to move towards each other to hold the shale material or other mineral "in vertical line up within the retort, but when released will permit the whole column of material to descend evenly and in a body by gravity within the retort until the desired quantity has been passed through the lower hopper chamber into the hutches." The patentees have carried this idea into practice. Instead of leading the whole of the oil and ammonia gases away together and thence to condensers, there may be only partial condensation, and the ammonia gases may be neutralised by direct contact with acid, or the mixed vapours may be passed through separators and acid saturators of suitable construction. Or shale from which the oil has been wholly or partially distilled may be passed into other retorts or heating chambers, and there subjected to further heat, and the resulting vapours passed through acid saturators to form salts of ammonium.—D. B.

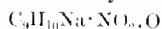
Improvements in the Manufacture of Mineral Oil and Ammonia. W. Young, Lasswade, N.B. Eng. Pat. 1587, April 12, 1881. Amended August 10, 1892.

THIS invention has for its object improvements in the system of distilling shale or other similar substances for the production of oil and ammonia, and consists in destructively distilling the shale at two temperatures, in such a manner that the oil shall be liberated and distilled from the shale at a low uniform temperature, and the remaining nitrogen liberated at a much higher temperature as ammonia. This is accomplished by first distilling out the oils from the shale at a low temperature in one retort, and thereafter transferring the residue into a second retort heated to a considerably higher temperature; or the operation may be conducted in one long retort, so divided that the shale shall be distilled free of its oil at one end and the distillation for ammonia completed at the other end, steam being employed for liberating the ammonia in the hot end.—D. B.

IV.—COLOURING MATTERS AND DYES.

Amethylcamphonitroketone. M. P. Cazeneuve. Bull. Soc. Chim. [3] 7, 1892, 327—331. (Compare this Journal, 1892, 512.)

THE sodium derivative of amethylcamphonitroketone,



is prepared by heating the nitroketone with soda in molecular proportion at 100°, crystallises in dark red micaceous scales containing 2 mols. H_2O , dissolves in water and alcohol, and dehydrates when heated on platinum foil. The ethyl derivative is formed when the potassium compound is heated for an hour with excess of ethyl iodide at 130°. It is a yellow, uncrystallisable, syrupy liquid, insoluble in water,

but soluble in alcohol and ether. It decomposes on distillation, and explodes when sharply heated. The sodium ethyl-derivative, $\text{C}_9\text{H}_9\text{NaC}_2\text{H}_5\cdot\text{NO}_2\cdot\text{O}$, is a red amorphous powder formed by treating a toluene solution of the preceding compound with sodium. It is soluble in water, and the solution gradually decomposes in the cold. It is also decomposed by carbonic anhydride. The acetyl derivative is obtained by treating the dry potassium or sodium derivative with acetyl chloride at 110° or acetic anhydride at 150°. It crystallises from alcohol in yellow hexagonal tables, melts at 65°, and remains in superfusion at the ordinary temperature. It explodes when heated above 250°. A sodium-acetyl derivative is formed by treating a toluene solution of the preceding compound with sodium. This is a bright red substance, soluble in water and more freely in alcohol; the aqueous solution gradually decomposes on standing. In conclusion, the author considers that the reactions of amethylcamphonitroketone point to the presence in it of the grouping $\text{CNO}_2\cdot\text{CH}_2\cdot\text{CO}$.—S. B. A. A.

The Tinctorial Properties of Amethylcamphonitroketone and its Auxochrome Group. M. P. Cazeneuve. Bull. Soc. Chim. [3] 7, 1892, 331—332.

AMETHYLCAMPHONITROKETONE has already been described (this Journal, 1892, 512) as possessing a golden yellow colour and tinctorial properties. In dilute alcoholic solutions it dyes wool and silk directly. When boiled with ordinary water it decomposes the carbonate of lime present, yielding a solution of the colour of the alkaline bichromates, which dyes wool and silk on boiling. It retains its dyeing powers in presence of tartaric acid, but not in alkaline baths. It does not dye cotton directly, but the material is dyed after one mordanting with tannin.

The author points out that whilst amethylcamphonitroketone contains the chromophoric group NO_2 , none of the salt-forming groups OH , NH_2 , COOH , SO_3H (Witt's "auxochromic" groups), which generally determine the dyeing powers of a compound, is present, and suggests that the acilic methylene group in the grouping $\text{CNO}_2\cdot\text{CH}_2\cdot\text{CO}$ may have a similar influence.—S. B. A. A.

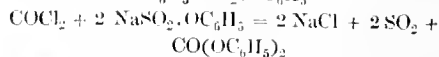
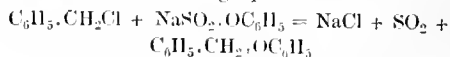
Is Magenta Poisonous? P. Cazeneuve. Monit. Scient. Aug. 1892, 557—560.

IT is stated that for upwards of 29 years a workman of the firm of Durand and Huguenin, of Basel, had sifted magenta, as made by Couper's process, without having suffered from any illness. He only observed great thirst, caused by the dust of the magenta. It was estimated that this man swallowed, in the form of dust, rosaniline hydrochloride in quantities of from 1 to 2 decigrams per diem. In view of this fact, it is pointed out that since 1 milligram of magenta can dye 1 kilo. of sugar pink, the hygienic expert need not fear the use of magenta for confectionery.

It is considered that the wine merchant who uses magenta in his wine is reprehensible as an adulterator, but not as a poisoner.—M. B.

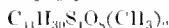
Reactions of the Addition-Product from Sulphur Dioxide and Sodium Phenylate. Formation of "Rubbadin." C. Schall and J. Uhl. Ber. 25, 1892, 1875—1901.

IT was recently shown by Schall that the product of the action of sulphur dioxide on sodium phenylate is presumably unsymmetrical sodium phenyl sulphite of the formula $\text{NaSO}_2\cdot\text{OC}_6\text{H}_5$ (Ber. 25, 1892, 1490). This substance reacts with benzyl chloride and with carbonyl chloride in accordance with the following equations:—



When sodium phenyl sulphite is heated with iodoform at 180°, a product having the composition $\text{C}_{14}\text{H}_{12}\text{S}_2\text{O}$ is obtained, and on account of its colour the author has named

it "*Rubbadine*." It is a reddish-brown crystalline colouring matter, which dissolves readily in alcohol, acetic ether, phenol, and in caustic soda solution. It yields a *diacetyl derivative*, $C_{41}H_{30}S_4O_8(OC_2H_3)_2$, and this on bromination gives $C_{41}H_{28}Br_2S_4O_8(OC_2H_3)_2$. *Dimethylrubbadine*—



forms reddish-brown microscopic crystals, insoluble in caustic soda, readily soluble in chloroform, and moderately in acetic ether.

A *hexanitro-derivative*, $C_{41}H_{25}(NO_2)_6S_4O_8$, obtained by the action of concentrated nitric acid on rubbadine, is a red crystalline dyestuff soluble in caustic soda with reddish-yellow colouration; also in ethyl acetate and acetone. A *tetra-nitrodiamido-product*, $C_{41}H_{25}(NO_2)_4(NH_2)_2S_4O_8$, obtained on reducing the hexanitro-compound, forms a black powder soluble only in phenol and in caustic soda solution.

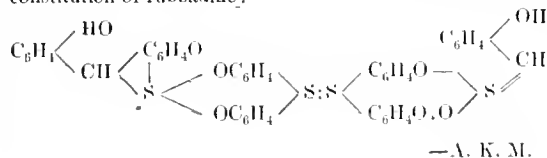
When rubbadine is heated at 200° in a sealed tube with dilute hydrochloric acid, it becomes decomposed in accordance with the following equation:—



The product $C_{32}H_{20}S_2O_8$ is a light brown crystalline substance extremely soluble in ethyl acetate and acetone, and yielding a dark red solution in caustic soda.

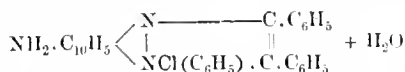
When rubbadine is fused with caustic soda, it yields *dihydroxydiphenylsulphoxide* $(HO.C_6H_4)_2SO$, together with some phenol, salicylic acid, and sulphur. Dihydroxydiphenylsulphoxide is a crystalline grey-yellow powder melting at 95.5° and is readily soluble in caustic soda, ether, alcohol, glacial acetic acid, ethyl acetate, acetone, and in amylalcohol. Its *diacetyl-derivative*, $(C_2H_3(C_2H_3O)SO)_2$, melts at 110.5° . Its *polymeride* $(C_{12}H_{10}SO_3)_2$, obtained by the action of dilute hydrochloric acid at 200° , is a reddish-brown dye readily soluble in solutions of the alkalis and their carbonates, also in alcohol and ethyl acetate.

In conclusion the authors discuss the theoretical bearings of the reactions which they have investigated, and they suggest the following formula as probably representing the constitution of rubbadine:—



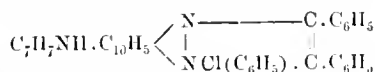
Azonium-Bases. O. N. Witt and C. Schmidt. Ber. 25, 1892, 2003—2008.

In this paper the authors describe some reactions of ethoxyphenyl-naphthostilbazonium chloride (Ber. 25, 1892, 1013), the most interesting of which is the substitution of the ethoxyl by an amido-group, thus bringing about the conversion of an azonium base into a saffranine. This reaction is effected by heating the stilbazonium chloride with alcoholic ammonia for two or three hours at 120° . The saffranine base crystallises out on cooling, and forms thick garnet-red prisms. The product is dissolved in boiling very dilute acetic acid, and the solution precipitated by the addition of hydrochloric acid. The *hydrochloride*—



obtained, forms scarlet needles, having a green metallic lustre; it dissolves in water and alcohol to scarlet solutions, which exhibit a faint greenish-yellow fluorescence. Silk, wool, and cotton are dyed bright pink by it. Its platinum-chloride has the composition $2(C_{30}H_{22}N_3Cl)PtCl_4$.

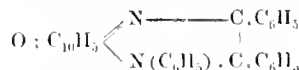
The corresponding *paratoluidine compound*—



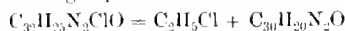
is obtained when the above stilbazonium chloride is heated with paratoluidine for 8—10 hours at 110° — 120° . It forms

rectangular plates, dissolves readily in alcohol, sparingly in water, and is insoluble in very dilute hydrochloric acid. It dyes cotton a beautiful reddish-violet colour.

When the stilbazonium chloride is heated in a dry tube it first melts, froths slightly, becomes suddenly deep blue-red, and solidifies on cooling to a crystalline mass. This melts above 300° and at a high temperature sublimes mostly unchanged. The product of this reaction possesses the general characters of Fischer and Hepp's rosindone, and is, in fact, *phenyl-naphthostilborosindone*—



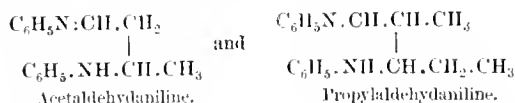
its formation being represented thus:—



A better method of obtaining it is to boil the stilbazonium chloride with six times its weight of dimethylaniline. It crystallises in garnet-red needles, is insoluble in water and dissolves only very sparingly in alcohol; it dissolves readily in phenol with orange-yellow colour, whilst concentrated sulphuric acid yields a beautiful violet solution which becomes yellow on dilution. The rosindone is a feeble base. Its *hydrochloride*, $C_{30}H_{20}N_2O.HCl$, crystallises in orange-yellow needles and scales, but is readily dissociated by water or by a temperature of 100° . The rosindone and its sulphonic acid dye silk red.—A. K. M.

Schiff's Bases. W. v. Miller and J. Plöchl. Ber. 25, 1892, 2020—2071.

In their paper on aldehyde-green (Ber. 24, 1891, 1700), the authors expressed the view that this substance is formed by the addition of hydrogen sulphide to the group $>C:N$. As this group is common to Schiff's bases the authors have attempted to effect the addition of hydrogen sulphide to the simpler members of this class of substances which they have also submitted to a closer investigation. The bases derived from the aromatic aldehydes, and of the type $C_6H_5N:C.H.C_6H_5$, are mostly well characterised crystalline compounds, whilst of those derived from the fatty aldehydes few are well defined and crystallised. With regard to their molecular weights, Raoult's method indicated a triple formula for *anhydroformaldehydaniline* and double formulae for *anhydrovaleraldehydaniline* and *acetaldehydaniline*. Whilst, however, anhydroformaldehydaniline and anhydrovaleraldehydaniline behave as simple bases in their reactions, acetaldehydaniline and the corresponding propylaldehyde derivative are shown by their abnormal behaviour to be differently constituted. The latter yield acetyl-, benzoyl-, and nitroso-derivatives, and consequently contain an imido group. When acetaldehydaniline is heated with hydrochloric acid it readily breaks up into aniline and quinoline, whilst propylaldehydaniline similarly yields aniline and α -ethyl- β -methylquinoline. The most probable formulae for these two bases are accordingly—



Isobutylaldehydaniline can also be partially converted into a similar polymeride, but all the other bases yield polymerides possessing a tertiary character.

All these bases can be obtained in their simple form—as oils—but they polymerise on standing and yield mostly solid products.

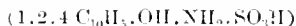
Of the hydrazones and oximes, only those belonging to the fatty series react with hydrogen cyanide. An interesting method of obtaining nitriles of the simple (*i.e.*, unpolymerised) bases is to dissolve aniline (or other amine) in ether, add hydrogen cyanide and then drop in the aldehyde. In this way nitriles can readily be prepared which cannot be obtained by other methods. This reaction

is of special interest as the nitriles yield important acid amides and acids. By the action of hydrogen cyanide on anhydroformaldehydaniline and subsequent hydrolysis of the resulting nitrile, the authors readily obtained phenyl-amido-acetic acid, $C_6H_5.NH.CH_2.COOH$, and since the yield is quantitative the reaction is of importance in connection with the synthesis of indigo.—A. K. M.

PATENTS.

Improvements in the Manufacture of Colouring Matter. H. H. Lake, London. From F. Reverdin and Ch. de la Harpe, Geneva, Switzerland. Eng. Pat. 16,377, September 26, 1891.

By the action of the air on a solution of β -amido- α -naphthol sulphonic acid in presence of an alkaline carbonate, a colouring matter is produced suitable for wool-dyeing. The oxidation is more rapid if the solution be heated whilst a current of air is passed through it. A solution containing 3 kilos. of amido- α -naphthol sulphonic acid—



and 2.3 kilos. of calcined sodium carbonate in 50 litres of water is heated in an open vessel on the water-bath and well stirred. For the first three hours the water which evaporates is replaced and the solution is then evaporated to about 20 litres, when it is allowed to cool and the colouring matter separates out as a violet-black powder, which, after filtering off, is washed with cold water and dried. It dissolves in hot water and dyes mordanted or unmordanted wool from an acid bath, giving dark shades fast to light and fulling. The amido-naphthol sulphonic acid is prepared by reducing azo-colouring matters obtained from 1.4 α -naphthol sulphonic acid or else by reducing the nitroso-compound obtained from the same body or from the sulphonic acid of α -hydroxynaphthoic acid, in the latter case, the NOH group replacing the carboxyl group.—T. A. L.

Manufacture of Colouring Matters from Protocatechuic Acid and Phenols. O. Imray, London. From "The Farbwerke vormals Meister, Lucius, und Brüning," Höchst-am-Maine, Germany. Eng. Pat. 19,547, November 16, 1891.

By heating acetic acid with resorcinol or pyrogallol in presence of zinc chloride, the following ketones are produced: resacetophenone, $CH_3.CO.C_6H_5(OH)_3$, and gallacetophenone $CH_3.CO.C_6H_3(OH)_3$. By applying this reaction to two bodies which hitherto have not been employed industrially, protocatechuic acid and pyrocatechol, new products result yielding very valuable colouring matters. When 34 kilos. of protocatechuic acid, 32 kilos. of pyrocatechol and 50–100 kilos. of zinc chloride are heated to about 150° C. for several hours and the melt dissolved in hot water, a tetrahydroxydiphenyl ketone crystallises from the solution and may be purified by crystallisation from water. When pure it melts at 175° C. By substituting resorcinol for the pyrocatechol an isomeric tetra-hydroxydiphenyl ketone is produced, which melts at 93° C. A penta-hydroxydiphenyl ketone is formed in a like manner from protocatechuic acid and pyrogallol. All the hydroxy ketones derived in this way from protocatechuic acid can be employed for dyeing and printing chrome-mordanted cotton and wool and give shades said to be absolutely fast to fulling.—T. A. L.

ERRATUM.

This Journal, 1892, page 808, col. 1, 2nd abstr., six lines from end, for "*p*-tolylglyceocine" read *p*-tolylglyceine.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

The Determination of Fibrous Materials in a Crude State. S. Gabriel. Zeits. f. Physiol. Chem. 16, 1892, 370.

See under XXIII., page 944.

Pita-Flax or Sisal-Hemp. Annal. Indust. Paris, July 24, 1892; Proc. Inst. Civil Eng. 110, iv. 63–65.

The plant from which pita-flax is obtained is a native of South America and the West Indies, but it has been naturalised and become almost indigenous to all countries bordering on the Mediterranean—Algeria, Egypt, Sicily, Spain, and Portugal—where it is much employed as a boundary hedge for roads and fields. It is a species of aloe with a fibrous root, a very short trunk, large fleshy leaves of a sea-green colour, with prickly edges and pointed ends, from 20 in. to 4 ft. in length. The leaves increase in size year after year, and usually at the age of 20 or 30 years, but sometimes as early as its eighth year, a tall shaft is thrown up, which in about the space of a fortnight grows to the height of from 23 to 28 ft., and produces a flower at the top, but this so exhausts the plant that the effort usually kills it.

It is chiefly in the West Indies and Mexico that it is cultivated for profit. With the exception of the outermost and innermost leaves, of which the first are too coarse and the latter too tender, the rest are cut as near to the root as possible, and on being scraped and beaten with wooden instruments produce a valuable fibre of great strength. That from the exterior leaves is used for cordage and mats, and from the intermediate leaves coarse cloths are made, and the inner leaves produce a fine quality of fibre from which delicate tissues are woven resembling fine linen. It is sometimes prepared in Spain of a sufficiently fine texture to be exported to Lyons for mixing with silk fabrics. The Mexican varieties of aloe, called in that country "Magney," produce not alone a fibre which in France is known as Tampico horse-hair, and in England as Mexican grass, pita-flax, or sisal-hemp, but also a favourite intoxicating beverage (pulque), somewhat resembling perry, which is largely consumed in that country.

Hitherto the recovery of the fibre has in almost all countries been a tedious operation performed by hand, but in Yucatan a considerable trade has been created during the last few years by the application of machinery worked by means of horses or steam. From 5,000 to 7,000 leaves are daily crushed and the fibre separated by means of a wheel fitted with metal blades which revolves in a circular pan, each thousand leaves yielding from 55 to 90 lbs. weight of dry flax, and in this way the Yucatan production has been raised to an average value of 200,000l. per annum. This system, however, is in some ways objectionable, for it occasions a great deal of waste and often injures the attending workmen.

Mr. Berthet, who is already well known as the inventor of useful machinery of a similar kind, has recently introduced a greatly improved machine which, described and illustrated in Vol. 9, p. 33, of the "Bulletin de la Soc. ind. de Rouen," consists of two parts. The leaves are first crushed between fluted rollers, and are then made to pass between a curved wooden support and a drum fitted with many blades. This drum in revolving tears away the pulp from the whole length of the leaves and lays bare the fibre, but the operation is again repeated, whereby the separation of the fibre is completed.

In his work on the "Fibrous Plants of India," Mr. Forbes Royle gives the result of many tests made by him in India of the comparative strength of pita-flax and other fibres. He found it to be 70 per cent. stronger than Russian flax, and also that it has greater resistance than cocoa-nut fibre; when wet it shrinks 25 per cent. less than ordinary hemp-rope. (See Colonial Reps. Annual, No. 44, Bahamas, paragraph 15.)—W. S.

PATENTS.

Improvement in the Treatment of Fibrous Plants for the purpose of obtaining Fibres therefrom. D. Stuart, London. Eng. Pat. 751, January 15, 1891.

ALOE, jute, pine-apple ramie, flax and kindred plants in their green state are crushed and steam and water are then injected through the mass, by which means the pulp is speedily released and the gums are absolutely removed.

—E. J. B.

Improved Process and Means for the Chemical Treatment of Ramie Fibre, Flax, or Hemp, in either a Green or Dried State. J. P. A. Blaye, Paris. Eng. Pat. 13,072, August 1, 1891.

THE process consists in treating the above-named fibres for from 15 to 35 minutes at 95° to 100° C. in a bath composed of water, 100 litres, slaked lime, 10 kilos., carbonate of soda, 2½ kilos., alum, 2 kilos. After such treatment the fibres are easily removed by hand.—E. J. B.

Improvements in the Manufacture of Bookbinders' Cloth. T. A. Sutton and W. H. Sutton, Salford. Eng. Pat. 13,148, August 4, 1891.

THE inventors take grey calico or other similar fabric and raise upon one or both sides a pile or nap. They then dye or pad on to the pile the desired colour and then proceed to stiffen, glaze, calender or otherwise finish, and if necessary emboss a pattern. By this means the cloth is more evenly dyed and gains in density and solidity.—E. J. B.

Improvements in the Manufacture of Floor Cloth and like Fabrics, and Machinery therefor. R. Scott and W. J. Beard, London. Eng. Pat. 17,081, October 7, 1891.

DESCRIBES a machine for the manufacture of linoleum or similar fabrics in which a continuous pattern in various colours runs through the piece. A strong canvas back covered with an adhesive or sticky substance travels intermittently over a heated table. During the periods of rest, the various coloured portions of linoleum material are stamped out above the table on to the cloth. For each separate colour there is a special stamp and a special die-plate which exactly correspond to the shape and size of those portions of the pattern that are to be of that particular colour. When the linoleum of one colour has been stamped out and fixed in position on the canvas, the drum carrying the stamps revolves bringing into work a new set of stamps or punches and a corresponding die-plate. When the pattern is complete, it may be by seven or eight colours,

the canvas moves on the length of the pattern and is ready to receive the next length. Finally, the whole passes out between rollers which firmly fix the segments of linoleum to the canvas back.—A. J. K.

Improvements in Apparatus for Gassing Silk and other Yarns. C. Ideson, Leeds. Eng. Pat. 17,562, October 14, 1891.

IN order to effect an economy in time, gas, and power, the inventor has devised a new finger bar for gassing frames. At a point somewhat less than half way from the delivery end, the bar is bent into horse-shoe form; the gas flame playing across the centre of the bend. The straight portions of the bar at each side of the bend are in alignment, and along these are arranged at intervals pot friction tubes working on steel spindles. Two of the latter are also placed on each side of the bend and form equilateral triangles with the end tubes of the rows. This triangular arrangement is an essential feature of the invention, since by threading in different ways it permits of the yarn being passed from one to eleven times through the flame according to requirements.—W. M. G.

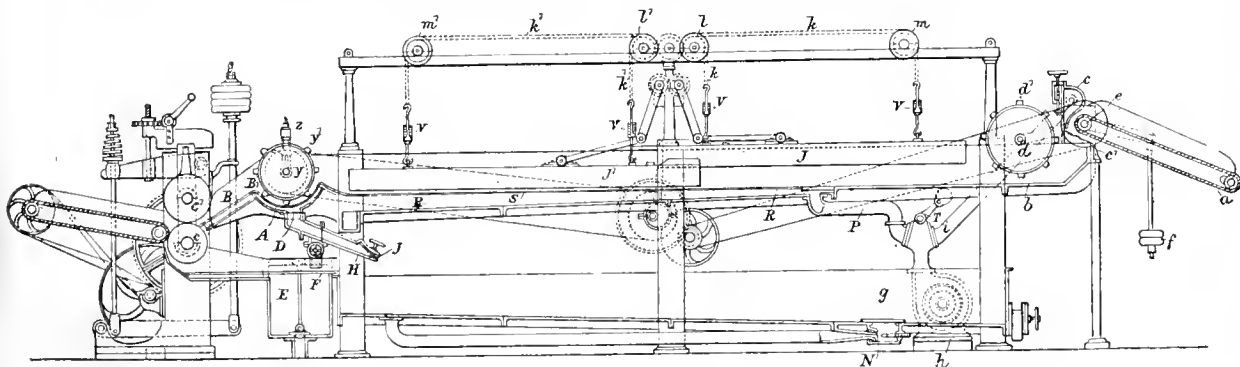
Improvements relating to the Waterproofing of Canvas and other Materials, and to Apparatus therefor. L. Silverman, Bexley, and W. McLaren, London. Eng. Pat. 17,977, October 20, 1891.

THE material to be waterproofed is placed in a suitable vessel from which the air is partially exhausted. The paraffin wax or other waterproofing material is then introduced under pressure. When thoroughly impregnated the fabric is withdrawn and passed first through two hot rollers, then between two revolving brushes, and finally between two cold rollers.—A. J. K.

Improvements in Machinery for Washing and Scouring Wool and other Fibrous Materials. J. Petrie and J. Fielden, Rochdale. Eng. Pat. 18,384, October 26, 1891.

IN this apparatus the principle is adopted of causing the flow of liquid to carry the wool through the machine; but in order to secure the maximum effect the wool passes through much less quickly than the liquid, and the method of bringing about this retardation is a principal feature of the invention.

The machine is constructed mainly on the lines of the ordinary wool-scouring machine, being provided with a long trough with perforated false bottom, feed and delivery apparatus, squeezing rollers, &c. The novel features will be understood by reference to the diagram in which *a* is a



MACHINERY FOR WASHING AND SCOURING WOOL.

feeding brat, and *b* the scouring trough over which is placed a perforated pipe *c*, extending the whole width of the trough. A continuous spray of scouring liquor from this serves to saturate the wool and also to feed the scouring trough. The revolving cylinder *d* depresses the wool

below the surface of the liquor, after which it is carried forward by the latter until it comes into contact with the retarding arrangement *j, j'*. This consists of several (two in the diagram) series of parallel bars placed horizontally to the apparatus, and spaced so as to allow the overlapping

ends of each series to fork into each other. By means of suitable mechanism each series of bars is alternately lifted out of, and depressed beneath the stream of liquid, squeezing the wool sufficiently to stop or retard its movement when in the latter position; but to prevent undue pressure, springs *r r* are inserted. The drum *y* at the delivery end of the machine serves to express a great portion of the liquor which flows through a perforated plate placed beneath the drum. The circulation of the liquid is brought about by a pump or injector.—W. M. G.

Improvements in the Treatment of Paper, Linen, and other Textile Fabrics applicable to the Manufacture of Show-Bills, Show-Cards, Posters, Tablets, Wall Decorations, and other Purposes. F. G. Annison, London. Eng. Pat. 19,710, November 13, 1891.

TEXTILE fabrics in long or short lengths are, by a special machine, which is fully described with reference to drawings, impregnated with an opaque or white solution of xylonite, celluloid, or ivoryine, and then passed through a heated chamber to remove alcohol and camphor. The fabric can then be printed in the usual manner, and is finally glazed or varnished.—A. J. K.

Improvements in the Treatment of Rhea, and in Apparatus therefor. E. Viarengo, Turin, and E. Casper, London. Eng. Pat. 20,610, November 26, 1891.

THE roots and tops are cut off the stems of the China grass, and the stalks sorted into three grades, thick, medium, and thin: for separate treatment. The stalks are immersed in water and boiled until the outer bark can be readily peeled off, after which the stems are placed in a closed vessel and boiled for about two hours under a pressure of at least 75 lb. in the following solution: water, 50 kilos.; soda, 1 kilo.; unpurified oleine, 500 grms. This removes all extraneous matters, including the gum. After thoroughly washing by means of a spray of water, the thoroughly-cleansed fibre is dipped in water containing 1 per cent. glycerin and 3 per cent. sodium carbonate, and dried in the open air.—W. M. G.

An Improved Hygienic Fabric, Tissue, or Material. J. Nyssen, Paris. Eng. Pat. 21,455, December 8, 1891.

AN electric fabric is produced, which is very hygienic, by mixing a material capable of becoming electric, such as cats' hair, with wool or other material.—E. J. B.

An Improved Shower-Proof Fabric. E. Briggs, Bradford. Eng. Pat. 3067, February 17, 1892.

THE fabric is made of silk containing its natural gum, the spinning, weaving, and dyeing operations being so regulated as to retain this constituent.—E. J. B.

Improvements in or Relating to Apparatus or Machines for Breaking, Washing, or otherwise Treating Vegetable Fibres. W. P. Thompson, Manchester. From S. B. Allison, New Orleans, U.S.A. Eng. Pat. 14,528, August 11, 1892.

THE object of the invention is to provide a machine for treating wood fibres or leaves, such as pine-apple, bear grass, banana, or other plants, the whole machine consisting of "moss and fibre brake," hackle and washing machine, with pressure rollers adjusted by set screws, in combination with a series of scraping blades, which interlace by means of eccentrics.—A. J. K.

VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

The Weakening of the Fibre in Discharge Indigo Printing. A. Scheurer. *Lebne's Färb. Zeitung*, 1891—92, 355. (Compare this Journal, 1892, 33.)

Two samples of discharge printing paste having the following composition were experimented with. (A.):—Potassium bichromate, 40 grms.; potassium chromate, 160 grms.; dextrin thickening solution, 800 grms. (B.):—Potassium bichromate, 50 grms.; potassium chromate, 300 grms.; dextrin thickening solution, 650 grms. Dark blue dyed strips were used as in the former experiments (*loc. cit.*). The development was effected in the case of (A.) by a bath containing sulphuric acid and oxalic acid (50 grms. of each to 1 litre of water); whilst in that of (B.), glycerol (50 grms.) was also added to the bath. After this treatment the printed strips were boiled with a solution of sodium carbonate, and tested with the dynamometer:—

	Relative Strength of Fibre.
Vat-dyed fibre.....	100
Sample printed with (A.).....	65
" " (B.).....	64

These results prove von Niederhäusern's statement (*Färb. Zeit.* 15 Juni 1892) that the use of glycerol is superfluous when the strength of the printing paste is properly adjusted; but it by no means follows that the addition of a reducing agent to the developing bath is useless. In practice, however, the printing paste always contains more than the necessary quantity of chromate, and the addition of glycerol or of dextrin (10 grms. to the litre), to the oxalic acid bath, minimises the weakening of the fibre, as previously stated by the author (*loc. cit.*).—A. R. L.

The Tannins and Tanning Extracts and their Application in Dyeing Cotton. V. H. Soxhlet. *Lebne's Färb. Zeitung*, 1891—2, 352—356, 378—379. (Continued from this Journal, 1892, 744.)

PINE bark extract, in spite of its being the cheapest tanning material in Germany, has a more limited use in cotton dyeing than even oak wood extract. Extract of Hungarian galls ("*Knoppern*") can be used in many cases for bright shades; the tannin-antimony compound is comparatively faint-coloured. Hungarian galls can therefore be used as a substitute for gall-nuts (or gallotannic acid), but of course they contain less tannic acid, and the accompanying colouring matters are stronger. The extract of Hungarian galls reduced to 15° B. has a clear colour, and contains about 25 per cent. of tannin; it produces no harshness with cotton fibre.

Bearberry leaves (*folia urse ursi*) contain a considerable percentage of tannin (also some gallic acid), but scarcely any soluble colouring matter. The extract (15° B.) contains 12 per cent. of tannin. The tannin-antimony compound is pure white, and the iron compound a beautiful bright blue.

White sea-rose roots were formerly employed as a substitute for nut-galls.

Quebracho wood contains as much as 20 per cent. of quebracho tannic acid, together with an intensely red-coloured resin, which latter restricts its general application for dyeing. It would, however, pay to decolorise the extract, and also to use it in admixture with logwood extract, but for the fact that the colours produced with it assume a foxy tone. Hemlock extract contains even more tannin (at 30° B., 44 per cent.), than quebracho extract, and is used in Canada with black dyes for cotton; the goods, however, invariably exhibit a foxy tone. The so-called black dye preparation sold in America is largely made up of hemlock extract.

Divi-divi extract comes into the market in a concentration of 30° B.; the author found 47 per cent. of ellagitannic acid in a sample. The yellowish tint of the antimony compound precludes its application for bright and medium shades; it yields, however, with iron salts a very deep greyish-black colour, and it can with advantage be used with all dark coal-tar colours.

Extract of myrabolans will unquestionably supersede that of sumae and other poorer tanning materials. This raw material contains 45 per cent. of tannin, a certain quantity of fat, and but little colouring matter; it is therefore well adapted for tinctorial purposes. The author prepared an extract by extracting the crushed substance five times with distilled water, and evaporating the extract to 15° B. on the water-bath. The tannin-antimony compound was very similar to that from sumae, whilst the iron compound had a beautiful full colour. The more fiery and intense tint which is produced with red, violet, and green basic coal-tar dyes fixed with myrabolans, as compared with sumae, is generally ascribed to the fat which the former contains; in most large English dyeworks, myrabolans or the extract are employed with predilection.

Bablah pods yield an extract (15° B.) containing 18 per cent. of tannic acid and some gallic acid, together with colouring matters and resin. This material might, if purchased at a moderate price, take the place of sumae; its chief application is for greyish-brown colours. Valonia meal, containing as much as 42 per cent. of tannin, can be purchased at 40 mk. per 100 kilos.; it yields 87 per cent. of extract (15° B.), and is a cheaper material than sumae extract containing 14 per cent. of tannin.

Cajota bark, probably identical with *Ecorce de palétuvier* (Bull. Soc. ind. Ronen, 1880, 187), contains 27 per cent. of tannin, and yields an extract resembling quebracho and hemlock extracts.

Algarobella seed husks (Chili) contain 61 per cent. of tannin, and yield 43 per cent. of extract (30° B.); it is not an advantageous tanning material for blacks, and the colour of its tannin-antimony compound precludes its use with coal-tar colours.

The employment of gallotannic acid is to be recommended, but the cost is generally prohibitive. Next to it may be placed the various extracts in accordance with the amounts of tannin they contain, and their costs. Sumae extract, on account of its high price and comparatively low percentage of tannin, is to be placed last. All extracts should be bought with a guarantee of their percentage of tannin. No such guarantee can be given with the raw materials, as they are liable to undergo changes by weathering, &c., and the author is of opinion that they should not be purchased.

—A. R. L.

The Gilding and Silvering of Textiles. E. Odenheimer. *Lehne's Färb. Zeit.* 1891—2, 375—377.

Two methods are in use for gold and silver printing on textiles. The first consists in the employment of the metals in the form of leaf or powder. On account of the expense of metallic gold and silver, bronze powders have been used as substitutes for them, with, however, somewhat unsatisfactory results. The second method depends upon the precipitation of metallic gold or silver on the fibre, from a solution of a salt, by means of a reducing agent. Neither of the methods in their present forms can be said to give perfectly satisfactory results. The author then gives a historical sketch of the development of the second method. He finds that in order to precipitate gold and silver on the fibre in a lustrous form, it is necessary to employ a gaseous reducing agent. Sulphuretted hydrogen produces, on fibres moistened with a solution of a gold salt, a brown or silver grey metallic deposit, which loses its lustre on drying; sulphurous acid gives no better result. Exposure of a fabric moistened with gold salt to sunlight yields a brownish or violet colour, whilst solution of ferrous sulphate gives rise to a brown or grey colour. Hydrogen precipitates the gold in a lustrous form, but its action is slow. By far the best results are obtained with phosphoretted hydrogen.

Reduction by Means of Phosphoretted Hydrogen.—A slow and continuous current of phosphoretted hydrogen is evolved on gently heating red phosphorus and alcoholic potash, and by this method the spontaneous inflammability of the gas is avoided. It acts very quickly, a beautiful lustrous deposit of metallic gold being produced when a small quantity of the gas is passed into a closed vessel in which the fabric moistened with gold solution is suspended. The fabric at first assumes a green colour, having a metallic

shimmer, and then passes through bluish violet to red; it finally has the lustrous metallic appearance above described. If the fabric in the dry state is treated with the reducing agent, or is insufficiently impregnated with gold solution, the deposit is more or less red without metallic lustre, and gold purple is formed when phosphoretted hydrogen at a high temperature is made use of. After drying, the deposit on the fabric loses its lustre, a result due to unevenness of surface, but the lustre is to some extent restored by rolling. The smoother the surface of the fabric, the more easy is it to obtain a lustrous deposit. Silk is in this respect the best material. The porosity and unevenness of the fabric are therefore the chief difficulties in the way of obtaining the desired effect; these may be overcome, however, to a certain extent by previously rolling. It is, however, preferable, in the case of making gold designs, to print the fabric first with a dilute solution of albumen, and subsequently, after drying and steaming, with a thickened gold solution, prepared by adding to 50 cc. of gum Senegal solution 5 cc. of a 2 per cent. solution of sodium gold chloride and 2—3 cc. of glycerol (compare this *Journal*, 1892, 600). The moist fabric is then subjected to the action of phosphoretted hydrogen, whereby lustrous gold designs are produced which withstand brushing and rubbing, but cannot be washed.

Silver behaves similarly to gold on reduction, and gives rise to various colours. Yellow is produced when the fabric is moistened with a 0.04 per cent. solution of silver nitrate and warmed for some time in a glycerol bath or tannin solution. Lustrous deposits of metallic silver are produced in the same way as those of gold, and good results are obtained with a 0.02 per cent. solution of silver nitrate. When the silver solution is too dilute, a thin naecous metallic film is deposited. For printing designs, the following mixture is employed:—Silver nitrate (0.1 gm.), gum Senegal solution (50 grms.), and glycerol (2 grms.) For silvering the entire fabric, a 0.02 per cent. solution of silver nitrate is strong enough. After reduction the silvered fabric is passed between heated rollers for the purpose of burnishing.—A. R. L.

PATENTS.

Improvements in Machinery or Apparatus for Cleaning and Lustreing Dyed or Undyed Yarns of Silk, Cotton, or other Fibrous Substances. S. Fisher and A. Murgatroyd, Huddersfield. Eng. Pat. 18,878, November 2, 1891.

In the usual machines for the above purpose the yarn passes from the winding-off bobbins round the lustreing cones, and finally through two sets of niches to the winding-on bobbins. In order to wind the thread laterally, one set of niches is made to traverse backward and forward, which has the effect of putting much more strain on the thread at one period than at another, thus limiting the drag which can safely be applied to the yarn. The use of niches at all is objectionable, because they collect the fluff which is removed occasionally by the thread, causing an uneven yarn.

The object of the present invention is to overcome these defects by passing the yarn in an approximately straight line from the unwinding to the winding-on bobbins without contact with any eye or niche, thereby securing the entire available amount of friction for the purpose of lustreing. A rotating brush removes the fluff.—W. M. G.

Improvements in Machines for Printing Fabrics. J. Wood, Ramsbottom. Eng. Pat. 19,174, November 6, 1891.

In some cases it is desirable that the cylinders of printing machines should be capable of horizontal adjustment, especially in duplicate machines, where both sides of the fabric are printed upon. The inventor proposes to arrange matters so that this can be brought about as follows:—The bearing blocks of the cylinders are fitted to slide horizontally, in planed ways, in carriages which are made to slide vertically, and are capable of being raised or lowered as occasion requires.—W. P. D.

Improvements in or Relating to the Dyeing of Silk and other Fibres. J. Longmore and R. Williamson, London. Eng. Pat. 20,574, November 26, 1891.

THE dyeing of silk in the higher qualities has only been successfully practised after it has been spun into yaru. The inventors propose the following method for dyeing it in the sliver, either before or after it has been dressed or combed. The sliver is wrapped round a drum by means of a gill-box, and dyed in this form of a lap, by which means it is possible to handle the silk in the sliver state without damaging it.

After removing the laps from the drum they are placed on a length of wire gauze, which is then rolled up and tied. The sliver is then easily handled and dyed. The dyeing operation may be made continuous.—W. P. D.

Improvements in or Relating to Means or Apparatus for Dyeing Yarns, Piece-goods, and the like. S. Smithson, Heckmondwike. Eng. Pat. 14,101, August 4, 1892.

THE object of this invention is to keep the goods from coming in contact with the dyewoods, or other solid materials used in the process of dyeing. Also to prevent any of the waste dyewoods, &c. from entering the drains, and thus becoming a nuisance.

The dye tank is divided transversely into two or more compartments, one of which contains the goods. A smaller division holds the dye-wood, and the liquor can flow from one to the other, through perforations in the sides, which are, however, not large enough to allow the dye-wood to get through and come in contact with the goods. Similar arrangements are made to prevent the solid matter escaping down the drains, when the tank is run off. A winch is added for piece-goods dyeing.—W. P. D.

VII.—ACIDS, ALKALIS, AND SALTS.

Improvements in the Manufacture of Sulphuric Acid during 1891. A. Schertel. Chem. Ind. 1892, 165—170.

IN the above year a work of considerable magnitude has appeared, by Alfred Retter (this Journal, 1891, 364), offering singular interest from the fact that the results given refer to the working of a one-chamber system. The dimensions of this single chamber were 188 ft. × 27 ft. × 21 ft. high, equal to 105,850 cub. ft. capacity; the capacity of the Glover tower was 1,020 cub. ft., or 0.96 per cent. of the chamber space. The pyrites burners, made in six compartments, consumed 3—3.3 tons of pyrites per 24 hours. The gases were sampled—(1.) In the tunnel between the Glover tower and the chamber. (2.) At two points situated 4 ft. 11 in. from the front wall of the chamber, about 3 ft. 4 in. from the floor, and 3 ft. 4 in. from the top. (3.) 33 ft. from the front wall, near the bottom and top. (4.) 92 ft. from the front wall, near bottom and top. (5.) 158 ft. from the front wall, as before. (6.) In the down-draught from the Guy-Lussac tower. The sample tubes reached in each case to a depth of 5 ft. into the chamber.

Working under normal conditions (i.e., consuming 3 tons of pyrites and 132 lb. of nitre per day), there is a remarkably sudden decrease of sulphurous acid in the chamber gases. Even in rejecting the tests taken at point (2)—the same being situated in a dead corner, away from the gas supply—we find only a slight reaction taking place between points (2) and (3), and almost no reaction past the latter. It was further remarkable that any attempt to increase the output by charging more than the above quantity of pyrites resulted only in irregularities in the process and in increased consumption of nitre. The tests show further, that nitrous oxide disappears along with sulphurous acid, as already pointed out by Lunge and Naef.

In reducing the air but increasing the nitre, the reaction advances as far as the far end of the chamber, and sulphurous acid along with nitrous fumes escape from the Guy-Lussac. But the most curious fact is an increase of oxygen from the point at which the gases leave the Glover. In the chamber inlet there is a deficiency of 1.89 per cent. (volume) of oxygen to completely oxidise sulphurous acid into sulphuric acid. At test-hole 2 there is already an excess of 0.36 per cent. (volume) of oxygen, which increases to 1.16 per cent. at the 4th test-hole. It is peculiar, too, that the proportion between nitrous acid and nitrous oxide remains uniform all through, although a deficiency of oxygen would lead one to expect a strong reduction of nitrous acid.

Increasing the air leads to an increased escape of sulphurous acid from the Gay-Lussac tower, and in some cases the chamber process is likely to be continued there. The sulphurous acid causes evolution of nitrous acid, which escapes. Under the above conditions it is very difficult to regulate the supply of air and nitre, and the losses in the exit gases are occasionally 30 times in excess of the average loss.

The temperatures are not subjected to strong variations and high figures, such as Sorel recorded; these were not observed here.

The output of this chamber being so very low, the same was divided into two smaller chambers, measuring 121 ft. long (68,607 cub. ft.) and 60.7 ft. long (34,417 cub. ft.) respectively. A passage 6.2 ft. wide divided the two new chambers. The chamber space decreased thus by 3.3 per cent., but the surface increased by 2.8 per cent. As a result of the alteration, 4.2 tons of pyrites could be burnt in 24 hours (i.e., this means an increase of 40 per cent.), with a consumption of 4.4 nitre per 100 of sulphur. The gas tests taken show that the sulphurous acid, when entering the chamber, does not decrease as suddenly as was the case in the one-chamber system. It decreases only very slowly past the second sample hole, but rapidly, almost to zero, in the second chamber. The samples taken on the top and bottom differ to a greater extent than formerly. The temperatures are much higher after splitting the chamber than formerly, even when burning the same quantity of pyrites, a circumstance which cannot be explained yet. Nevertheless, although there is a considerable source of heat in the chambers, one cannot help being struck by the considerable difference in the temperatures in the Glover tower and chamber (about 45° C.). Lunge and Naef observed in Uetikon a slight increase of temperature; the same was the case at the Oker and at the Mulden works, whilst there was a considerable rise in the temperature at the Freiberg works. The knowledge of chamber space and chamber surface do not throw sufficient light on this matter, and it is evident that the temperatures in the chamber system are influenced by conditions which are not yet recognised.

The behaviour of nitrous acid to sulphuric acid has been subjected to further studies since it became probable that the sulphuric acid vapours floating in the atmosphere of the chamber combine with nitrous acid, and thus prevent a further formation of sulphuric acid. The tension of the nitrous acid of nitrous vitriol has been studied by Lunge, Zalcwiecki, and Marchlewski (this Journal, 1891, 364—366). The specific gravities of nitric acid of different strengths were ascertained by Lunge and Rey (this Journal, 1891, 543—546).

The estimation of nitrogen in nitrates is treated of by Fricke, Alberti, and Hempel and Ulsch. The method employed by the latter is specially adapted to substitute the usual indirect nitre determinations.

Among the patented processes, the following may be mentioned:—Lunge and Kosmann electrolyse a solution of zinc sulphite (obtained by passing sulphurous acid gas through a paste of roasted zinc ore) for the purpose of obtaining zinc and dilute sulphuric acid. G. Léon obtains fuming or anhydrous sulphuric acid by electrolysis concentrated sulphuric acid. Neuerburg proposes to concentrate sulphuric acid in a copper apparatus, which is lined with gold up to the point of contact with the sulphuric acid.—H. A.

PATENTS.

Improvements in the Apparatus for the Manufacture of Bleaching Powder (Chloride of Lime) or Similar Commodities. J. M. Milnes and A. Milnes, London. Eng. Pat. 15,833, September 18, 1891.

AN endless belt made of suitable material, preferably of asbestos cloth, is caused to travel through a series of chambers, and upon it is placed the material to be saturated. In the case of bleaching powder the material is lime, which is fed in at a hopper, and chlorine is admitted at the end near the hopper and drawn through the chamber to the other end of the series. Hanging from the roof of each chamber are a number of combs which turn the material over as it is carried along by the travelling belt, thus continually presenting fresh surfaces for absorption of the gas. Drawings of the plant are given.—H. S. P.

Improvements in or Connected with the Production of Monocarbonates from Bicarbonates of the Alkalis. F. H. Gossage, Widnes. Eng. Pat. 15,822, September 18, 1891.

THE bicarbonate of soda or potash is placed in a closed vessel or series of vessels in a wet or dry state, and hot gas or hot air is passed through it by means of pressure or suction, the temperature being such as to convert the bicarbonate into monocarbonate. The gases that may be used are those that come from limekilns, in which cases they are enriched by the CO_2 expelled from the bicarbonate. When hot air is used it may be heated by passing through an interchanging apparatus subjected to the hot gases from the flues or furnaces of steam generators.—H. S. P.

Improvements in the Manufacture of Nitric Acid. R. E. Chatfield, Sewardstone, Essex. Eng. Pat. 16,512, September 29, 1891.

THE object of the invention is to obtain nitric acid free from sulphuric acid by distillation of nitrate of soda with sulphuric acid. To effect this a mixture of nitrate of soda is heated with large excess of sulphuric acid, preferably two equivalents to one of nitrate, at a temperature not exceeding 445°F . About 75 per cent. of the nitric acid distils over under 300°F ., and the remainder comes over, save a slight trace, at about 445°F . A temperature a few degrees higher removes the last trace. Owing to the low temperature the nitric acid is free from sulphuric acid. At the same time the resulting residue is liquid, and may be run off at any temperature above 350°F ., and may be used with an equivalent of salt to form muriatic acid and furnace salt-cake for the manufacture of glass, soda, &c.

—H. S. P.

Improvements in the Manufacture of Acid Sulphites. A. Boake and F. G. A. Roberts, Stratford, Essex. Eng. Pat. 16,647, October 1, 1891.

IN the ordinary process of manufacturing sulphites, sulphurous acid gas carries over from the plant in which it is generated minute particles of sulphur which are not removable by the ordinary means of washing, and this sulphur forms an unstable compound with the lime or other base, which even in minute quantities affects the value of the final product, especially if it be intended for the purpose of preserving beer. To obviate this the inventors first liquefy the sulphurous acid gas by pressure, and then allow it to gently boil off from the closed vessel in which it has been liquefied. The gas thus evolved carries over no sulphur, and is led through a suitable pipe into a solution of alkali or milk of lime, and the usual process of manufacture of acid sulphite solutions carried through.

—H. S. P.

Improvements in Apparatus for the Manufacture of Chlorine. P. de Wilde, A. Keyehler, Brussels, Belgium, and F. Hurter, Widnes. Eng. Pat. 17,659, October 15, 1891.

IN the De Wilde and Keyehler process for manufacturing chlorine (this Journal, 1890, 510), alternate currents of air and hydrochloric acid are passed through one heater at different temperatures. Considerable wear and tear is thus caused on the apparatus. This can be remedied to a certain extent by having separate heaters for the respective gases, but there still remains a certain wear and tear on the idle heater. The proposition is to work two heaters, one for air and one for hydrochloric acid, each connected with two cylinders, for containing the decomposing material, and with means for putting either heater in communication with each such cylinder alternately, and for drawing off the gases from each such cylinder conjointly. This is managed in such a way that air or hydrochloric acid can be turned on either decomposer; and whilst one of the decomposers produces weak chlorine, the other turns out strong chlorine, both uniting into a common main and giving a continuous stream of chlorine of uniform quality.—H. A.

An Improvement in the Manufacture of Bay Salt. A. MacNab, Cocanada, India. Eng. Pat. 10,851, June 8, 1892.

WHEN salt is produced by evaporation of sea-water there is always mixed with it other salts, chiefly magnesium chloride, which being of a deliquescent nature absorb moisture and render the salt damp. The invention consists in removing this impurity by placing the damp salt in the drum of a centrifugal machine having its outer wall of perforated metal or wire gauze, which may be lined internally with a porous fabric. The drum is then revolved and brine is poured into it, which is caused by the centrifugal motion to filter through the salt and to pass through the porous drum, carrying with it most of the magnesium chloride, which is more soluble than the salt. When the salt is very wet the addition of brine is unnecessary.—H. S. P.

Improvements in and Relating to the Manufacture of Crude Acetone. C. Lowe, Reddish. Eng. Pat. 12,660, July 9, 1892.

IT is proposed to submit to destructive distillation the acetates of strontium or magnesium instead of the acetates of potassium, sodium, calcium, or barium, hitherto employed. The resulting crude distillate is larger in quantity and of higher quality as regards the percentage of pure acetone present, and is also more free from empyreumatic or other by-products of decomposition. Any carbonic anhydride simultaneously evolved during the process of distillation, is separated by drawing or forcing the vapour of crude acetone over or through aqueous solutions of the alkalis or of their hydroxides, either in a pulverulent or semi-fluid state contained in covered vessels, whereby the carbonic anhydride is absorbed, afterwards condensing the vapour of crude acetone in an ordinary worm or surface condenser. Any crude acetone mechanically retained by the alkali is subsequently expelled therefrom by a current of steam or direct heat supplied in or to the vessels containing the absorbing agents. The patentee further proposes to utilise the by-products of the destructive distillation either after separation by fractional distillation from or while still mixed with the acetone of the crude acetone, obtained by employing them for the solution of copal or other suitable gums or resins for the preparation of varnishes, paints, enamels, cements, and the like.—D. B.

Improvements in the Manufacture of Vinegar and in Apparatus therefor. E. Küchenmeister, Zittau, Germany. Eng. Pat. 12,884, July 13, 1892.

THE apparatus consists of a wooden vat fitted with a cover which is hermetically closed and nearly full of the usual shavings.

The vinous liquid to be aceticated is discharged into the upper part of the vessel in a state of very fine division, which is produced by a current of air suitably applied, and which may be heated to any required temperature.

The excess of air passes off through a tube, by which it is first led through water to deprive it of any acetic acid or alcohol which might be carried away by it.

It is claimed that complete acetication is attained by one passage through the apparatus, so that a large quantity of liquid can be dealt with in a very short time.—A. L. S.

Improvements relating to the Manufacture of Sulphate of Ammonia. W. Malster, Catford. Eng. Pat. 13,208, July 19, 1892.

For the purpose of conveying ammonium sulphate from the bottom of the saturator on to an elevated drainer, a lead syphon is used, the vertical arm of which dips in the saturator, whilst the other arm delivers on the drainer. This end is closed with a metal plate valve hinged at the top. The syphon pipe, somewhat past the bend, is connected to a vacuum pump; each upward stroke of the pump fills the syphon with crystals, and each down stroke empties the arm leading to the drainer.—H. A.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Oxygen in Glass Manufacture. Eng. and Mining J. 54, 413.

Recent experiments show that the introduction of pure oxygen gas in the crucible greatly facilitates the melting of glass; in fact, an economy in fuel of 30 per cent. is claimed.

The gas is contained in steel cylinders under a pressure of 120 atmospheres, the flow being maintained at a uniform pressure of $2\frac{1}{2}$ atmospheres by a regulator. The gas is introduced into the crucible through a platinum tube, which terminates in a spiral perforated on its under side. The gas is at first introduced very slowly, the quantity being gradually increased toward the last. The effect is to hasten the operation and promote the chemical combination of the different constituents. According to the figures given, 100 kilos. of glass require 600 litres of oxygen.

The glass made by the aid of oxygen is claimed by the workmen to be more easily workable, but the main advantages of the method are rapidity of fusion, which permits of an increased number of fusions per crucible, and in the rapid clearing of the melt, giving a glass free from air bubbles.—W. S.

PATENTS.

Improvements in the Manufacture of Cloth used for Press Sheets, Filtering Sheets and other similar Purposes. Sir E. Armitage and Sons, Lim., and P. Dunkerley, Pendleton. Eng. Pat. 10,643, June 23, 1891.

This invention relates to the strengthening at various places subjected to extra pressure the press sheets used in the manufacture of porcelain. The object is attained by using a double warp or weft, by doubling over and stitching down the cloth, or by sewing on an extra thickness.—E. J. B.

Improvements in and Applicable to Filter-Press Cloth, chiefly intended for Use in Filtering "Slip" for making Pottery's Clay. W. T. Lucas, Burslem. Eng. Pat. 6224, March 31, 1892.

These cloths are made in one piece, and are strengthened by a patch sewn on to the middle; a hole is made in the centre through which the slip-tap nozzle may be placed; the periphery of the hole is protected by two metallic collars which are placed on opposite sides of the cloth and clenched together.—J. C. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

PATENTS.

Improved Fire-Extinguishing and Fireproofing Compound. O. G. Hunkel, Besingo, Austria. Eng. Pat. 13,117, August 1, 1891.

A quick, reliable, and trustworthy fire-extinguishing compound may be obtained by mixing, and diluting to 22 gallons, solutions of about:—

	Lb.
Ammonium chloride in 1·4 gallons soft water.....	2·204
Burnt alum in 2·2 gallons soft water.....	0·770
Cryst. ammonium sulphate in 1·1 gallons soft water.....	0·140
Sodium chloride in 8·8 gallons soft water.....	4·408
Sodium bicarbonate in 1·1 gallons soft water.....	0·770
Sodium water-glass (liquid).....	9·920

—H. A.

Improvements in the Manufacture of Artificial Wood. P. A. H. Wehner, Dresden. Eng. Pat. 10,196, May 28, 1892.

ARTIFICIAL wood is prepared by mixing together sawdust, wood shavings, jute, flax, cotton, or waste animal matters with a solution of magnesium chloride and burnt and powdered magnesite.—E. J. B.

A New or Improved Heat-Insulating and Waterproof Material. E. Biernath, Charlottenberg, Germany. Eng. Pat. 13,702, July 22, 1892.

SEVENTY parts of infusorial earth, 10 parts of woollen waste, and 20 parts of "calf's hair" are worked into a thin paste with water, and if desired a colloid solution of any suitable kind. The composition is made into sheets about one-fiftieth of a millimetre in thickness, the sheets being cast on each other until a plate of about 4 millimetres in thickness is obtained, and the composite sheet subjected to a pressure of at least 12 atmospheres to free it from water, any remaining being driven out by heating. Ground asphaltum is mixed with a little "asphaltum oil," brought to its boiling point, and brushed on to the plates. Gravel or stone chippings about the size of barley grains are then strewn over their surface. The product is said to be suitable for lining silos and covering damp floors and walls.—B. B.

An Artificial Stone Composition. J. E. Keseling and C. Fuchs, New York, U.S.A. Eng. Pat. 15,147, August 23, 1892.

225 lb. of sand are mixed with half a gallon of a solution of asphaltum in turpentine, and with a mixture of 75 lb. of magnesia and 5 gallons of a solution of magnesium chloride, and 3—4 gallons of albumen dissolved in water at 150°—160° F., gradually poured in. The product is used as an artificial stone. The proportions may be varied.—B. B.

Improvements in or Relating to Decorative Artificial Stone for Forming Pavements and for other Purposes. W. F. Thomas, Dolgvan, Wales. Eng. Pat. 15,281, September 9, 1891.

THE process patented consists in forming letters or devices throughout the whole depth, from back to front, of artificial stones, by the insertion of suitable moulds and mixtures of ground stone with cement and the like, and the withdrawal of the moulds while the matrix is in a plastic state. The device may be used for the lettering of street names, tombstones and advertisements.—B. B.

X.—METALLURGY.

The Action of Carbon Monoxide upon Iron. Guntz.
Bull. Soc. Chim. **13**, 1892, 278—281.

THE action of carbon monoxide upon iron has been studied by many observers on account of its metallurgical importance. Stammer found that on passing carbon monoxide over oxide of iron heated to a temperature below the softening point of glass, a considerable quantity of carbon in a bulky state was obtained as well as metallic iron. Deville has recorded the fact that when iron is heated in carbon monoxide a deposit of carbon is formed upon the cooler parts, while those which are hotter are unaffected. Lowthian Bell has shown that when the oxides of iron, nickel, and cobalt are reduced by carbon monoxide, carbon is always set free. Some years later Grüner stated that pure iron does not decompose carbon monoxide free from carbon dioxide, but this was refuted by Schützenberger. Deville's observation is explained by the fact that the heat evolved by the reaction $\text{Fe} + \text{CO} = \text{FeO} + \text{C}$ decreases as the temperature rises and disappears or becomes negative at high temperatures. Failure to accept this view is due to the erroneous assumption that a substance stable at high temperatures is similarly resistant to chemical action. Thus carbon monoxide is very stable at high temperatures, but it is easily decomposed by oxidisable bodies as its heat of formation is low, 14.4 cal., a quantity of the same order of magnitude as that of mercuric oxide, viz., 15.5 cal. The reason why carbon monoxide is less vigorous an oxidant than mercuric oxide is that, on account of its stability, it is not dissociated when heated, and therefore needs the expenditure of work upon it to start its reducing action. If the metal to be oxidised is obtained in a sufficiently fine state of division, the reaction is much aided. Manganese, for example, burns easily in carbon monoxide when once the oxidation is started. It may be said that the oxidising action of carbon monoxide occurs at temperatures ranging between 100° and 400° C., and its reducing action from 300° C. to a red heat, the molecular state of the metal acted upon and its chemical activity determining the precise limits. Examples of both kinds of reaction are afforded by iron.

When carbon monoxide, at the ordinary temperature, is passed over iron, obtained by distilling an electrolytic iron amalgam in a vacuum at a temperature of about 250° C., iron carbonyl is formed in sufficient quantity to give a mirror-like ring of metallic iron, which is considerably more marked than that formed when iron reduced from the oxalate is used. On raising the temperature to 150—160° C. a part of the gas is absorbed with the formation of ferrous oxide and carbon, the presence of the latter becoming evident on dissolving the contents of the tube in acid. When heating is effected rapidly to about 300° C., carbon monoxide is at first absorbed almost completely, but afterwards, as the reaction diminishes, carbon dioxide is produced in small quantity, as a product of the reduction of oxide of iron by carbon monoxide. The reduction is never complete, as the action is reversible. Iron reduced from the oxalate or oxide gives the same reaction, but more feebly, its inertness increasing with the temperature at which it was originally reduced. Mechanically comminuted iron will behave similarly, though still less vigorously.

By these results certain phenomena in the smelting of iron may be explained. In one zone of the blast furnace spongy iron comes into contact with carbon monoxide yielding ferrous oxide and carbon; in another zone this ferrous oxide is reduced by carbon monoxide, giving spongy iron and carbon dioxide; finally, on reaching a zone of higher temperature, the finely-divided iron and carbon unite to form carburetted iron.—B. B.

Iron Carbonyl. Berthelot. Bull. Soc. Chim. **7—8**, 1892, 434—435.

METALLIC iron reduced from precipitated ferric oxide at the lowest possible temperature, or from ferrous oxalate by heating and subsequent completion of the reduction in hydrogen, is acted on by carbon monoxide at a temperature

of 45° C., the gas, after passing over the iron, containing sufficient iron to cause it to give a brighter flame than is usual. The flame has a characteristic spectrum, and deposits iron (partly oxidised) upon a piece of porcelain thrust into it. On passing the ferruginous gas through a narrow heated tube, a ring of iron, containing a little carbon, is deposited. Evidence is thus afforded of the existence of iron carbonyl (this Journal, 1891, 644), which helps to explain certain metallurgical phenomena such as the transference of carbon in the cementation process.—B. B.

Nickel Carbonyl. Berthelot. Bull. Soc. Chim. **13**, 1892, 431—434.

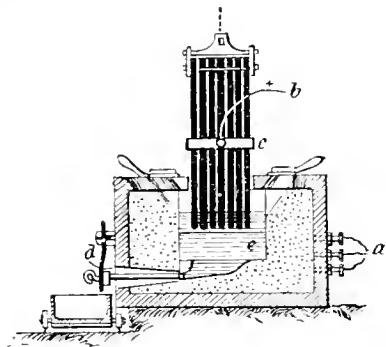
THE vapour tension of nickel carbonyl (boiling point 46° C.) at 16° C. (this Journal, 1890, 808), is about one-fourth of an atmosphere. A drop of the liquid allowed to evaporate spontaneously forms a certain quantity of crystals, which consist of the solidified substance, and speedily volatilise on continued exposure. It has no sensible tension of dissociation at the ordinary temperature, but in contact with air oxidises rapidly. The precise mechanism of oxidation varies according to the conditions under which it takes place. For example, when an inert gas, charged with the vapour of nickel carbonyl, is passed through a strongly heated tube, the products are metallic nickel and carbon monoxide, as observed by Mond and his colleagues (this Journal, 1892, 750). The same chemists have found that when nickel carbonyl is heated sharply to 70° C., at which point detonation takes place, the same bodies are formed. The author, however, has observed, that a certain amount of carbon dioxide and carbon is produced. He is of opinion that this reaction determines the occurrence of the detonation, as the equation $2 \text{CO} = \text{CO}_2 + \text{C}$ implies the evolution of 38.8 cal., i.e., 77.6 cal. for the 4 mols. of carbon monoxide in $\text{Ni}(\text{CO})_4$. The only assumption necessary to justify this view is that the heat of combination of Ni and CO is less than 77.6 cal.

The reactions of nickel carbonyl are generally those dependent upon the presence in it of nickel, but when they are induced gently and at a low temperature, bodies comparable to organo-metallic compounds are formed. The vapour of nickel carbonyl is not sensibly soluble in water or dilute acid or alkaline solutions or cuprous chloride. Hydrocarbons are its natural solvents; spirits of turpentine is specially suitable, and can be used for determining it. Explosion of a mixture of nickel carbonyl and oxygen can be effected by violent agitation over mercury as well as by direct ignition. Slow union takes place when such a mixture is kept in contact with a little water. In contact with strong sulphuric acid dry liquid nickel-carbonyl explodes after a short interval, but if in the form of vapour and diluted with nitrogen it is decomposed gradually, the theoretical quantity of carbon monoxide being liberated. Strong caustic potash has no perceptible action on nickel-carbonyl. Gaseous ammonia does not act immediately *per se*, but if a little oxygen be added fumes are produced, and if the action of oxygen be continued, a whitish deposit of complex composition and destroyed with charring on being heated, is gradually formed.

Sulphuretted hydrogen acts on nickel-carbonyl vapour, mixed with nitrogen in the cold, a black sulphide (of nickel) being precipitated. Phosphoretted hydrogen under similar conditions gives a brilliant black deposit. Nitric oxide gives rise to a very notable reaction. When nitric oxide is mixed with nickel-carbonyl vapour, diluted with nitrogen, or passed into the liquid itself, blue fumes, which fill the whole vessel, are produced. The formation of nickel carbonyl proves carbon monoxide to be capable of forming organo-metallic compounds similar to those derived from hydrocarbons, and is analogous to that of the salts of rhodizonic and croconic acids produced by the union of the condensed derivatives of carbon monoxide with an alkaline metal. Further study may elucidate the relationship. Nickel carbonyl serves as a fresh example of the tendency of carbon monoxide to form loose combinations and products of condensation, in virtue of its character as an unsaturated body.—B. B.

The Neuhausen Aluminium Factory. H. Wedding. Ber. d. Ver. z. Beförd. d. Gewerbeff. 1892, 125.

HÉROULT'S process, as employed by the Neuhausen "Aluminium-Industrie-Aktien-Gesellschaft," consists in fusing and decomposing pure alumina by an electric current. The vessel used for the reduction and fusing processes consists of an iron box lined with charcoal, which is connected by the copper wires *a* (see Figure) with the



HÉROULT'S PROCESS.

negative pole. The lower ends of a number of carbon-rods, serving as anode, are placed vertically in the box, as shown in the figure, the rods being held together by a frame *c*, which is connected with the wire *b*. At the commencement of the operation small pieces of copper are placed at the bottom of this vessel, and fused by means of the current. Then alumina is added, which is fused and decomposed by the current. The aluminium produced is run off at *d*, as shown in the figure, and cast into moulds. If aluminium bronze is required, copper and alumina must be added at the same time and in the necessary proportions. The working capacity of the factory is 1,000 kilos. of pure aluminium in 24 hours.—H. S.

Alloys of Iron and Chromium. Including a Report by F. Osmond. R. A. Hadfield. Iron and Steel Institute, Autumn Meeting, 1892.

This paper is a most exhaustive treatise on the above subject, commencing with a review of the early history and experiments, dealing with the various methods of producing ferro-chromium, its crystallisation, magnetic properties and uses, the soundness, hardness, mechanical tests, and applications of chrome steel, the electrical properties of chrome steel wire, and the laws of cooling and fusion of the alloys.

Extensive tables of figures are given, with the results in most cases plotted out into curves.

From a consideration of the methods of preparation it appears that the first step in the production of malleable iron-chromium alloys or chromium steel is to obtain reliable and uniform ferro-chromium. Attempts to obtain chromium steel by adding to, or melting with the bath under treatment chrome ore have practically failed, and until Baur had made a satisfactory ferro-chromium no success was achieved. The production of the latter by the crucible method being expensive it is applied only to making material containing high percentages, the blast furnace being employed in other cases. Alloys as high as 70 per cent. can now be bought and percentages as high as 80 or even 90 have been obtained experimentally. Chrome-iron ore is the most abundant source, and is found in Shetland, Uist and Fetlar; near Portsoy; at Var in France, Silesia, Bohemia, the Ural, New Caledonia, Maryland, Sydney, and California. It contains about 40 to 50 per cent. of the oxide. Large supplies also come from Brusa and Harmanjick, in Asia Minor. In California during the last seven years about 15,000 tons were raised, but the production is falling off owing to competition. The Tasmanian Iron and Charcoal Co., about 1872, produced in their blast furnaces iron containing

7 per cent. of chromium, but as the chromium converted all the carbon present into the combined form, and they could get nothing but a hard white pig-iron, of little use for foundry purposes, and which could not be puddled or converted into steel, they came to grief. Several hundred tons of the pig-iron were shipped to England, however, and as an alloy its use was beneficial for special purposes. The Ilfracombe (Tasmania) deposit is remarkable and on a very large scale. The ore is valued at the mines at 5s. per ton, and could probably be delivered in England for 15s. to 20s. per ton.

In 1869, Baur, produced ferro-chromium of 21 to 26 per cent. The ore was finely powdered, mixed with 6 to 8 per cent. pure anthracite or charcoal, and a certain quantity of flux containing calcium or sodium fluoride and lime or borax, and melted at a high temperature in plumbago crucibles. In 1875 Kern produced 74 per cent. ferro-chromium by melting Uralian chrome-iron ore with charcoal. Brustlein more recently prepared 84 per cent. alloy from specially prepared ore, which added greatly to the cost. 28 to 30 per cent. ferro-chromium has been sold at 25l. per ton, while 66 to 70 per cent. metal prepared in crucibles ranges from 90l. to 100l. per ton. The author found by experiments made 8 or 9 years ago, how comparatively easy it is to partially reduce chromium from the ore. About 40 lbs. grey hematite pig-iron was melted in a crucible and in an hour and a half 20 lb. of chrome ore was gradually stirred in. 4.37 per cent. chromium pig-iron, showing almost a spiegel fracture was formed. 15 lb. of chrome ore produced a similar effect, while, singularly, with 10 lb. the grey nature of the iron was unchanged, and no chromium was reduced.

In the blast furnace, in the latest and best practice, it is found easier to reduce chromium from its oxides than manganese, but to obtain high percentages of chromium, *e.g.*, 30 to 40 per cent., is much more difficult than that of 80 to 84 per cent. ferro-manganese, and requires much more fuel. The cause appears to be that ferro-chromium requires a considerably higher temperature for fusion, and through the practical necessity of allowing little or no chromic oxide to get into the slag, for it is found that even with so little as 5 per cent. the metal would not be fluid enough to flow from the furnace. It has been suggested that the presence of slag containing much oxide of chromium in contact with the fused metal tends to decarbonise or desilicise it and so to decrease its fusibility. If so, chromium behaves like iron rather than manganese. In any case large quantities of fuel must be used, and the reduction of the chromium oxide must be quite or nearly complete. In the case of ferro-manganese or spiegel more than 80 per cent. of the manganese is seldom reduced, but its oxide fluxes readily into the slag. Holgate found on reducing a mixture of iron and manganese as well as iron and chrome ore with carbon and flux in crucibles, all the iron and chromium were reduced in the one case, but only about two-thirds of the manganese in the other.

In practice more than three tons of coke per ton of ferro-chromium are required, much experience being necessary before high percentages can be obtained, and also very high temperatures of blast, *e.g.*, 1500° to 1600° F., to produce the necessary temperature for fusion. To form the slag, large quantities of alkaline carbonates, fluorspar, borax or lime are necessary. It has been stated that some of the ferro-chromium produced on the Continent is made by mixing a good quality of Bessemer slag with the chrome ore.

F. Osmond reports that "it appears that the chromium interferes with and impedes the crystallisation of the iron to a considerable extent, in this way reacting upon the structure:—(1) By the absence of Sorby's alternating lamellae. (2) By the absence or diminution of crystallised structure as shown by Brustlein in his publications on chromium steels." This action persists at all temperatures, but is more marked when not above about 1,000° than when at 1,200° C. or above. Small amounts under 0.5 per cent. are relatively more active than medium amounts; in the former case the chromium appears to be dissolved; dilute nitric acid dissolves the steel without leaving a residue. According as the amount of chromium increases, the compound

of chromium, iron, and carbon, only partially attacked by acid and possessing great hardness, appears to be formed. This hard compound may even be isolated in the form of globules.

General conclusions.—It appears to result from all the experiments that chromium may exist in at least three states, separately or simultaneously:—(1), as dissolved chromium; (2), as a compound of iron, chromium, and carbon in the form of isolated globules; (3), also the same condition in the form of a solidified solution. Pure chromium dissolved in pure iron seems to have no physico-chemical action, and would not have any other effect than that of interfering with the crystallisation of the iron, but this is extremely interesting as regards the mechanical properties. The triple compound as isolated globules imparts to the more malleable matrix a certain degree of hardness, combined with the relative plasticity of the matrix itself. The same compound when dissolved, owing to the introduction of carbon into the molecule, behaves like a body of small atomic volume, from which results the general or partial hardness of the whole, according to the proportions of chromium and carbon, and the more or less regular diffusion of the compound. The isolation of this compound presents great difficulties, as it is more or less attacked by all the reagents which have been tried. However that may be, the behaviour of chromium from the chemical point of view does not stand alone, for many bodies combine with iron, or with iron carbide, forming definite compounds which may be either dissolved in the mass of iron, or separated as free constituents, when the alloyed body is present in sufficiently large proportions. One of the peculiarities of chromium is its property of remaining free or combining with carbon, so passing from the class of bodies with high atomic volume to that of bodies with small atomic volume. It is difficult to foresee where these peculiarities will find new practical applications, but it seems evident that the scientific study of chromium steel, together with its mechanical properties, would introduce a greater degree of regularity and certainty in its manufacture.—A. W.

A New Process for the Purification of Iron and Steel from Sulphur. E. H. Saniter. Iron and Steel Institute, Autumn Meeting, 1892.

THE author in September 1890 commenced a series of experiments with the object of removing sulphur from iron. At first lime was tried but the effect was very irregular and imperfect. Remembering that many chlorides, *e.g.*, aluminium chloride, are easily reducible it occurred to him to try the action of calcium chloride, and he soon found that calcium chloride and lime, which he calls the "oxychloride," formed a very powerful desulphurising agent, being very rapid in its action and reducing the sulphur in the two experiments cited from 0.42 per cent. to a mere trace in half an hour. A mixture of 90 per cent. lime, and 10 per cent. calcium chloride was used which did not fuse but only softened.

The process on a larger scale is carried out as follows—calcium chloride and lime are mixed, and ground to a moderately fine powder in such proportion as to fuse readily at the temperature of the iron to be acted upon. About equal parts of each are required. The mixture is placed on the bottom of the ladle or receiver, and consolidated by heat or kept in position by any suitable means. At first a blow-pipe arrangement, using blast and furnace gas, may be used but when in continuous use the ladle retains sufficient heat to consolidate the mass. The iron, which may be drawn direct from the blast furnace, is run in, and the mixture, becoming melted, rises through the molten iron to the surface, carrying with it as sulphide of calcium nearly the whole of the sulphur. About 25 lb. each of lime and calcium chloride are sufficient for every ton of iron. Three tons of iron were treated at one time, and even when the first or coldest iron from the furnace was used, no "skull" was made, hence it may be concluded that larger masses would never "skull." The uniformity of the results was very marked as shown by a number of analyses cited, the results showing reductions from 0.220 per cent. sulphur to 0.060 per cent. from 0.300 to 0.060 per cent. and from 0.070

to 0.006 per cent. while the average of eight successive experiments with basic iron was from 0.077 per cent. to 0.022 per cent. The average elimination of sulphur was 73.6 per cent. and of silicon 35.8 per cent. The percentage composition of an average slag was calcium chloride 39.1, calcium sulphide 5.8, lime 38.6, and silica 12.9. Much of the calcium chloride in the slag can be washed out for further use. The ladle was of 4 tons capacity and lined with ordinary fire-bricks, but appliances are being constructed to deal with the whole product of the furnace as the metal is run. The plant is simple and inexpensive in character, consisting of ladles on wheels. The cost of materials is about 6d. per ton of iron treated, but against this cost may be set the cheaper production and enhanced price of the purer pig iron.

The process can be used for the purification of steel in the ladle after leaving the converter, and for the purification of hematite, basic, or common irons as they run from the blast furnace or cupola, producing an iron low in sulphur and silicon, suitable for direct steel-making. It is well established that in the "basic open hearth" process as ordinarily worked no sulphur is eliminated, and when ore containing much sulphur is used for feeding, sulphur is taken up, and the steel may contain even twice as much sulphur as did the scrap and pig iron originally used. The author states, however, that his process applied to the basic open hearth not only prevents increase but causes elimination of sulphur. For this to occur soon after melting a very basic slag, containing 50 to 60 per cent. of lime must be obtained, and suitable quantities of calcium chloride be added, when under these conditions irons and minerals containing sulphur may be used.

In 14 samples before treatment the amount of silicon varied from 0.04 to 0.65 per cent., the sulphur from 0.05 to 0.76 per cent., and the phosphorus from 0.05 to 3.5 per cent. After treatment the silicon (average 0.23 per cent.) was always reduced to traces, the sulphur from the average of 0.36 per cent. to an average of 0.045, and the average phosphorus from 2.3 per cent. to 0.038, the proportional reduction in the samples being very uniform. The steel has been sold for all purposes for which open-hearth steel is used, and found fully equal to that produced from the pure cast irons. The commonest iron scrap and ore may be used, and the use of common iron high in sulphur and low in silicon and carbon has the advantage that less steel scrap and a smaller quantity of ore for feeding are needed. The cost of calcium chloride is about 1s. per ton of ingots produced, while owing to the saving in cost of materials and in the quantities of scrap and ore there is really a saving of 4s. per ton. Neither hearths nor brickwork of furnaces and regenerators are affected by use of calcium chloride. This process is referred to by Stead in his paper (see the following abstract) on the same subject.—A. W.

The Elimination of Sulphur from Iron. J. E. Stead. The Iron and Steel Institute, Autumn Meeting, 1892.

THE author commenced his paper by a review of the present state of our knowledge of the occurrence of sulphur in the materials used in the smelting of iron ores, and the conditions under which it passes into the iron. In the coal the sulphur occurs in two forms:—(1.) as pyrites, the amount in that form being reduced by crushing the coal and washing out the pyrites before coking, and during the coking process; (2.) as sulphate of lime.

The low price of pig iron, and small profits thereon, prohibit the use of expensive methods of removing the sulphur from the ores. Magnetic ores can be separated from pyrites by crushing and the use of magnetic machines, but the powdered ore tends to choke the driving of the furnace and to choke the flues, whilst the increased blast pressure would increase the amount of dust carried into the flues. Calcining causes the elimination of sulphur as sulphur dioxide, but careful observation at Eston has shown that if carbonate of lime be present in the ore, the sulphur dioxide expels carbonic acid and sulphate of lime is formed, no sulphur being expelled, while the quantity is sometimes increased by retention of the sulphur dioxide from the coal used in calcining. There is no method of removing the

sulphates of lime and baryta from the ore when diffused through it.

The following general facts may be accepted as to the behaviour of sulphur in the blast furnace:—(1) When sufficient lime is present to combine with all the silica and sulphur and the temperature high, practically all the sulphur is retained by the slag; (2) other conditions being constant, as the temperature falls, to produce iron of closer texture more and more of the sulphur passes into the iron; (3) the more basic the slag, the smaller is the amount of sulphur in the iron; and (4) if manganese be charged in with the materials and the temperature be high enough, less sulphur will pass into the iron and more into the slag, this being constantly taken advantage of in producing basic iron in Cleveland and other districts. In the blast furnace when much below a red heat the sulphates of lime and baryta are not materially affected, but near or at a red heat they will be reduced to sulphides, and at a point in the furnace just hot enough to produce the lowest class of white iron capable of being fluid, we may assume that all the sulphur present in any form in the ores passes into the iron. As little coke is consumed before it comes in contact with the blast near the hearth, we may regard its sulphur as being locked up until then, and only when the coke is being burnt can the sulphur pass into the iron. The higher or lower the temperature, the greater or less will be the reducing power of the coke and the greater or less the distance above the tuyeres at which fluid cast iron is produced. During its passage downwards the fluid iron is exposed to higher and higher temperatures, encountering everywhere hot carbon, lime, and basic silicates. Hence it is easily understood how if the reducing power and basic material are sufficient, a high temperature favours the passage of the sulphur into the slag.

After discussing the older puddling processes, the author passes to the consideration of the sulphur in the acid steel-making processes. While Wedding states that sulphur, by the interaction of iron sulphide, silica, and carbon, is eliminated even to the extent of over 90 per cent. as sulphur dioxide, Bell, Howe, the author, and others state that no elimination takes place. In the ordinary English practice of melting in a cupola preparatory to blowing, the sulphur is often increased by 0.01 to 0.06 per cent., and the steel contains more sulphur than the original metal. Baker found that the sulphur at the end of a blow had been reduced from 0.107 per cent. to 0.093 per cent. At Seraing, with metal containing 3.75 per cent. Mn and 0.04 per cent. S, there was no change in the percentage of sulphur, the loss of that element being equal to the loss of metal in blowing. The author believes that the theory that during the first part of the blow the silica oxidises the sulphur must be abandoned, because there never is any free silica present, for it is well known that the magnetic or other oxides produced near the tuyeres are the main agents in removing silicon, which they do at their own expense with the formation of metallic iron and the immediate production of silicate of iron.

In the open-hearth acid process, Snelus, Hardisty, and the author agree that the sulphur is increased by absorption from the furnace gases, and any sulphur in the ore also passes into the metal. Willis found that 30 per cent. of the sulphur in sulphate of baryta contained in the ore passed into the metal. The siliceous slag always present in contact with the metal approximates in composition to that produced in burning out the silicon in the acid Bessemer process, and its having no action in eliminating sulphur in the open hearth completely demolishes the theory that it may have that effect in the converter.

In the basic Bessemer process nearly all observers agree that a notable amount of sulphur is removed. The estimates vary. From an examination of all the results it is ascertained that the larger the amount of sulphur present the greater generally is the amount of elimination, thus—

Per Cent.	Per Cent.
With 0.12 in the pig, the steel contains 0.15 or 0.4 per cent. less,	
" 0.397 "	" 0.085, 73 "
" 0.169 "	" 0.10, 37 "
" 0.09 "	" 0.06, 33 "
" 0.05 "	" 0.05, no change.

Harbord says that in the basic-hearth process 45 to 50 per cent. of sulphur is eliminated, while Hardisty estimates the average reduction at 33 per cent. It would appear that desulphurisation results from one or more of four causes:—(1) that the manganese added in the metal in passing out may carry some sulphur with it; (2) that the manganese reduced from the slag during dephosphorisation effects an elimination of sulphur; (3) that the calcareous slag in contact with the upper surface of the bath containing carbon may absorb sulphur; and (4) that some of the manganese added in the ferro-manganese does, undoubtedly, leave the bath again, carrying with it a small quantity of sulphur.

The author next considers the processes for the removal of sulphur from iron. Rollett's process consists "in melting pig iron and maintaining it at a very high temperature under a double action, slightly reducing and slightly oxidising, in the presence of a slag obtained by admixture of limestone or lime, iron ores, and fluorspar, in proportions depending on the quality of the pig or castings employed." He states that "the elimination is complete up to 99 per cent. or even more." The process is carried out in a jacketed or basic-lined cupola furnace, coke is the fuel, and a large excess of lime with some fluorspar is used, so that the silica in the slag is not more than 2 per cent. The author considers that probably the very calcareous slags employed are mainly responsible for the elimination.

Desulphurising with alkaline salts.—In Heaton's process fluid iron was poured upon nitrate of soda placed in a receiver and kept in place by a grating. Miller and Snelus found the sulphur was reduced to a trace, and the latter found a considerable amount of sulphate of soda in the slag. In Warner's process a mixture of ground limestone and soda-ash, and small quantities of other materials are used instead of nitrate of soda. Flames of what appears to be sodium burst out from the top of the vessel, and the slags contain some soluble sulphides. In two experiments cited the eliminations were 77 and 90 per cent. In Ball and Wingham's process potassium cyanide, sodium carbonate, or hydrate and metallic sodium were used, showing eliminations from 83 to 100 per cent. (this Journal, 1892, 751).

Massenez' process practically consists in mixing together in a suitable metal-mixer, pig iron, poor in manganese and high in sulphur, with iron containing more manganese and little sulphur, the manganese of the one combining with the sulphur of the other and the sulphide rising to the surface. Analyses of the metal from three furnaces showed respectively of manganese 1.72, 1.30, and 2.50 per cent., and of sulphur 0.15, 0.20, and 0.08 per cent., but after they were mixed the amount of manganese was 1.68 per cent., and sulphur 0.04 per cent. The author in his laboratory melted together 100 parts of ferro-manganese and a quantity of sulphide of iron in a plumbago crucible. After fusion and cooling, the scoria on the surface contained 56 per cent. of manganese, 28 per cent. of sulphur, and 1 per cent. of iron, proving conclusively that the reaction had taken place.

Ordinary foundry iron containing manganese, after melting in a cupola and pouring into large moulds in which it remains fluid for a considerable time, is often richer in sulphur and manganese in the upper portion than in the lower. An analysis by Ridsdale gave in the upper part 0.75 per cent. of sulphur and 1.35 per cent. of manganese, but in the lower only 0.112 per cent. of sulphur and 0.547 of manganese; but strangely the upper part was not white, hence it may be concluded that manganese and sulphur when combined and dissolved in the metal have not the same influence in preventing the carbon becoming graphitic as when in combination with the iron.

Saniter's process (see preceding abstract) is next dealt with by the author, who recently was present during the working of several charges at the Wigan steel works. The limestone added with the pig and scrap is more than in ordinary work, and as soon as the proper amount of calcium chloride is added when the charge is melted, lime and mine are thrown in. The following table illustrates the changes:

—	Calculated Analysis of the Charge.	7.20 after Melting	8.35 after adding CaCl ₂	10.10.	11.30.	Steel.
	Per Cent.	Per Ct.	Per Cent.	Per Ct.	Per Ct.	Per Ct.
Carbon ...	1.67	0.40	0.33	0.22	0.15	0.15
Silicon....	0.15	Trace	—	—	—	Trace
Sulphur ..	0.37	0.36	0.093	0.082	0.058	0.047
Phosphorus	1.67	1.25	1.106	0.343	0.065	0.056
Manganese	0.46	0.22	—	—	—	0.590

The slag, after adding calcium chloride, contained 10.81 per cent. of phosphoric acid and 1.25 per cent. of sulphur, and the steel slag 12.30 per cent. of the former and 0.65 per cent. of the latter. The sulphur removed in 1½ hour, after addition of calcium chloride, was 73 per cent., and the total sulphur removed was 87 per cent. Another charge showed reductions from 0.17 per cent. of sulphur, and 1.07 per cent. of phosphorus, to 0.055 per cent. and 0.048 per cent. respectively, a reduction of 67 per cent. in the amount of sulphur, but in this case there was a deficiency of lime.

A series of small experiments bearing on this process is then described. A small quantity of pig iron containing 4 per cent. of sulphur was heated to whiteness for two hours with lime alone, when all its sulphur was removed. With "the mixture," in one hour 97 per cent. was eliminated, while in two hours 100 per cent. was removed. Ninety-eight per cent. was removed by "washing" or pouring the molten metal into an excess of the mixture, the reduction in this case being from 1.86 to 0.04 per cent. of sulphur. An experiment to ascertain the action of molten iron on calcium chloride showed that oxide of iron formed on the surface of the former, and that the latter was decomposed to the extent that it contained over 14 per cent. of lime at the end of the experiment.

Taking all the facts into consideration, desulphurisation may be the result of one or more of the following reactions:—(1.) The chloride of lime in presence of free lime may be split up in contact with molten iron, the calcium in the "nascent" state may then combine with the sulphur in the iron, the chloride of iron in contact with free lime being converted into calcium chloride and iron oxide; (2) the extra lime in the slag may assist in the change; and (3) the sulphide of iron may simply be dissolved out by the oxychloride. When ordinary slag in the open-hearth process contains more than 0.25 per cent. of sulphur, some of the latter is liable to pass into the metal, and if sulphur is in the ore some of it also passes to the steel, but in this process the slag may contain 1.25 per cent. of sulphur, and yet continue to abstract sulphur from the charge.

In a supplementary paper the author describes many laboratory experiments undertaken to remove all doubt from certain disputed questions. He finds that both at low and high temperatures lime and sulphide of iron react, and that when the fused mixture is melted with silica, sulphide of iron is again formed. Pure iron will extract the sulphur from basic furnace slag if that slag is rendered acid with excess of silica. In smelting hematite with barium sulphate and an acid slag all the sulphur goes into the iron, but the same with a basic slag gives a metal containing only a small quantity.

Calcium chloride is incapable of absorbing sulphur *per se*, but it reacts to a certain extent with sulphide of iron, and in an iron containing 0.4 per cent. of sulphur it reduces it to less than 0.3 per cent. in half an hour. As the chloride on heating in air yields lime, however, it is pointed out that the change in the two latter cases might be due to lime. Strangely enough, calcium fluoride reduces the sulphur in the above iron to the same extent as the chloride when similarly employed.

The author states that it is certain that lime alone can remove the sulphur, which is always found afterwards as sulphide and not as sulphate of calcium. The lime is probably reduced to metallic calcium, which then decomposes the sulphide of iron. This is supported by the fact that the

percentage of carbon is reduced also, which action in some instances takes place in large excess of the proportion required by the calcium sulphide reaction. This, the author suggests, might be due to further oxidation by lime. He inclines to the conclusion that in the Saniter process lime is the acting agent, and that the calcium chloride acts as a vehicle by which the lime is brought into intimate contact with the molten metal.—A. W.

The Chemistry of the Cyanide Process. C. Butters and J. E. Clennell. Eng. and Mining J. 54, 1892, 391—417.

Solubility of Gold in Potassium Cyanide.—Faraday pointed out that gold leaf immersed in cyanide of potassium solution became so thin that it transmitted green light. Prince Bagnatton observed (J. pr. Chem. 31, 367) that the very finely-divided gold obtained by precipitating a solution of the chloride with ferrous sulphate may be dissolved by this reagent. Elsner showed, however (J. pr. Chem. 37, 333), that the presence of oxygen is required for the solution of the gold. A solution is obtained which, on evaporation, yields colourless octahedral crystals of the composition KAuCy_2 (auro-potassium cyanide) which may be looked on as a double cyanide of gold and potassium ($\text{KCy} \cdot \text{AuCy}$). The reaction which occurs may probably be represented by the following equation:—



There are two interesting points indicated by the above equation which may be remembered in conjunction with the application of potassium cyanide as a solvent for gold on a commercial scale.

1. That the quantity of cyanide theoretically necessary to dissolve a given weight of gold is infinitesimal in comparison with the weight actually required in practice. We see then that 130.04 parts by weight of potassium cyanide should be capable of dissolving 196.8 parts of gold, or, approximately, two parts of the cyanide should dissolve three parts of gold. The minimum actual consumption in treating free milling ore, assaying, let us say, 10 dwt. per ton, is about 40 parts by weight of cyanide for 1 part of gold. In the leaching tanks alone a pound of cyanide is generally consumed per ton of material treated.

2. That an extremely small quantity of oxygen is sufficient to bring about the solution of the gold, 15.96 parts being required for 396.6 parts of gold, or one part for nearly 25 parts of gold. The quantity present in a porous mass of tailings, to say nothing of that dissolved in the water used in making up the solution, would be considerably in excess of that actually required for the reaction.

Decomposition of the Cyanide.—How then does it happen that such an enormous consumption of cyanide occurs? In the first place there is the great instability of the simple cyanides. The atmospheric carbonic acid is accountable for a certain amount of decomposition, in which a constant evolution of hydrocyanic acid takes place according to the reaction $2 \text{KCyanide} + \text{CO}_2 + \text{H}_2\text{O} = 2 \text{HCyanide} + \text{K}_2\text{CO}_3$.

Then, again, we must consider the proneness to oxidation which the cyanides exhibit, and which, in fact, lies at the base of most of their technical applications. Potassium cyanide readily changes into cyanate, and ultimately into carbonate—



The presence of alkalis, which always occur in commercial cyanide, tends to induce loss by hydrolysis, which occurs mainly in the zinc boxes, and seems to be induced by this presence of the metal. In this reaction the alkali appears to determine a chemical change in which water plays a part, while the alkali itself is not in the least affected.

The hydrolysis of potassium cyanide, which undoubtedly occurs to a considerable extent when excess of alkali is present in the solution, or has been added to the tailings before treatment with cyanide, gives rise to ammonia and potassium formate.

The smell of hydrocyanic acid, generally noticeable in the neighbourhood of the cyanide tanks, is partly accounted for by the decomposition due to atmospheric carbonic acid. But there are grounds for supposing that in dilute solutions a

dissociation of the cyanide takes place, so that what we term a weak solution of potassium cyanide is in reality a mixed solution of potassium hydrate and hydrocyanic acid $\text{H}_2\text{O} + \text{KCy} = \text{HCy} + \text{KHO}$.

The truth of this theory is supported by the extraordinary fact that a distillation of hydrocyanic acid takes place when a current of a neutral gas (e.g., nitrogen) is passed through a cold dilute solution of cyanide. This being the case, it is evident that hydrocyanic acid, which is an extremely volatile body, must be constantly disengaged from all vessels in which weak cyanide solutions are freely exposed to the air.

Where the agitation or circulation systems are adopted, the consumption must be still greater, since these methods involve a constant exposure of fresh surfaces.

The tendency of the simple cyanides to form double salts with each other, or with other metallic compounds, must likewise be taken into account. Salts of iron, and to a lesser extent, salts of aluminium, magnesium, calcium, and the alkali-metals are liable to occur in tailings, especially such as have been long exposed to atmospheric influences.

We have said enough to show that, even under the most advantageous circumstances, an enormous waste of cyanide must take place. Some of these losses are doubtless preventable; the use of closed tanks and careful attention to the purity, both of the cyanide itself and of the water used for dissolving it, would reduce the extent of the decomposition in a very marked degree.

Action of Cyanide on Pyritic Material.—The surface ores of the celebrated "basket" formation consist almost exclusively of silica and oxide of iron. These occur in the form of rounded quartz pebbles, imbedded in a softer matrix highly charged with ferric oxide, which imparts its characteristic reddish tinge. The gold is found in this matrix associated with the oxide of iron, or sometimes in small scales on the surface of the pebbles. The pebbles themselves carry little or none. At a lower level this "free-milling" basket passes into an ore precisely similar in structure, but much harder, and containing the iron in the form of sulphide instead of oxide, which gives it a peculiar bluish tint.

There can be little doubt that the free-milling ores have been formed by gradual oxidation of the pyrites through the influence of air and moisture during a long period of time, and in fact we see this same change in progress whenever pyritic material has been exposed to the action of the atmosphere.

The pyritic ores likewise contain small quantities of arsenic, copper, and sometimes cobalt and nickel, but the amount of these foreign metals has so far been so small that they have not practically interfered in the cyanide treatment. It is noted as a fact observed in the treatment at the Robinson Chlorination Works of pyritic concentrates purchased from the various gold-mining companies, that copper and arsenic seem to occur in gradually increasing quantities with the increasing depth of the working. These elements may in the future be a source of serious trouble in the application of the cyanide process.

Suppose, now, that we attempt to treat a charge of partially oxidised pyritic tailings directly with cyanide solution. The moisture in the tailings has a distinct acid reaction, chiefly due to the presence of free sulphuric acid. This, of course, liberates hydrocyanic acid.

Ferrous sulphate (green vitriol) reacts upon the cyanide with formation of ferrous cyanide, a yellowish-red flocculent precipitate.

This, however, is under ordinary circumstances slowly converted into potassium ferrocyanide by the excess of cyanide present $\text{FeCy}_2 + 4 \text{KC}y = \text{K}_4\text{FeCy}_6$.

If sufficient acid be present, the ferrocyanide reacts upon an additional quantity of the ferrous salt, ultimately giving rise to Prussian blue.

The appearance of a blue colouration on the surface of the tailings, or in the solution, is a sure indication that acid iron salts are present, and that an enormous waste of cyanide has taken place.

Ferric salts, when present unmixed with any ferrous compounds, decompose cyanide solution with evolution of hydrocyanic acid, and precipitation of ferric hydrate, part

of which is in a finely-divided or possibly colloidal condition, and is with difficulty removed by filtration, as it chokes the pores of the filter.

A mixture of ferrous and ferric sulphates, such as is probably always present in partially oxidised pyritic tailings, causes the appearance of a blue colour on addition of cyanide, after the free alkali of the commercial product has been neutralised, Prussian blue being produced when the ferric salt is in excess, and Turnbull's blue when the ferrous salt is in excess.

Preparatory Treatment of Pyritic Material.—Before attempting to treat such ores or products with cyanide, it is therefore necessary to get rid of the free sulphuric acid and soluble iron compounds. This is generally done by giving a leaching with water until the liquid running off the tanks no longer shows a colouration with ammonium sulphide. After the treatment, however, there still remain the insoluble basic sulphates, which are gradually decomposed by water, and would act upon the cyanide solution. A washing is accordingly given with caustic soda or lime-water, which converts the basic salts into ferric hydrate, and sodium or calcium sulphates.

But the preliminary water-wash may be omitted with a laantage in cases where the quantity of free acid and iron salts is comparatively small. Lime, in the dry state, is sometimes mixed with the tailings before the cyanide treatment commences. When this method is adopted, the iron is precipitated as a mixture of ferrous and ferric hydrates.

After the washing with alkali is complete, the tanks are allowed to drain, and "strong cyanide solution" (about 6 per cent.) is pumped on. Even after this treatment, the consumption of cyanide, with moderately pyritic tailings which have been partially decomposed by exposure, is found to be four times that which occurs with free-milling material. The presence of a large excess of alkali in the solution brings about various secondary reactions which lead to a loss of cyanide, such as the hydrolysis, before alluded to, and a peculiar action in the zinc box, to be discussed later.

Lime, although slower in its action, is preferable to caustic soda as a neutralising agent, as it is equally effective in decomposing the iron salts, less active in bringing about secondary reactions on the cyanide, and also less energetic in attacking the zinc in the precipitating boxes.

Ferric hydrate does not appear to be acted upon by potassium cyanide, but ferrous hydrate, which is formed in the neutralisation of the iron salts by alkalis, reacts on the excess of cyanide, with formation of ferrocyanide of potassium $\text{Fe}(\text{OH})_2 + 6 \text{KC}y = \text{K}_4\text{FeCy}_6 + 2 \text{KOH}$.

Deposition of Gold from Cyanide Solutions.—Under certain conditions, such as the absence of sufficient oxygen in the solution, a partial precipitation of the previously dissolved gold appears to occur. If by any chance the solution should become acid, there is a decomposition of the double cyanide of gold and potassium, in which the gold is generally supposed to be thrown down as (insoluble) aurous cyanide, e.g. $\text{KAuCy}_2 + \text{HCl} = \text{KCl} + \text{HCy} + \text{AuCy}$.

In working on the circulation and transfer system, it is found that where pyritic material is under treatment, it is not safe to transfer a solution already rich in gold to a fresh lot of tailings, as the extensive decomposition of the solution which takes place may lead to a final loss of gold.

Selective Action of Cyanide.—It is claimed by the promoters of the McArthur-Forrest process, that in a mixture containing metallic gold, silver, copper, and base metals, cyanide of potassium exerts a selective action, dissolving first the gold, then the silver, and afterwards attacking the copper and base metals. The process, however, does not appear to have been successfully applied to ores, such as those met with in California and Australia, which contain considerable quantities of foreign metals. Ores containing sulphide of silver and sulphide of copper produce considerable decomposition of cyanide, the copper being partially dissolved as sub-sulphocyanide, the silver, however, remaining unattacked. In two experiments carried out by Mr. William Bettel, chief chemist of the Robinson Gold Mining Company, on ore from the Albert silver mine containing 30 oz. of silver and 10 per cent. of copper, it was

found that no extraction of silver occurred, this metal being present as sulphide.

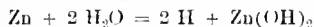
Action of the Zinc Shavings on the Solution.—Theoretically a simple substitution of zinc for gold occurs in accordance with the following equation:—



Taking $\text{Zn} = 65.1$, $\text{Au} = 196.8$, it follows that 65.1 parts by weight of zinc should be sufficient to precipitate 393.6 parts of gold, or 1 lb. of zinc should precipitate about 6 lb. of gold. The actual consumption is about 1 lb. of zinc per ounce (Troy) of gold recovered. It is evident then that zinc is consumed in some other way than in mere substitution for gold.

During the passage of the solution through the zinc boxes a constant and vigorous evolution of hydrogen gas is observed. The outflowing liquid is found to possess a greater degree of alkalinity than it had on entering at the top of the box, and a smell of hydrocyanic acid, and sometimes of ammonia, is constantly observed in the neighbourhood of the zinc boxes. It is clear, then, that a decomposition of the potassium cyanide solution itself by the zinc is in progress, and this is not to be wondered at when we consider the powerful electro-chemical effect which must be produced by the contact of such a highly positive metal as zinc with a strongly negative metal such as gold. It is well known that the "copper-zinc couple" produced by immersing zinc in a solution of a copper salt decomposes water.

An analogous reaction of the gold-zinc couple accounts for the evolution of hydrogen mentioned—



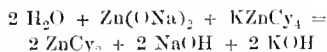
The hydrate of zinc is at once dissolved in the excess of cyanide $\text{Zn}(\text{OH})_2 + 4 \text{KCy} = \text{K}_2\text{ZnCy}_4 + 2 \text{KOH}$, which reaction explains the increase in the alkalinity of the solution.

There are reasons for believing that the black deposit formed on the zinc shavings is an actual chemical compound of gold and zinc, which acts as the negative element in the electric couple, the undecomposed zinc forming the positive element.

When strong solutions of caustic soda have been used for neutralising the acid salts of the ore a white deposit is frequently observed on the zinc. The alkali first attacks the metal to form a zinc-sodium oxide—



This then reacts on the double cyanide of zinc and potassium always present in the solution, and precipitates the white insoluble simple cyanide of zinc—



This reaction is of some importance as affording one means by which the excessive accumulation of zinc in the solutions is avoided.

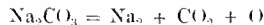
Affinity of Zinc for Cyanogen.—Potassium anrocyanide (KAnCy_2) appears to be one of the most stable of the salts of gold, but the reaction in the zinc boxes shows that the affinity of zinc together with potassium for cyanogen is greater than that of gold with potassium for the same radical. Hence a solution of potassium cyanide cannot dissolve gold which is in contact with zinc; neither can gold replace zinc in a solution of the double cyanide of zinc and potassium. So long as any zinc is present, therefore, we need not fear that the precipitated gold will redissolve in the excess of potassium cyanide flowing through the boxes.

It is evident also that the cyanogen contained in the double cyanide of zinc and potassium is not available for dissolving gold, and when a solution charged with zinc is employed in the treatment of a fresh lot of tailings it is only effective in so far as it contains a certain quantity of simple cyanide of potassium or other alkaline cyanide.

New Methods of Precipitation.—The cyanides of sodium and ammonium, and those of the alkaline-earth metals (calcium, barium, &c.), will dissolve gold, as well as potassium cyanide. Sodium cyanide is more difficult to

manufacture than the potassium compound, but a given weight of it should be more effective than the same weight of potassium cyanide, since 49 parts of the former are equivalent to 63 parts of the latter.

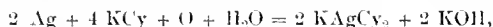
The advantage of Molloy's process and others which employ sodium or potassium amalgam are undoubted. The alkali metal is obtained by the electrolysis of the carbonate between electrodes of lead and mercury—



The sodium forms an amalgam with the mercury. Sodium amalgam may also be manufactured direct from its elements. It is claimed for this method of precipitation that the whole of the cyanogen is restored to a condition in which it is available for dissolving gold, as shown by the reaction $\text{Na} + \text{KAnCy}_2 = \text{Au} + \text{KCy} + \text{NaCy}$.

Composition of the Zinc Slimes.—Any base metals which happen to be in solution in the cyanide liquor are liable to be precipitated by the zinc along with the gold. Hence the "zinc slimes" are found to contain a certain percentage of copper as well as traces of arsenic and antimony. Moreover, any impurities in the zinc will also find their way into the slimes, as zinc will be dissolved by the cyanide in preference to any less oxidisable metals (e.g., tin and lead).

Silver is dissolved by cyanide and reprecipitated by zinc by a set of reactions precisely analogous to those of gold—



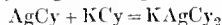
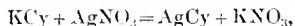
It has been observed that the proportion of silver to gold is greater in the "cyanide bullion" than in the gold from the batteries, and this is explained by supposing that the loss of silver in amalgamation is greater than that of gold.

Treatment of the Zinc Slimes.—The removal of the zinc is a troublesome operation and is only very partially carried out in smelting the dried slimes. The admixture of sand is made for the purpose of forming a fusible silicate of zinc. A portion of the zinc is volatilised, and burns at the mouth of the crucible with a greenish flame, producing the white oxide, ZnO , which is found incrusting the flues, and doubtless carries with it no inconsiderable quantity of gold and silver. The most promising method of treating these slimes appears to be that suggested by Mr. Bettel, of fluxing with acid sulphate of soda and fluorspar.

Attempts to remove the zinc prior to smelting have been only partially successful, as all such methods involve the filtration of a slimy mass which retains soluble salts with great tenacity.

The slags from the fusion of the zinc slimes contain a considerable amount of gold, some of which is in the form of round shots, and may be removed by pounding up the slag, passing through a coarse sieve, and "panning-off." The residue from the first fusion should always be fused again, with addition of lead, to form an alloy with the gold. The same lead-bars may be used for a number of successive fusions of the slag, and when sufficiently enriched, the gold may be recovered from them by cupellation.

Testing of Cyanide Solutions.—It is a matter of importance to determine exactly what strength of cyanide solution is used in treatment of tailings. The ordinary method of testing depends on the fact that silver cyanide is soluble in excess of potassium cyanide, with formation of a double cyanide of silver and potassium—

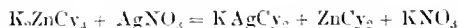


When silver nitrate solution is added drop by drop from a burette to a solution of cyanide, a white precipitate is formed, which quickly redissolves. At a certain stage the precipitate becomes permanent, when, in fact, the whole of the cyanide has been converted into the soluble silver salt, and an additional drop of silver nitrate produces a permanent precipitate of the insoluble simple cyanide of silver, $\text{KAgCy}_2 + \text{AgNO}_3 = \text{KNO}_3 + 2 \text{AgCy}$.

From these reactions 107.66 parts by weight of silver are equivalent to 130.04 parts of potassium cyanide. A

convenient standard silver solution is one of such a strength that every cc., added to 10 cc. of the solution to be tested, corresponds to 0.1 per cent. pure KCy .

This method gives good results when pure cyanide solutions are under examination, but when we come to test solutions containing zinc, it is difficult, if not impossible, to determine the end of the reaction. A white flocculent precipitate occurs at a certain stage, probably consisting of simple (insoluble) cyanide of zinc, formed by decomposition of the soluble double cyanide—



This precipitation occurs long before the whole amount of potassium cyanide has been converted into the soluble double salt of silver (KAgCy_2), for the solution, after the appearance of the flocculent precipitate, still gives the Prussian blue reaction with acidulated ferrous sulphate. A standard solution of iodine in potassium iodide may be used with great accuracy for determining the total amount of cyanogen in a solution, whether in combination with zinc or not, making use of the reaction—



The colour of the iodine is discharged so long as an excess of cyanide is present. The sharpness of the end reaction may be increased by adding a small quantity of starch to the solution under examination, which gives a permanent blue colour as soon as an excess of iodine has been added.

What is most needed, however, is a rapid method of determining the amount of cyanide available for dissolving gold, for, as was pointed out already, the cyanide in combination with zinc is not available for that purpose.

The method of testing solutions containing zinc for "available cyanide," which was introduced by Mr. Bettel at the Robinson General Mining Company's works, is as follows:—Two perfectly clean flasks of equal size are taken. To each of these is added a considerable bulk, say 50 cc. of the solution to be tested, and 50 cc. of water. The liquid in both flasks will probably appear slightly turbid, but the degree of turbidity will be the same in each. Standard silver nitrate solution is run into one flask until the slightest possible increase in turbidity is observed on comparison with the liquid in the other flask. This point is taken as indicating the conversion of the whole of the free potassium cyanide into the soluble silver salt, and, therefore, as determining the amount of available cyanide present in the solution.

The amount of gold in the solution is generally found by evaporating a known bulk with litharge, fluxing the residue, and cupelling the resulting lead button. Evaporation on lead foil may likewise be employed.

Poisonous Properties of Cyanide.—The men employed in the "clean-up" and in melting the slimes are subject to a peculiar eruption, especially on the arms, and complain of headache, giddiness, and general depression. Ferrocyanide of potassium has been recommended as a remedy for the eruption; it may be taken internally and also applied as a lotion. Considering the dangerous nature of the substance, it is remarkable how few fatal accidents have occurred through the use of cyanide on a large scale. In cases of poisoning, precipitated carbonate of iron, obtained by mixing solutions of sodium carbonate and ferrous sulphate, may be used as an antidote. This forms internally an insoluble blue compound with the cyanide.

Hydrocyanic acid acts directly on the nervous system, causing instant paralysis; hence any treatment which will excite the action of the nerves, such as application of cold water to the spine, inhalation of ammonia, &c., may be tried in cases of faintness produced by breathing the vapour of the acid.

The disposal of waste cyanide liquors is a matter for serious consideration. Solutions containing 0.1 or 0.2 per cent. of potassium cyanide must occasionally be discharged, and are likely to contaminate the water of the dams or streams which receive them to a dangerous extent. If some effective means of precipitating the zinc, or, better still, of dispensing with the use of zinc altogether could be

devised, there would never be any necessity for allowing cyanide liquors to leave the building (this Journal, 1891, 93—98).—W. S.

The Cyanide Process in South Africa. C. Butters and J. E. Clennell. *Eg. and Mining J.*, October 1892, 341—342, and October 15, 365—366.

The following is a description of the process as carried out by the Robinson Gold Mining Company:—

Solution of the Gold.—When the cyanide process was first introduced about two years ago, it was thought necessary to agitate the material under treatment with the cyanide solution. At the present day the "percolation" system is almost invariably adopted. The operation is carried out by the African Gold Recovery Company, who represented the patentees in South Africa, as follows:—The damp tailings, taken from the tailings pits, are charged into wooden vats of a capacity of 35 to 50 tons; these vats are usually square. The best works are now building circular tanks. Those at the Robinson works have a capacity of 75 tons; those now in use at the Langlaagte Estate have a capacity of 400 tons, and still larger vats are being constructed for the cyanide works at the New Primrose mine. The vats are filled to within a few inches of the top, and the surface of the tailings levelled. Cyanide solution of 0.6 to 0.8 per cent. strength is then allowed to flow into the tank until it is completely filled. The ore settles from 3 in. to 1 ft. below the rim of the tank (the amount of shrinkage depending on the depth of the vat). This solution is allowed to remain undisturbed, in contact with the ore, for 12 hours. Each vat is provided with a false bottom—usually a wooden framework covered with cocoanut matting. Below this is a layer of coarse sand and pebbles through which the solution percolates. An iron pipe communicates with the vat below the false bottom, and conveys the filtered solution to the "zinc boxes," where precipitation takes place.

The dilute cyanide solution does not attack a wooden vat, nor does it corrode the iron piping to any appreciable extent. As to wear and tear of apparatus the use of cyanide offers decided advantage over chlorine or chlorine water. Brass plungers and valves, such as are in use in ordinary pumps, are attacked, but not very rapidly. The pumps at the Robinson works were in use for four months with comparatively little wear, but iron is, of course, preferable for all pump fittings where cyanide solution is used. As the liquor is drawn off during the leaching process it is replaced by fresh solution. This operation is continued for a longer or shorter period, depending on the value of the tailings (about six to twelve hours).

At the end of this period, which is known as the "strong solution leaching," a weaker solution (containing 0.2 to 0.4 per cent. of cyanide) is turned on, and allowed to filter through the ore for about 8 to 10 hours. This "weak solution" is then drawn off through another zinc box. Finally, a quantity of water is run into the tank, more or less equivalent to the amount of moisture which the ore contained when the tank was filled. This last water-washing displaces the weak cyanide solution, so that the volume of cyanide solution in use remains unchanged. The "weak solution" is, in fact, the liquor which has previously passed through the zinc boxes into the receiving tanks or "sumps," and has been pumped again to the leaching tanks. The cyanide is usually contaminated with carbonaceous matter and iron, but contains 72—78 per cent. of pure potassium cyanide.

The actual amount of cyanide used is about half a ton of strong (0.6 to 0.8 per cent. solution) and half a ton of weak (0.2 to 0.4 per cent.) solution for every ton of ore treated. As the amount of cyanide actually entering into combination with gold and silver is almost infinitesimal in comparison with the quantity consumed in the different stages of the process, it will be obvious that there is still considerable scope for inventive genius in determining the conditions of economical working. When the final water-wash has been added, and has displaced the weak solution, the "exhausted tailings" or "residues" are discharged, usually by the somewhat tedious process of shovelling out over the side. A truck-line runs across the top, or by the

side of the tank to receive the discharged tailings, which are then removed and deposited outside the works. The tank is then ready for a fresh charge.

The "percolation system" has been modified in various ways.

One of the first difficulties in the application of this process arose when tailings were treated containing a small percentage of pyrites, which by exposure to the air had become partially converted into sulphate of iron and free sulphuric acid. The difficulty could be minimised by treating tailings direct from the battery, first with water and then with some alkaline solution, such as lime or caustic soda. At the Robinson works lime was found to be in every way preferable to the stronger alkali, as it is less active in inducing the decomposition of the cyanide solution in the tanks, and in attacking the zinc used in the subsequent precipitation. It was, moreover, found that 20 tons of solution sufficed to fill a tank holding the usual charge of 75 tons of tailings, covering the charge to a depth of 3 or 4 in. Instead of replacing this 20 tons of solution by fresh cyanide, the solution filtering through was continually pumped back again into the same tank for about 36 hours, and then passed through the zinc box. The extraction of gold by this circulation system was equal to that obtained by the ordinary method, and the consumption of cyanide was much less, since a much smaller quantity of solution was exposed to the action of the zinc. A further modification suggested itself, namely, the transference of the solution charged with gold, from one tank to a second and third, in order that it might take up an additional quantity of gold from fresh tailings, before passing into the zinc boxes. The advantages of this method are that the solutions from which the precipitate is obtained are much richer in gold, giving a cleaner deposit on the zinc, with much less consumption of cyanide.

The usual practice, as we have pointed out, is to dissolve the cyanide in a special tank set apart for that purpose. At the Robinson works the strength of the cyanide solution is kept up by adding cyanide in lumps, dissolving it under the steam from the pump. By this method a cyanide solution of required strength is formed in the leaching tank itself, and not in the pump. This simplifies the operation, and diminishes the number of tanks required in the treatment. It also furnishes an easy means of getting rid of the insoluble impurities of the cyanide (the so-called carbide of iron), which would otherwise accumulate as a black slimy deposit in the concentrated solution tank. This insoluble residue is of course discharged with the tailings when the tanks are emptied.

Another difficulty frequently encountered in the application of the cyanide process is the treatment of "battery slimes," i.e., the very finely-divided material produced during the crushing, and which has a tendency to accumulate in pasty masses. These either resist the penetrating action of the cyanide or retain the dissolved gold during the leaching operation. No satisfactory method of breaking such material has yet been devised—the evil may be lessened by mixing the slimy tailings with clean coarse sand.

Various improvements have been introduced in the mechanical details of construction. The large leaching vats of the Robinson Company are rapidly and conveniently discharged by means of a trap door placed in the centre of the tank bottom, and which may be hermetically closed by a patent screw fastening. The enormous underground vats of the Langlaagte Estate Company are discharged by means of a dredge, which appears to give perfect satisfaction.

Precipitation of the Gold.—The zinc shavings now in use are prepared by turning thin sheets of zinc on a lathe. These shavings are placed in wooden troughs, commonly known as "zinc boxes," and the solution from the leaching vats is allowed to flow slowly through them, depositing the gold as a finely-divided black slime on the surface of the zinc, while the zinc gradually dissolves in the liquid. After passing the zinc box, the "exhausted solution," which should not contain more than $\frac{1}{2}$ dwt. of gold to the ton, flows into a storage tank or "sump," whence it may be pumped back to the leaching tanks, when a fresh charge has to be treated. But the simple replacement of gold by

zinc is not the only reaction which occurs in the zinc box; it is found that a notable falling off in the strength of the cyanide occurs, due to secondary reactions caused by the gold-zinc couple.

The zinc boxes are usually divided into several compartments so arranged that the liquid flows alternately upward and downward through the shavings. The shavings are placed in a tray, the bottom of which is an iron wire screen of about four holes to the inch. This is supported a few inches from the bottom of the zinc-box. The fine "gold slimes" fall through this screen, and may thus be separated from the undecomposed zinc when the "clean up" takes place.

The zinc boxes in use at the Robinson works are about 20 ft. long, 2 ft. wide, and 2 ft. deep, with inclined bottoms. They are divided into compartments of about 20 in. in length. Each compartment holds about a bushel of shavings, weighing perhaps 40 lb. Seven compartments in each zinc box are filled with shavings, a single compartment at the head is left empty to receive any sand that may be carried through the filters by the solution from the tanks. A double compartment at the foot is also left empty to allow any gold that may be carried away by the stream of liquid to deposit before the solution flows into the sump. About 60 tons of solution, which is the quantity required for treating the ordinary daily charge of 225 tons of tailings, are allowed to run off through two zinc boxes in about nine hours. This solution may carry from one to three ounces of gold per ton of liquid; after passing through the zinc boxes it rarely contains more than 2 dwt., and should not contain more than $\frac{1}{2}$ dwt. if the precipitation has been properly carried out.

There are two sets of zinc boxes, one to receive the "strong solutions" (0.6 to 0.8 per cent. cyanide), and one for the "weak solutions" (0.2 to 0.4 per cent.). The slimes formed in the weak boxes are as a rule much poorer than those in the strong boxes, and less consumption of zinc takes place in them.

The total amount of zinc consumed amounts to about 100 lb. a day. Two men are constantly employed at the lathes, so that the turning is an arduous and somewhat costly operation. It is desirable to use freshly-turned zinc, as the surface rapidly oxidises and becomes much less active in precipitating the gold.

The most vigorous action of course takes place in the compartments which first receive the solution from the tanks. It is here that the zinc dissolves most rapidly, and is accordingly replaced by shavings from the lower compartments, while fresh zinc is continually added as the last compartment becomes empty.

The clean-up takes place once or twice a month. The screens containing the undissolved shavings are lifted from the zinc boxes. The boxes are then left undisturbed for an hour so as to allow the zinc-gold slime to settle at the bottom. The liquid is then drawn off by a syphon until very little is left above the slimes. The box is then cleaned out, and the slimes and muddy water allowed to drain through a screen of 40 meshes to the inch. The mass, consisting of water, finely-divided gold, and very fine zinc, is rubbed through this screen by means of a short stick 5 or 6 in. in length, to the end of which is fixed a piece of india-rubber.

The stuff remaining on the screen consists almost entirely of unconsumed zinc, fine enough to pass through a screen of 12 meshes to the linear inch. This is replaced in the first divisions of the zinc boxes over a fresh lot of shavings.

The slime, consisting of finely-divided gold and silver, with a large proportion of zinc and lead, and a certain quantity of tin, antimony, organic matter, and other accidental impurities, is allowed to settle in a small tank placed beneath the 40-mesh screen, and is now ready to undergo the drying and smelting operations necessary for its conversion into bullion.

In the Molloy process alluded to already, the use of zinc is dispensed with altogether. The solution passes through a shallow trough containing mercury, in which is an inner cylindrical vessel filled with solution of carbonate of soda; the edges of the cylinder just dip beneath the mercury, so that its contents are entirely cut off from the outer portion

of the vessel. A rod of lead dips into the soda solution; the lead and mercury are connected with opposite poles of the battery, and the solution is electrolysed by the passage of a current. The sodium combines with the mercury to form sodium amalgam, which at once decomposes the gold cyanide solution with formation of ordinary gold amalgam, sodium cyanide being simultaneously produced. It is claimed that much less decomposition of the cyanide takes place than with zinc, and, moreover, that the outflowing solution is better adapted for dissolving fresh quantities of gold. It is obvious that in the ordinary method a large accumulation of zinc in the solutions must take place, which in time would render them valueless for gold extraction, whereas sodium cyanide is just as effective as the potassium compound.

Production of Bullion.—The slimes are now transferred to enamelled iron pans, and carefully dried over a small furnace. This is a tedious operation, and requires considerable time. The pans in use at the Robinson works contain about 5 or 6 gallons of dried precipitate. This may contain as much as 150, or as little as 20 oz. of gold.

The precipitate, when nearly dry, is mixed with sand, borax, and bicarbonate of soda, and melted in a No. 60 crucible at a fairly high temperature. The material melts very easily, forming a very liquid slag, which, however, rapidly corrodes the pots, so that a good 60 crucible rarely lasts for more than eight meltings. The charge is not added all at once, but as each portion melts and sink down fresh quantities of the mixture are added. When the pot is full of liquid slag it may contain from 100 to 150 oz. of bullion. Large quantities of oxide of zinc are volatilised during the melting, which carry off a very appreciable amount of gold. The zinc fumes, together with the products formed by the decomposition of the cyanide salts, render the operation anything but healthy.

The bullion produced is whitish in appearance, and about 650 fine. It is very hard and brittle, and the bars are by no means uniform, so that it is difficult to obtain an accurate assay. In addition to zinc, they contain silver, lead, and sometimes a little copper.

Scope of the Process.—In its present phase the limitations of the cyanide process appear to be:—

(1.) That it is only completely successful with "free-milling ores." Pyritic ores may be treated, but at a greatly increased cost.

(2.) That it is not applicable to ores containing a considerable percentage of coarse gold.

(3.) That it cannot be economically applied to rich material.

On the other hand, the cyanide process is admirably adapted for recovering the so-called "float gold," i.e., gold

in an extremely fine state of division which remains suspended in the water for several hours, and cannot be obtained by any process of amalgamation or concentration. That the cyanide process is well adapted for the treatment of Rand ores is shown by the fact that although the system has been in use little more than two years, over 40,000 tons of tailings are now being treated per month.—W. S.

A New Method of Assay of Antimony Ores. A. Carnot. *Annales des Mines*, 1, 1892, 303; *Proc. Civil Eng.* 100, (iv.), 52.

See under XXIII., page 941.

The Action of Sulphuric and Nitric Acids on Aluminium. G. A. Le Roy. *Bull. de la Soc. Ind. de Rouen*, 1891, 232.

ACCORDING to Deville, Wurtz, Hunt, Langley, Roscoe, and others, who have written on the subject of aluminium, that metal is entirely unaffected by sulphuric and nitric acids, whether dilute or concentrated. The author having in consequence been induced to study the possibility of replacing lead and platinum by aluminium in chemical manufactories, has been surprised to find that these statements are entirely incorrect, and further experiments have therefore been made with four different samples of the metal, the composition of which is given below, in order to determine the rate of solution. Two of these, A and B, were made by Deville's process, at the former Nanterre works, by Messrs. P. Morin and Co., the others were of a more recent make:—

	A.	B.	C.	D.
Aluminium	98.28	98.45	99.60	99.47
Iron	1.60	1.30	0.30	0.40
Silicon	0.12	0.25	0.10	0.13

The samples which were cut into thin plates, and cleaned from grease by a solution of soda, were exposed to the action of acid for given periods, after which the loss of weight was determined, after washing with water and alcohol, and drying in an air-bath. From the loss of weight, the amount dissolved in the day of 12 hours, per square metre of surface exposed, has been calculated as follows:—

Solvent.	Quality.	Specific Gravity.	Temperature.		Sample Treated.			
					A.	B.	C.	D.
Sulphuric acid	Pure	1.842	° B.	° C.	Grms.	Grms.	Grms.	Grms.
			65	15 to 20	18.4	18.9	16.4	16.5
	Common	..	..	..	21.0	21.3	17.5	16.4
	Pure	1.711	60	..	24.5	25.0	22.0	20.0
"	Common	..	..	..	25.8	25.7	24.6	22.1
	Pure	1.589	55	..	19.0	18.0	17.9	16.3
	"	1.263	30	..	4.6	..	2.6	3.4
	"	1.383	40	..	17.0	16.0	15.5	14.5
Nitric acid	"	1.383	40	..	20.5	19.6	18.0	16.6
	"	1.332	35	..	16.3	16.3	14.0	13.4
	"	1.842	65	150	249.0	225.0	150.0	200
	Common	1.842	65	150	267.0*	250.0	210.0	220
Sulphuric acid	Pure	1.383	40	100	..	..	Violent action.	
	Common	1.383	40	100	..	..

* This corresponds to a thickness of about $\frac{1}{16}$ millimetre per square metre.

From this it is evident that pure aluminium is so rapidly attacked by strong acids, even the cold, as to be quite unfit for use in apparatus for the manufacture of these acids.

—W. S.

The Effect of Heat on Mercury Compounds. F. Janda. Oester. Zeits. für Berg- und Hüttenw. 1891, 583; Proc. Inst. Civil Eng. 108, 88.

The sulphide, oxide, sub-oxide, sub-chloride, and basic sulphate of mercury are completely decomposed by heat when mixed with forge scale (magnetic oxide of iron) under a covering of zinc oxide, but the chloride shows a loss of 8 per cent., and the normal sulphate of 4 per cent. volatilised unchanged by the same treatment. When the zinc oxide cover is omitted the mercury obtained from cinnabar is almost always blackened with amorphous sulphide.

Theoretically, the mercury contained in these compounds is as follows:—

	Per Cent.
Mercuric oxide HgO	92.5
Mercurous oxide Hg_2O	96.1
Mercuric sulphide HgS	86.2
Mercuric chloride HgCl_2 (corrosive sublimate).....	73.8
Mercurous chloride Hg_2Cl_2 (calomel).....	81.9
Mercuric sulphate HgSO_4	67.5
Basic mercuric sulphate Hg_2SO_6 (Turbeth mineral).....	82.1

These figures are realised in the new Idria method of assay with iron oxide and zinc, using a gold dish for collecting the mercury, except in the case of the sulphate and chloride, which gave lower results.

When heated without any reagents, the following facts have been observed:—

Mercuric sulphide (cinnabar) is changed to metallic mercury, sulphur dioxide, and, to a small extent, to black sulphide.

Mercuric oxide darkens, and at very low red heat is changed to mercury and oxygen; the salts of this oxide volatilise with partial decomposition. Mercuric chloride volatilises almost without any change, only about 5 per cent. being reduced to metal, as does also mercuric nitrate, which is but very slightly decomposed by heat.

Mercurous oxide changes at 100° into mercury and mercuric oxide, and by further heating is completely reduced to metal with the separation of oxygen. The salts of this oxide are all decomposed at a red heat. Mercurous chloride is completely volatilised without decomposition. Mercuric sulphate, which is white when cold, turns yellow and melts to a brown fluid, which gives the original white salt when solidified and cooled. At a higher temperature it is completely volatilised without change, but more slowly than any of the other compounds.

Turbeth mineral, a basic sulphate obtained from HgSO_4 , by washing it with a large quantity of hot water, which results in the formation of free sulphuric acid and yellow turbeth ($3\text{HgSO}_4 + 2\text{H}_2\text{O} = \text{Hg}_2\text{SO}_6 + 2\text{H}_2\text{SO}_4$) is completely volatilised with decomposition when heated for about four times as long as the oxide or chloride.

The mercurial flue-stuff (*stupp* of Idria, *hollines* of Almaden), which is of the following composition:—

Metallic mercury	81.04	} 86.52 Hg
Mercuric sulphide	5.76	
Basic sulphate	0.52	
Mercurous chloride	0.12	
Mercuric chloride	} Trace	
Ammonium sulphide		
Calcium sulphate	2.71	
Magnesium	0.21	
Hydrocarbon	2.66	
Carbon (soot)	6.46	
Silica	0.15	

decomposes by heat into metal and mercury-black, a finely-divided mixture of metal and sulphide. This black powder, when mixed with and distilled under a cover of lime, gives metallic mercury, which also happens when the cover is omitted, and only 25 per cent. of lime is used in the mixture, but with a larger loss. The amalgam obtained on the gold plate is bright, with only a slight covering of hydrocarbon

oil. Mercuric chloride and sulphate are not completely decomposed by lime alone, and the deposited amalgam is covered with a sublimate of the unchanged salt.

When cinnabar, or flue-soot is mixed with 25 per cent. of lime and 25 per cent. of lamp-black, which contains both carbon and hydrocarbons, and heated for 15 minutes, the mercury is almost completely recovered, but the deposit is coated with black. The oxide and lower compounds are completely decomposed, giving a clear amalgam by the same treatment; but the higher chloride and basic sulphate show a loss of 8 and 4 per cent. respectively, or the same as in the method of assay with iron and zinc oxides.—W. S.

Smelting the Phosphoric Ore of Gellivara. Stahl und Eisen, 1892, 490; Proc. Inst. Civil Eng. 110 (iv.), 37.

At Finshtytte, in Sweden, experiments have been made in smelting the waste ore of Gellivara, which consists chiefly of apatite and magnetite with some rock, and contains from 20 to 25 per cent. of iron, being in fact a ferriferous apatite. In order to prevent the slag from taking up silica by corrosion of the bricks in the hearth and boshes, the lower part of the furnace, to a height of 6 or 8 in. above the tuyeres, was built of carbon bricks. The ore was for the most part reduced to the size of coarse sand, which rendered the working of the furnace so difficult that pieces of nut size were added to keep the charge open. Only 110 ewt. of unroasted ore were smelted in four days, with air heated to 120 or 150°C ., both alone and with various fluxes of quartz and lime. The best results were obtained without lime, or with at most 10 per cent. The slag, which ran very liquid, was crystalline when cooled, and of a grey or greenish colour, with white enclosures consisting chiefly of semi-fused pieces of apatite. The composition was:—

	A. With Ore alone.	B. With 10 Per Cent. of Lime.
Silica.....	26.20	21.45
Alumina.....	1.59	3.62
Ferrous oxide.....	1.40	0.13
Manganous oxide.....	0.20	0.28
Lime.....	43.80	18.15
Magnesia.....	5.16	5.95
Phosphoric acid.....	15.48	17.38
Titanic acid.....	2.30	2.00
Sulphur.....	0.16	0.21

The proportion of phosphoric acid is fully equal to that in the slag of the basic converter, but the state of combination is somewhat different, only 7.5 per cent. being soluble in citric acid, while in English and German basic slag the soluble part is 14.5 per cent. Both kinds are, however, much more readily decomposed by acid than apatite, and their solubility would probably be increased by using more lime.

The metal corresponding to these slags contained:—

	A.	B.
Phosphorus.....	10.61	11.86
Combined carbon.....	0.50	0.65
Silicon.....	0.08	0.09
Sulphur.....	0.03	0.02

When tapped it ran very fluid without giving off sparks, and cooled to a silvery white metal, which was very brittle, breaking with a wire-like crystalline structure, and very

similar in appearance to ferro-manganese. The composition is a very remarkable one, as, apart from the phosphorus, the analysis is essentially that of a steel.—W. S.

Progress of the Metallurgy of Nickel. D. Levat. *Annales des Mines*, **1**, 1892, 141; *Proc. Inst. Civil Eng.* **110** (iv.), 54—60.

NICKEL is found in New Caledonia in a single mineral, *Garnierite* or *Noumeite*, a hydrated silicate of nickel and magnesium, of a bright apple-green colour when pure, which is deposited in concretionary masses in the fissures of serpentine rock. The mode of occurrence indicates clearly that the mineral has been deposited by water in the form in which it is now found. The distribution of the mineral through the serpentine matrix is not arbitrary, it being always found at or near the contact of the rock with the red clays, but never in the clay itself. These masses of clay are products of the decomposition of the serpentine, and contain all its constituents and in addition, manganese, cobalt, and chromium.

The nickel ore, which is newer in origin than those of manganese and cobalt, is found as vein-matter in hollows resulting from the shrinking of the red clay from the sides of the rock funnel enclosing it. These veins vary very much in size, the maximum breadth being about 8 metres, but in some cases the whole of the rock is filled with small veins of mineral, so that it may be worked as a whole up to a thickness of 250 ft. By far the larger number of the workings are in open cast, at altitudes varying from 300 to 600 metres above the sea level, where it is easy to follow the richer developments, and with a comparatively small preliminary outlay to make provision for some years of quarry working in the same locality. The preliminary working is mainly in the direction of removing the red clay, which can only be imperfectly separated from the ore by washing, and the iron ore it contains, if left behind, impoverishes the yield of nickel, besides being objectionable in the smelting, by reason of its adding alumina to the charge, which is refractory through the presence of silica.

The mineral is carefully sorted by hand at the quarries and divided into rich and poor qualities, the former containing 8 per cent. and above of nickel, and the latter all below that limit. These are confined to simply washing away the red clay, and even this preparation cannot be carried too far without risking considerable loss (up to 3 or 4 per cent.) in the mud washed away. Hence the necessity of carefully clearing the waste away before working the mineral. The quarry waste, containing 3 to 4 per cent. of nickel, is not utilised.

The treatment of the mineral has undergone several modifications before arriving at the present practice. The old method of concentrating the metal as sulphide by the addition of pyrites or sulphur is adopted. The average composition of the ore available for smelting was: silica, 45 to 50; iron, 16 to 14; nickel, 8 to 7; magnesia, 12 to 10; alumina, 3 to 5; water and oxygen, 16 to 14 per cent.

This requires from 25 per cent. to 30 per cent. of bases (oxide of iron or limestone), besides a sulphurising material. As neither gypsum nor pyrites, free from arsenic and copper, was available for the latter purpose, the charge for the blast furnace was made up as follows:—

	Kilos.
Ore.....	1,000
Coral.....	300
Sulphur.....	35
Small coal or coke.....	75

The greater part of the sulphur passed into the regulus, and a fluid slag was obtained with 48.0 per cent. of silica, 12 to 13 of iron, and not more than 0.10 per cent. to 0.45 per cent. of nickel, but the local smelting was given up owing to difficulties in procuring coke, and now the ores are for the most part smelted in England, alkali waste being used as flux. The consumption of coke is about 20 per cent. of the weight of the charge, or about 30 per cent. of that of the ore treated. Small-sized water-jacket cupolas, smelting from 25 to 30 tons in 24 hours are used. The

product contains nickel 50 to 55, iron 25 to 30, and sulphur 16 to 18 per cent., the latter being necessary to make the regulus sufficiently brittle to be easily powdered. The subsequent concentration may be done either in the reverberatory furnace or the Bessemer converter. In the former two calcinations, followed by fusion with quartz sand, are necessary for the removal of the iron. The furnace treats 2 tons in 24 hours, with the consumption of an equal weight of coal. The operation, which lasts eight hours, is controlled by sampling during the progress, and is stopped when the iron has completely disappeared, in order to prevent loss of nickel in the slags, which, however, are not thrown away, but are returned to the ore-furnace as they fine an excellent flux, besides containing $2\frac{1}{2}$ per cent. of nickel. By the first concentration the iron is reduced to 2.5 to 3.0 per cent., and by the second to 0.5 to 0.75 per cent., the sulphur being kept to 16 per cent. at least. In the Bessemer converter the concentration is more rapidly done, a charge 1 ton of regulus melted in a cupola is introduced into the converter and blown with air at a pressure of about 40 centimetres of mercury. The temperature rises from the combustion of the sulphur, and sand is added to flux the iron. If the proportion of the latter metal does not exceed 36 per cent. it may be completely removed in about one hour and 20 minutes, but with a larger quantity the bath should be skimmed after blowing for 25 minutes and fresh flux added, as the fining will be imperfectly done if too large a quantity of slag is retained in the converter. When the slags begin to show signs of containing nickel oxide the refined metal is poured into moulds. It contains less than 0.50 per cent. of iron. Arsenic, antimony, and silver are removed either in the slags or by the blast; cobalt remains with the nickel sulphide.

The converter slags are much richer than those of the reverberatory furnace, containing from 14 to 15 per cent. of nickel, mostly as shots of diffused regulus, which may in part be collected by running the slag into conical pots and separating the cake of metal at the bottom. The whole of it must in any case be returned to the ore furnace.

Attempts have been made to continue the blowing up to the complete removal of the sulphur to produce a material that would only require a final reducing treatment to obtain pure nickel. This has, however, been found to be impossible, owing to the high affinity of nickel for sulphur, the heat developed in such an afterblow being less than sufficient to counteract the cooling effect of the air, and as the product when free from copper has a high melting-point approximating to that of iron, it sets very rapidly, and blocks up the tuyeres.

The refined regulus, whether obtained from the reverberatory furnace or the converter, consists essentially of nickel sulphide (or nickel and copper sulphides, if obtained from pyritic ore like that of Canada), with not more than 0.50 per cent. of iron, and the same proportion of other foreign matters. It is crushed to pass a 65-mesh sieve, and charged in quantities of 600 kilos. upon the bed of a reverberatory calciner 10 meters long and 2.50 metres broad, with four working doors on one side, forming a layer about 2 in. thick, which is constantly rabbled and moved gradually from the flue of the fire-bridge end. The operation lasts eight hours with pure nickel sulphide, and only six when the regulus contains copper.

The consumption of coal is 2,000 kilos. for 2,400 kilos. of material roasted. The temperature is kept to dull redness, except towards the end, when the furnace is raised to bright red heat. The finished product, which should not contain more than 1 per cent. of sulphur, is ground to pass a sieve of 120 mesh, and subjected to dead roasting in a furnace of the same breadth as the preceding one, but with a shorter bed. The charge is 500 kilos. renewed every six hours, and the temperature is kept at bright redness; 3 tons of coal are burnt in 24 hours. The product is nickel oxide or nickel and copper oxides, and should not contain more than 0.40 per cent. of sulphur.

The reduction of the oxide is effected by mixing it to a paste with flour or other organic matters, dividing into small pieces when dried, and strongly heating with charcoal powder. Formerly the paste was cut into cubes of 12 to 15 millimetres, but in France discs of regular shape, 50

millimetres in diameter and about 15 millimetres thick, made in a press, are preferred. They must not be made thicker, or the reduction will be imperfect in the centre. The Chinese, who are somewhat considerable consumers of nickel, prefer to have it moulded into ingots similar to those used as money in China.

Formerly the reduction was effected in crucibles holding 50 to 60 kilos. in a gallery or reverberatory furnace, but owing to the imperfect and irregular heating the process was very wasteful of fuel, and the pots did not last for more than five or six operations. This method has therefore been abandoned in favour of furnaces working continuously. The first of these is a large muffle 3.5 metres long and 1.8 metre broad, heated by the flame of a gas-furnace, which is passed several times round it by a series of spiral flues. The shorter sides are closed by balanced doors, and the iron pots containing the mixture of oxide and charcoal are subjected to a gradually increasing heat for 24 hours, being entered at the coolest side and pushed gradually nearer to the fireplace. This, with mixed oxides, gives a coherent product; but pure nickel oxide, although it is reduced by carbon at a comparatively low temperature, must be subjected to a temperature of 1,100° or 1,200° for four hours to obtain the coherent metallic character required by the consumer; and, as such a heat is unattainable in the muffle, the operation must be finished in a crucible furnace.

Another and more improved plan of reduction is in a regenerative furnace resembling that used for reducing zinc oxide in Belgium, but having retorts open at each end. The mixture of oxide and charcoal is charged by a semi-circular scoop at one end, and when finished the charge is pushed out at the other end into closed receivers, where it is allowed to cool out of contact with the air. A furnace with 22 retorts is capable of reducing 1,500 kilos. of nickel oxide, or 3,000 kilos. of nickel copper oxides, in 24 hours, the charge of 750 or 800 kilos. requiring 10 hours in the furnace in the first and five hours in the second case. About 2 tons of coal are required for heating in the 24 hours, and the work is done by two men per shift of 12 hours.

The reduced metal is sifted to separate the cubes or discs from irregular and broken masses, which are afterwards collected by a magnet. The former are polished by friction upon each other on a rapidly rotating barrel, while the latter is added in packing the barrels to make up the exact weight of 100 kilos.

Among the more important recent applications of nickel is that of the alloy (20 of nickel with 80 of copper) for the casing of bullets for the small-bore rifles adopted in modern armament. This combines a higher tenacity than that of the best brass with a high coefficient of elongation, the former being from 28 to 31 kilos. per square millimetre, and the latter 25 to 35 per cent., and exceptionally as much as 39 per cent., in the metal as cast. The coefficient of elongation increases with the freedom of the alloy from iron. By rolling cold, the tensile strength is increased to 60 or 62 kilos., and the elongation is diminished to 3 or 4 per cent. When annealed under the most favourable conditions the strength is 30 to 40 kilos., and the elongation 32 to 39 per cent., as compared with copper, where the corresponding figures are 25.1 kilos. and 34.1 per cent.

The annealing of this alloy is a very delicate operation, requiring special manipulation, the details of which are mostly kept secret by the manufacturers. The principal object is to avoid oxidation, and this, according to the author, may be most effectually done by separating the sheets in the annealing piles by sheets of eardboard, which are carbonised during the process. If badly annealed the mechanical properties are altered in a remarkable manner, the burnt metal having a tensile strength of 30 kilos., with only 1 per cent. elongation. In a general way the annealing is considered to be bad if the tensile strength is below 33 kilos., and the elongation less than 30 per cent. The elastic limit is from 11 to 15 kilos. when well annealed, and 45 kilos. when the metal is hard from the rolls.

The ready malleability of this alloy seems to render it particularly suitable for locomotive fire-boxes, and plates for this purpose were exhibited by the Société des Métaux at the last Paris Exhibition.

The production of nickel, which was about 400 tons in 1878, the period of the discovery of the New Caledonian ores, rose to 1,200 tons in 1880, and 2,000 tons in 1884. The application of the metal to military purposes in 1886 created an extra demand of 400 to 500 tons per annum, and in 1887 the total consumption of the world was about 3,000 tons, of which amount New Caledonia supplied about 2,600 tons. Since that date the mines of the district of Sndbury have been largely developed, and at the present time copper-nickel regulus is equal to the daily output of 12 to 15 tons of pure nickel, or from 4,500 to 5,000 tons per annum. In New Caledonia arrangements are being made for an equal production, so that in the near future a total supply of from 9,000 to 10,000 tons of pure nickel per annum is likely to be available from these two sources.

In 1876 the price of refined nickel, which was then 18 francs per kilog., fell rapidly to 10 francs and 6 francs, and ultimately, in 1886, to 5.50 francs to 5 francs, which rates have been nearly stationary ever since.—W. S.

PATENTS.

Improvements in the Treatment of Iron and Basic Slag, and in Extracting Silicon and Phosphorus. W. P. Thompson, Liverpool. From B. Talbot, Chattanooga, Tennessee, U.S.A. Eng. Pat. 10,583, June 3, 1892.

The iron is purified by pouring it while molten through a deep column of basic slag contained in a suitable vessel outside the furnace. The metalloids and other impurities combine with the slag, so liberating the heat necessary to maintain the slag in a fluid state.—J. H. C.

An Improved Process of or Means for Extracting or Recovering Metal from Ores or other Metal-Bearing Bodies. W. Noad, Upton Park, Essex; C. Minns, Westminster; and P. H. Stevens, London. Eng. Pat. 9784, June 9, 1891.

A SOLVENT is used which is prepared by mixing hydrochloric acid, about 100 galls.; saturated solution of edcium hypochlorite, about 100 galls.; sodium or potassium nitrate, about 50 lb. (but varying according to the class of ore or metal to be treated); water, about 750 galls. The clear liquor, after settlement, is the solvent required, and the finely-crushed ore is treated with it in tanks, at first without, and afterwards with agitation and heating. The metals dissolved are then recovered from the solution by successive precipitation in separate tanks.

The chemical constituents of the solvent may be compounded in a dry form for export by concentrating the hydrochloric acid to about half its bulk, completely drying the requisite proportions of the calcium hypochlorite and sodium or potassium nitrate, thoroughly mixing them with the concentrated acid, adding, if necessary, sodium chloride or other suitable dry and absorbent material, and evaporating the whole to dryness.—J. H. C.

Improvements in the Extraction of Gold and Silver from Ores or Compounds containing the Same. H. Parkes, Dulwich, and J. C. Montgomerie, Stair. Eng. Pat. 11,342, July 3, 1891.

According to this process the finely-divided ore is treated with a chlorinating or oxidising solution containing manganese dioxide and hydrochloric acid, hypochlorite of calcium, sodium, potassium or magnesium and hydrochloric acid, or chromic or chlorochromic acid and hydrochloric acid. Such solutions as these do not dissolve appreciable quantities of gold or silver, but merely render the ore more susceptible to a subsequent treatment with an alkaline potassium cyanide solution. Any gold or silver which is dissolved by the chlorinating or oxidising solution is separated by ferrous sulphate or other precipitant. Ores rich in gold may be advantageously treated with hydrogen peroxide or oxygen under pressure in presence of the chlorinating agent; rich ores of a refractory nature are

treated in a similar manner, but with the addition of potassium cyanide to the chlorinating solution. Some ores are subjected to the action of a mixture of lead and sodium chlorides saturated with chlorine or bromine. Ores which are treated with potassium cyanide or other solvent in the presence of oxygen or hydrogen peroxide may, in the same solution, be subjected to the action of sodium chloride saturated with chlorine or bromine; copper chloride or sulphate may also be added to the liquid.—W. J. P.

An Improved Method of Smelting Complex Silver Ores.
C. James, Swansea. Eng. Pat. 13,740, August 14, 1891.

THE inventor smelts silver ores rich in zinc in a reverberatory furnace in place of in the blast furnace at present employed; loss of lead and silver is thus prevented. Sulphuretted silver ores are pulverised and intimately mixed with the quantity of litharge necessary to oxidise all the sulphur present; this mixture is smelted in the reverberatory furnace, and the reduced lead is found to contain nearly all the silver. Should the ore contain zinc blende, a preliminary calcination is necessary to convert this into zinc oxide; galena is then added, and the whole smelted just as when litharge is employed. Halogenated silver ores are smelted with a mixture of galena and litharge in such proportions that metallic lead is produced; the reduced silver then alloys with the lead and is extracted by the usual methods.—W. J. P.

Improvements in the Process of Smelting Copper or Copper Ores, and in Furnaces or Apparatus applicable therefor. J. H. Bilby, St. Helens. Eng. Pat. 16,273, September 24, 1891.

THE ores and fluxes are melted in a cupola furnace and then run off into a settling furnace where the ore separates from the slag. After running off this slag, the regulus is exposed to blasts of air, preferably in a third furnace, till it contains from 70 to 80 per cent. of copper, when it is run into an ordinary reverberatory furnace to be finished into blister copper. The furnaces all communicate by channels or gutters.—J. H. C.

Improvements in and relating to the Manufacture of Wire, Sheet Metal, and the Like. C. F. Claus, London. Eng. Pat. 16,553, September 29, 1891.

IN the manufacture of iron or steel wire, the "wire-rod" as usually obtained is coated with iron oxide, and has therefore to be pickled before it can be drawn. The inventor removes the oxide by subjecting the hot wire-rod to the action of hydrogen, coal-gas, purified water-gas, or other producer-gas; the wire is then drawn in the ordinary manner. This process also obviates the necessity of frequently annealing and subsequently pickling the wire, which is so great an inconvenience in the ordinary process of drawing. Sheet metal also, if treated in the above manner, may be rolled without annealing.—W. J. P.

Improvements in Means or Apparatus for Extracting Precious Metals from their Ores. F. Webb, Walworth, Surrey. Eng. Pat. 17,636, October 15, 1891.

THE crushed ore is agitated with an appropriate solution by means of a hollow and perforated vessel or piston moving to and fro in an outer closed vessel or chamber, which is capable of being partially rotated on trunnions. These may be hollow, so as to serve as channels for the solution. Any required solution may be used, those containing chlorine, bromine, iodine, or potassium cyanide being recommended as suitable for ores containing gold.—J. H. C.

Improvements in Basic Furnace Lining and Basic Material. J. B. Alzugaray, London. Eng. Pat. 17,755, October 16, 1891.

BASIC bricks, when allowed to cool down, are acted upon by the moisture and carbonic acid of the air, and develop splits and cracks, and need frequent renewal. To obviate this objection, the patentee uses, as the chief ingredient of his basic linings, barium carbonate, which is stated to be free from these defects on account of its stability being greater than that of the carbonates of the other alkaline-earth metals, and because of its tendency to form barium dioxide. It may be used alone or mixed with magnesia, magnesium carbonate, alumina, bauxite, lime, or carbonate of lime, dolomite, strontianite, ilmenite, wolfram, scheelite "chromate," oxides and carbonates of iron and manganese, "magnetic iron," hematite, &c. The agglomeration of the mass may be effected by the use of a little silicate of soda, from 2 to 5 per cent. of the whole weight, and in certain cases 20 to 50 per cent. of plumbago may be added.—B. B.

Improvements in the Manufacture of Iron, and in Fuel or a Compound suitable therefor. W. A. Sngden, Keighley. From W. R. Sngden, Fall River, Wisconsin, U.S.A. Eng. Pat. 18,442, October 27, 1891.

See under H., page 899.

Improvements in the Manufacture of Iron. H. Le Neve-Foster, Brierley Hill, Staffordshire. Eng. Pat. 19,118, November 5, 1891.

IN preparing refined iron suitable for puddling a basic or neutral lining is employed in a regenerative or other suitable furnace. Calcined or shrunken dolomite, with or without an admixture of basic slag or chrome iron ore, is used to deprive common pig iron of phosphorus and silicon.—J. H. C.

Improvements in Leaching Ores and in Apparatus therefor. S. H. Johnson and C. C. Hutchinson, Stratford, Essex. Eng. Pat. 19,389, November 10, 1891.

A FILTER-PRESS is used having chambers which can be varied in depth according to the mechanical condition and permeability of the ore under treatment, and this is worked in conjunction with a pneumatic forcing receiver, with an agitator for the purpose of working fine ores and slimes.

The material to be filtered should be supplied at such a rate as to fill the chambers in about three minutes, and under a gradually rising pressure, finally at about 50 to 60 lb. per square inch.—J. H. C.

An Improvement in Copper Alloys. A. K. Huntington, London, and J. T. Prestige, jun., Deptford. Eng. Pat. 19,771, November 14, 1891.

THIS invention is based on the particular property of nickel which enables it to alloy in any proportion with either copper or iron. The claim is for copper alloys containing iron or ferro-manganese, increased by admixture of nickel. Zinc also is included in some instances. The proportions may be varied according to the tensile strength, ductility, or elasticity required in the alloy. For a strong ductile metal copper about 50 parts, zinc about 40 parts, and iron and nickel about 2 parts each are recommended. When the quantity of zinc is lessened that of iron, with its due proportion of nickel, is increased. Thus, if the zinc be entirely omitted, iron may be employed up to 5 parts and nickel up to 6 parts with the 50 parts copper. Ferro-manganese containing about 80 per cent. of manganese may be substituted for the iron.—J. H. C.

Improvements in Apparatus for separating Crushed Pyrites and similar Heavy Substances containing Gold or other Metal. W. Seoular, Johannesburg, South Africa. Eng. Pat. 19,782, November 14, 1891.

THE washing table is suspended at the four corners by metal straps from nprights on a suitable frame in such a manner that a to-and-fro percussive motion can be given to it by means of a triple cam in conjunction with a spring. The cam, driven on a shaft, forces back the table which, on being released, is pushed forward by the spring until the stop-piece attached strikes the frame-work, when the cam comes into play again. The jerk aided by a flow of water causes the separation of heavy from light particles, the former being discharged from an outlet at the side of the table while the latter are washed away at the end. The floor of the table is of uneven surface with a triangular depression cut diagonally across it and in which the concentrates accumulate. The depression narrows and rises towards the outlet in the side through which the heavy particles are discharged and broadens out towards the end where the outlet for the light particles is situated.—A. W.

Improvements relating to the Coating of Metals. E. Norton, Maywood, U.S.A. Eng. Pat. 21,114, December 3, 1891.

THIS patent is for an improvement in connection with the ordinary process of manufacture of tin-plate. To avoid the frothing and boiling over of the hot oil when the wet sheets are inserted the oil-bath is discarded and the sheets are passed direct from the bath of water through one or more pairs of heated rolls, the surfaces of which are continuously supplied with a covering of heated oil or other suitable material. In this way the water is evaporated and the sheets are coated with oil and raised to the necessary temperature for immersion in the molten metal bath at one and the same time.—A. W.

Improvements in the Extraction and Treatment of Metals. N. Löbdeff, St. Petersburg. Eng. Pat. 2193, February 4, 1892.

By this invention ores or metalliferous substances are melted in a furnace and a saucer-shaped cup of plumbago or other carbonaceous material placed on the molten mass. A current of furnace gases is then passed over the hearth and the ore becomes reduced by the carbonic oxide which diffuses through the saucer. This process may be also employed for removing the last traces of sulphur and similar impurities in the manufacture of steel.—W. J. P.

Improvements in the Method of Desulphurising Zinc Ores. P. Hart, Fairfield. Eng. Pat. 14,264, August 8, 1892.

THE blende or other ore is ground to a fine powder and mixed with sulphuric acid of sp. gr. 1.750, generally in the proportion of one equivalent of the monohydrated acid to each equivalent of metallic zinc present. The mixture is heated in an iron or other suitable vessel to a temperature between 300° and 400° F., when gases consisting chiefly of sulphurous acid are given off and are led into the vitriol chamber for conversion into sulphuric acid. After the mixture has been thus heated it becomes still and is then transferred to a close or blind furnace and the last of the sulphur expelled by heating to a low red heat. The zinc is left behind in a state of simple oxidation, or nearly so, and ready for smelting or any other method of extraction. The advantages are the quicker roasting with less expenditure for fuel and the obtaining the sulphurous acid in a concentrated condition suitable for economic conversion into sulphuric acid, whilst at the same time the ore passes into a condition from which the metallic zinc can be readily obtained.—A. W.

Improvements in Smelting Furnaces. H. H. Lake, London. From the Oliver Aluminium Company, New York, U.S.A. Eng. Pat. 14,406, August 9, 1892.

THE principal points claimed by the inventor are "the combination of a chamber, grate bars in the lower part of the chamber, a pot at the lower part of the chamber and having its bottom below the grate bars, provided with a discharge outlet and apertures or tuyeres for admitting gas through the top of the chamber to the pot."—F. S. K.

Improvements in Apparatus for Removing when Casting Gases and Impurities contained in the Metal or Alloy. J. L. Sebenius, Nykroppa, Sweden. Eng. Pat. 14,586, August 12, 1892.

THIS is an improvement on a previous patent for obtaining solid castings by swinging round in a horizontal plane the mould containing the molten metal, the centrifugal action forcing the gases and impurities to the surface of the metal, which surface for the time being is vertical and nearest to the centre of the circle of rotation. The apparatus, of which Figs. 1 and 2 are respectively vertical and horizontal sections, consists of a shaft A carrying a distributor *a*, which contains a circular channel, the bottom of which is built with radial ridges *h*, which are steep in one direction and sloping in the other. From the lower part of these ridges holes with mouthpieces lead out, opposite each of which a mould *c* is horizontally fixed in a suitable framework B, attached to the revolving shaft A.

The mould consists of a central compartment *b* surrounded with other compartments the shape of the castings to be made, the communication between which is made by channels in the bottom plate *g*. The whole is rapidly revolved and the metal, which is poured into *a*, is by means of the ridges *h* and the mouthpieces equally distributed

Fig. 1.

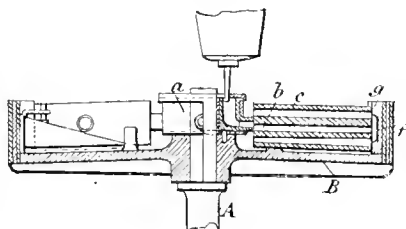
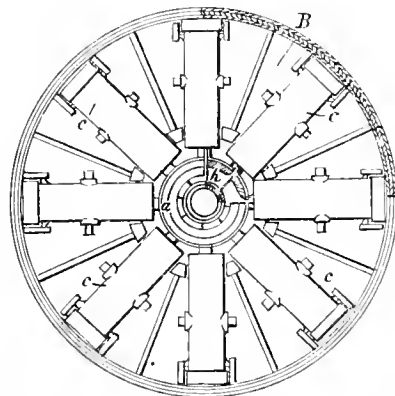


Fig. 2.



APPARATUS FOR REMOVING, WHEN CASTING, GASES AND IMPURITIES IN THE METAL OR ALLOY.

among the several moulds. It runs through the mouthpieces into the central chamber *b* of each and thence through the channels *f* into the outer compartments which are gradually filled from the bottom. The gases and impurities by the centrifugal force are driven towards the surface and the castings become clean, compact, strong, and homogeneous.—A. W.

Process for Alloying the Surfaces of Metal Wires, Ships, Plates, Sheets, and the like. E. Martin, Paris. Eng. Pat. 15,058, August 20, 1892.

THE ingot, rod, or plate of metal, for instance, copper, is cleaned and immersed in a solution of chloride of zinc or other pickle to obtain a first coating, after which it is dipped into molten zinc until the metal deposited is of the desired thickness. It is then withdrawn and heated in a muffle or other furnace with exclusion of air, when the zinc alloys with the copper and produces a brass surface. The metal is then rolled into sheets or drawn into wire. A bronze surface can be obtained by using tin instead of zinc. The coating of metal may also be deposited electrolytically.—A. W.

Improvements in the Wet Process for the Extraction of Gold or Silver, or both, from Pulverised Ores or other finely-divided Material, and in Apparatus therefor. J. W. Sutton, Brisbane, Queensland. Eng. Pat. 15,248, August 24, 1892.

THE ore is chlorinated in a vertical cylindrical chlorinator in which is a screw conveyor running in a smaller cylindrical casing. The screw, on revolving at a moderate speed, carries the ore upwards inside the casing, over the upper end of which it falls into and through the annular space between the casing and the wall of the chlorinator. Thus the thorough and constant circulation of the pulverised ore with the chlorine is effected. The mixture is withdrawn into a closed reservoir, the excess chlorine removed, and the liquid separated and the ore washed with the aid of a hydro-extractor of approved form. The gold is precipitated preferably with sulphate of iron, and separated by a small hydro-extractor, the liquor being afterwards evaporated to catch any gold that might have escaped filtration.

Silver can be extracted with the same apparatus, the chlorinated ore being leached with hyposulphite after separating from the chloride of gold. If no gold is present the ore is roasted with salt and the silver separated with hyposulphite in the hydro-extractor.—A. W.

Improvements connected with the Extraction of Metals from their Ores. J. W. Chenhall, Totnes. Eng. Pat. 15,584, August 30, 1892.

A SULPHATE which will decompose on roasting is added, in quantity from 1 to 10 per cent., in addition to common salt to the ore before grinding and roasting. The sulphate of iron or copper is preferred in cases where copper or silver is present in the ore. It is stated that the calcination or roasting is thereby quickened and that the metal contents become more soluble.—A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

The Colours and Absorption Spectra of Thin Metallic Films and of Incandescent Vapours of the Metals; with some Observations on Electrical Volatility. W. L. Dudley. American Chem. J. 1892, **14**, 185—190.

IN the cases of potassium, sodium and lithium, volatilisation by boiling was resorted to. The potassium vapour condensed in a film on the cooler portions of the tube, and exhibited in the thinnest parts colours by transmitted light, ranging from violet to blue, as the thickness increased, while by reflected light the film had the usual silvery

metallic lustre of potassium. The brilliant colours completely disappear, and the film assumes a frosted appearance owing to its breaking up into a number of minute globules. Sodium gave a yellow brown film, lithium a red-brown film, and in each case the glass was attacked, and the film was permanent. The colour was a source of surprise since it approached more or less closely to that of its incandescent vapour. Perhaps it may be accounted for in the same way as in gold "ruby glass," i.e., to the presence of finely-divided metal distributed through the glass.

(2.) The application of electro-deposition is limited, gold films, however, may be readily procured since it is easy to separate the film from the metal on which it is deposited, and the difficulties of the process may be largely obviated by following the method of Kundt (Ann. der Phys. Wied. **34**, 469).

(3.) The reduction of a thin film of the metallic salt was unsatisfactory, although films of platinum giving a purple colour by transmitted light could be easily obtained.

(4.) The electric arc between terminals of the metal to be volatilised was successful in a few cases, but was usually granular, and altogether unsatisfactory.

(5.) The condensed spark (Wright, Am. J. Sci. (3), **13**, 49; **14**, 169; (Hartley, Proc. Roy. Soc. **46**, 88; (Crookes, Chem. News, **63**, 287) between the two points of metal enclosed in an exhausted glass tube serves well in many cases. No relationship has yet been discovered between the degree of electrical volatility and any known constant, but a relationship might be discovered if the volatilisation were carried on under such conditions of temperature and pressure as would insure molecular conditions in each case.

If the order of the electrical volatility of the metals as found by Crookes be compared with Lothar Meyer's curve of atomic volumes, it will be found that the volatile metals lie at, or near the minima of the curves, close together on the ascending sides in the periods IV., V., and VII., alternating one from the other. Magnesium and aluminium, which are practically non-volatile, lie on the descending side of period III. Aluminium, which is less difficult to volatilise than magnesium, is nearer the minimum of the curve. The metals given in the order of their electrical volatility alternate in the periods as follows:—

Metal.	Comparative Electrical Volatility.—Crookes.	Period.
Pd.....	108.00	V.
Au.....	100.00	VII.
Ag.....	82.68	V.
Pb.....	75.04	VII.
Sn.....	56.94	V.
Pt.....	44.00	VII.
Cu.....	40.24	IV.
Cd.....	31.99	V.
Ni.....	10.99	IV.
Ir.....	10.49	VII.
Fe.....	5.50	IV.

A table is given for a number of metals, in which is given the colour of the films by transmitted light, and the colour of the incandescent vapour as observed, and as indicated from the spectral lines. The colour of a film varies somewhat with the thickness, but each metal has a strong tendency towards a characteristic colour, which is produced when the film is as thick as it can be to transmit light.

Absorption Spectra of Metallic Films.—If the same molecular conditions existed in the film as in the incandescent vapour, we would expect the same absorption; in every case examined, however, the films gave simply general absorption, no bands or lines being indicated.

Metal.	Colour of Film.	Observer.	Colour of Incand. Vapour.	Observer.	Colour of Incand. Vapour as indicated by Spectrum.
Gold.....	Pinkish, violet, blue, blue-green	Faraday, Wright, and others.	.. ..	.. ..	.. ..
Heated to 316°....	Green	Crookes and others	Green	Dudley	Green
" on glass....	Red	Faraday and Wright	.. ..	.. ..	.. ..
Silver.....	Deep blue	Wright	Blue Yellow-green in electric arc.	Stas Dudley	Yellow-green
Copper.....	Green	Wright, Fleming	Green	Dudley	Green
Aluminium.....	Fine blue Brownish	Fleming Wright	Green-blue	Dudley	Green-blue
Bismuth.....	Grey-blue	Wright	Blue, slightly greenish	Dudley	Blue-green
Platinum.....	Blue-grey Purple	Wright Dudley	Blue (?)	Dudley	Blue
Palladium.....	Smoky brown	Wright	Green	Deville and Debray (?)	Green
Lead.....	Smoky brown inclining towards olive.	Wright	Blue	Dudley	Blue
Zinc.....	Grey-blue, less deep than Ag, deeper than Bi.	Wright	Green-blue	Dudley	Green-blue
Calcium.....	Grey-blue about same as Zn, slightly less intense.	Wright	Green	Dudley	Green
Magnesium.....	Grey-blue, similar to Zn and Cd, but less clear.	Wright	Green	Wright	Green
Tin.....	Brown-grey	Wright	Blue (?)	Dudley	Blue-green (?)
Iron.....	Neutral tint with faint tinge of brown.	Wright	Green-blue	Dudley	Green-blue
Nickel.....	Grey or brown-grey	Wright	Blue-green	Dudley	Blue-green
Cobalt.....	Grey or brown-grey	Wright	Green-blue	Dudley	Green-blue
Tellurium.....	Dull purple	Wright	Golden-yellow	Gernez	Orange-yellow
Potassium.....	Blue-violet	Dudley	Violet	Davy	Violet
Sodium heated on glass	Brown-yellow	Dudley	Yellow	Davy	Yellow
Lithium " "	Dark brown-red	Dudley	Red	Arfvedson (?)	Red

—G. H. R.

The Thoferrn Electrolytic Copper Refining Process.
L'Industrie Electr. April 10, 1892; Iron, May 6 and 13,
404—405, 426.

THE process resembles the method adopted at Hamburg and Biache, but improvements have been introduced rendering the method more efficient and economical. Amongst these are—(1) the arrangement of the tanks; (2) the arrangement of the conductors; (3), the composition, heating, and circulation of the electrolyte; (4) the manufacture of anodes and cathodes; and (5) the oxidation of the anodes and the electrolyte. A description and the measurements of the tanks are given.

The dynamos are installed for a normal production of 1 grm. per ampère per hour per tank. In factories where several tons of copper are treated per day Thoferrn arranges his bath in such a way that the loss of E.M.F. per tank is not more than 1.4 volt, so that for 620 tanks an E.M.F. of 19 volts at the dynamo terminals would be required if the conductors absorb about 5 per cent. In small workshops the electrodes have a much smaller surface, and the loss of E.M.F. is about 0.3 volt.

The conductors are calculated so as to absorb not more than 5 per cent. of the total energy, or, in cases where the refining is carried on at a great distance from the dynamos, 8 per cent. The current should not exceed 1 ampère per square mm. of sectional area of the cable from the dynamo to the first row of tanks. The bars placed on the borders of the tanks need be only half the cross section, as two bars form one conductor. The bars are arranged on four rows of wooden girders placed laterally on the right and left of the tanks, the two external girders being at a slightly higher level than the two others, so that the transverse bars carrying the anodes rest only on two bars, as well as those carrying the cathodes. The bars carrying the current to

the anodes in one bath transmit it to the cathodes in the next. For this purpose each bar is twice the length of the bath, and bent in the middle to pass from one set of girders to the other. The groups of tanks are coupled by bars of special form, the baths being thus connected in series without soldering the conductors. The transverse bars supporting the electrodes are of iron, covered at the top with thin copper ribbon, and having a section of 4 centimetres by 3 centimetres. The ribbon is bent beneath the supports at each end of the bar to get contacts of copper upon copper.

The liquid is caused to circulate by means of injectors, pumps, or other apparatus continually raising it from a lower to a higher reservoir, whence it flows to the first tank, then from each tank in succession it is taken at a certain distance from the bottom by siphons to the next tank, successive differences of level of 2 centimetres between the 10 tanks of one group sufficing to ensure good circulation. From the last tank of each group the liquid flows to the collecting reservoir.

Thoferrn has devised the following mode of continuous automatic purification from the impurities with which the liquid becomes charged during working. He employs in each particular case a special arrangement for oxidising the impurities by sending a jet of air through the liquid at a temperature of, or above, 35° C. If pumps are employed to circulate the liquid, a ventilator is used to oxidise the liquid at the moment of falling into the distributing reservoir. If an apparatus similar to the one used in sugar refining is employed, the air escape of the apparatus is connected with the discharge pipe of the distributing reservoir. The action is so energetic that red spots of ferric oxide can be seen in the seum, and the reservoir should be large so as to allow the impurities to settle and the seum to disperse before passing the liquid into circulation.

The liquid is maintained at a temperature of 35° C. throughout the system with little or no extra expense by utilising the heat of coal cinders or waste steam. The anodes are made of different qualities of copper and are sometimes oxidised. In using them each one has two small lugs formed in casting, which are pierced, and by which the anode is hung so that the lug is kept above the surface of the liquid, thus preventing it from being corroded and the anode from falling to the bottom of the bath. The expenditure for attendance and for replacing the hooks is thus greatly diminished. If the plates were made large enough and suspended by strong lugs from the main conductors, all cross-pieces and hooks might be dispensed with, but large electrodes occupying almost the entire width of the bath impede the circulation of the liquid and cause the deposition on the cathode of the impurities of the anode.

To free the electrolyte from impurities a large quantity of free oxygen must be provided in the bath, and through the action of the current this accumulates near the anode, oxidising or peroxidising the impurities, thus rendering them practically insoluble. The oxidised substances form on the anode a small layer of adhesive mud which slowly flows down the walls and falls to the bottom without mixing with the liquid. This mud, being then in the neutral zone between the lower border of the anode and the bottom of the tank, and not affected by the circulation, is not subject to any chemical or mechanical influence. If the circulation of the liquid be not sufficient, part only of the impurities is rendered insoluble directly, and the remainder derives the required oxygen from the liquid itself. This action takes place throughout the entire space between the electrodes; whilst the mud produced is deposited everywhere, on the cathode as well as on the anode and the bottom of the tank, thus rendering the copper deposit very impure. The impurities, in the form of salts which accumulate in the tanks, impede electrolytic action and subsequently necessitate complete purification of the liquid.

The author has used currents of 30, 50, and even 60 amperes per square metre, but it is believed it would generally be well in refining copper not to exceed 50 amperes per sq. m. of cathode, and to use that strength of current only when all the precautions indicated by him are rigorously observed.

The composition of the electrolytic solution varies according to the quality of the copper treated and the current employed, e.g., for raw copper (92–98 per cent. Cu) and current of 30 amperes per sq. m., the composition is,—copper sulphate, 150 parts; sulphuric acid, 50 parts; and water, 800 parts. For raw copper with oxidised anodes and 50 amperes per sq. m., 200, 55, and 745 parts respectively. Finally, for copper coming from the converter containing 98–99 per cent., and afterwards properly oxidised, a current of 60 amperes per sq. m. may be used with advantage, the liquid then having the following composition:—Copper sulphate, 250 parts; sulphuric acid, 60 parts; water, 690 parts.

The cupric sulphate is generally manufactured at the works at the commencement of the electrolytic process, the tanks being filled with a mixture of 110 parts of sulphuric acid and 890 parts of water. If a current of 590 amperes would normally be used, a current of 100 amperes is passed until the composition of the liquid is that mentioned above. It will be understood that only one-fifth the normal amount of copper is deposited by this current, while the oxidised copper, dissolving easily in the acid, rapidly enriches the bath with sulphate, which is of excellent quality and is produced at moderate expense.—A. W.

Practical Notes on the Electrolytic Refining of Copper. F. B. Badt. The Electrical Engineer, New York, **13**, 1892, 598; Proc. Inst. Civil Eng. **110** (iv.), 78–79.

This paper contains a tabulated list of the various refineries electrolytically worked in the United States, the sum total of the output reaching 3,650 tons, and the capital invested in the several undertakings being over 200,000l.

The most general arrangement of vats is the ordinary multiple system of connection of plates as in secondary

cells, the anodes and cathodes being all in parallel in each vat, and the vats being connected in series and parallel to meet the electrical requirements.

The crude material is in general black copper cast into plates of convenient size, and containing 97 per cent. to 98 per cent. of pure copper, and in most of the works is the raw material introduced, though in some the plates are smelted and run from matte of 45 per cent. to 54 per cent. copper.

The solution employed is sulphate of copper, and this is in all cases purchased and not manufactured on the spot.

It should be noted that matte containing less than 30 oz. of silver per ton sells at the market price of copper matte; but if the silver is over that amount, then it is also paid for according to the assay results.

One pound of copper per hour is deposited by about 386 amperes; but the efficiency of the plant can be theoretically raised to any figure by increasing the number of vats and the size of plates, though in practice certain limits are reached which cannot be economically surpassed.

The usual density of current adopted is about 10 amperes per square foot, and this cannot be exceeded without affecting the purity of the copper deposited.

Good circulation of the liquid is also indispensable, and different methods for obtaining it are described; the most successful being afforded by two collecting tanks, into either of which the liquid flows after circulating through the depositing vats, fed from a storage-tank at higher level; these collecting tanks are used alternately, and when one is full it can be closed, and the liquid forced up to the storage-tank by air-pressure.

The scheme advocated for the dynamos is that of separate excitation of the field magnets so as to avoid reversal of current and fluctuation of the voltage.

The cost of a plant to deal with 1,000,000 lb. of refined copper per month, and driven by water-power, is put at about 25,000l., to which must be added the cost of copper under treatment, say 16,000l., and if steam power be required, an additional cost of 4,000l. must be allowed. Electrolytic refining is, therefore, expensive as regards the cost of plant, and should, therefore, be erected on carefully prepared plans of both electrical and mechanical details.—W. S.

PATENTS.

Improvements in the Extraction of Precious Metals from their Ores. W. H. Martin and W. Pethybridge, London. Eng. Pat. 14,823, September 2, 1891.

The pulverised ore, placed in a cylindrical vessel of wood or iron containing a number of iron balls, is mixed with water and ammonium formate, hydrocyanic acid, ammonium cyanide, ammonia or mercuric cyanide; a small quantity of mercury is sometimes added. The cylinder is then rotated at 100–500 revolutions per minute and an alternating or continuous electrical current of high potential passed through the material; air or steam, under pressure, is also forced into the cylinder. After 4–6 hours the solution is separated from the ore by a pump of special construction, the precious metals electrolysed on to carbon plates and the amalgam distilled.—W. J. P.

Improvements in Secondary or Storage Batteries. H. H. Lake, London. From P. Kennelly and C. J. Diss, Brooklyn, U.S.A. Eng. Pat. 16,934, October 6, 1891.

The electrodes are formed of slotted lead plates into the openings of which are inserted the frames which hold the active material which is preferably red lead. These frames are constructed preferably of a material composed of one part by weight of shellac incorporated with five parts, by weight, of finely pulverised glass (see following patent), and are provided with transverse openings expanding inwardly, and are placed one on either side of a conducting strip, and connected to it by heating them until they

become adhesive. The active material is filled into the openings in the frames which are placed in position in the slots in the plate and connected to it.—G. H. R.

Improvements in Secondary or Storage Batteries. H. H. Lake, London. From P. Kennedy and C. J. Diss, Brooklyn, U.S.A. Eng. Pat. 16,938, October 6, 1891.

This invention relates to storage batteries in which the electrical conductivity is provided by a conductor distinct from the structures which supports the active material, the latter being composed of materials which are practically non-conductors (see preceding patent). Some suitable bituminous, resinous, gummy or gum-resinous material which is capable of being brought to a plastic condition, and when in that condition of being mixed with some powdered mineral substance and moulded and subsequently setting into a solid mass which is a non-conductor. The best results are obtained with shellac and powdered glass in the proportions of one part by weight of the former to five parts of the latter.—G. H. R.

An Improved Compound for Insulating, Covering, Moulding, and Analogous Purposes. W. J. B. Banks, London. Eng. Pat. 17,831, October 17, 1891.

APPROXIMATELY equal parts of powdered slate, soap stone, or French chalk, are mixed into a stiff paste with a solution of potassium or sodium silicate, and moulded with light pressure. The articles thus formed are slowly dried and immersed in a saturated solution of calcium chloride, after which they are again slowly dried. A bath of an alkaline stearate, and then one of "compound sulphate of aluminium and potassium" may be substituted. The treated articles may be immersed in tar, bitumen, or paraffin, and may be glazed or polished by known methods.—B. B.

A New or Improved Portable Galvanic Battery. P. Stiens, Berlin, Prussia. Eng. Pat. 4185, March 3, 1892.

ACCORDING to this invention the battery is supplied with a reservoir placed on a shelf above it. This vessel is provided with three openings, one of which is in connection with the air, another is connected with the distributing apparatus, and the third with the pipe and pump which returns electrolyte from the vessel in which it collects after passing through the cells. The cells are arranged in tiers one over the other, and are hermetically sealed. The overflow from each tier is led to a counterbalanced vessel which tips up and discharges into the next lower tier of cells, the overflow from which fills the same counterbalanced vessel, and so on. The overflow from the last tier of cells passes into the lower reservoir from which it can be pumped up again into the upper. Means are provided for regulating the flow of the electrolyte.—G. H. R.

Improvements in and Relating to Electrical Accumulators or Secondary Batteries. D. Young, London. From A. E. Colgate, New York, U.S.A. Eng. Pat. 13,562, July 26, 1892.

THE plates are made of thin strips or ribbons of metallic lead which are perforated transversely in numerous rows. The strips are then corrugated and twisted loosely like a strand of yarn, and these strands are woven by any of the ordinary methods into a band or series of plates. When a sufficient number of the mats have been produced, two or three, or more of them, are laid upon one another and subjected to moderate pressure, whereby compound plates are formed sufficiently compacted to hold together in ordinary handling. The plates are then shaped by trimming their edges and fusing them by a blowpipe flame, and are then fitted into a cast lead frame by fusion of the parts in contact. The plates are then in a finished state and ready for the usual treatment or forming process.—G. H. R.

Electrodes for Secondary Batteries. J. C. Fell, London. From W. Morrison, Des Moines, Iowa, U.S.A. Eng. Pat. 14,044, August 3, 1892.

THESE electrodes are made up of elongated coils of lead ribbon which are compressed and set side by side transversely in a frame. These coils have a hollow space extending nearly their whole length, thus providing for the free circulation of the electrolyte.—G. H. R.

Improvements in Dry Galvanic Batteries. C. C. Lesenberg, Rostock, and J. von der Poppenburg, Berlin, Germany. Eng. Pat. 14,089, August 4, 1892.

THE battery consists of a zinc vessel or cup filled with finely-chopped or ground fibrous materials, such as straw, chaff, and other vegetable matters which have been steeped in hot water. Hydrates of carbon, such as dextrin, glucose, or starch may be mixed with this, and water is added so that the entire mass is moist, and yet will not give off any water. In the centre of the zinc cup is placed a cylindrical hollow carbon electrode which tapers at its upper end. This cylinder has been steeped in an aqueous solution of hydroxide of chromium which has been made by dissolving the precipitate formed on the addition of sulphuric acid to bichromate of potash solution. A small quantity of the hydroxide of chromium is inserted into the carbon cylinder, and the bottom is closed by a cork. When all the parts have been inserted the cell is sealed up.—G. H. R.

Improvements in Electric Battery Plates. E. P. Usher, Grafton, Massachusetts, U.S.A. Eng. Pat. 14,816, August 16, 1892.

THE improvements relate to battery plates which have no internal supporting frame. Tablets of finely-perforated lead filled with dry powdered oxide of lead, and having central longitudinal conducting strips protruding from one end, are taken, and these conducting strips are connected together by a transverse strip. The series of united tablets are held substantially parallel by transverse perforated strips which surround the several tablets, and project therefrom to ensure an open space between adjacent plates and tablets for the free circulation of the electrolyte.—G. H. R.

Improvements in Storage Batteries. E. P. Usher, Grafton, Massachusetts, U.S.A. Eng. Pat. 14,814, August 16, 1892.

THE bottom and sides of the battery elements are enclosed by a flexible wrapper of vulcanized rubber or similar compound, upon the surface of which inclined yielding lips are formed with a grooved space between the adjacent lips to receive the edge of the lead paste, or frame, and to hold it vertical. The lips of each pair separate at the line of meeting of their inclined surfaces to receive the edges of a separator sheet interposed between successive positive and negative plates. The battery plates are cast as a thin sheet with a series of vertical ribs or flanges projecting on opposite sides, between which ribs the active material is introduced, intermediate wells or spaces being preferably left open for more free circulation. The active material is in the form of tablets which may be introduced endwise after the plates and separators are in place. These tablets are preferably made by wrapping the proper amount of dry active material in an envelope of thin lead foil, and then flattening and perforating the envelope.—G. H. R.

Improvements in Diaphragms for Electrolytic Decomposing Apparatus. A. Breuer, Duisburg, Germany. Eng. Pat. 19,775, November 14, 1892.

THE object of this invention is to substitute for the porous partitions of clay, which soon lose their efficiency, particularly when used in the electrolysis of alkaline chlorides, a diaphragm formed of a porous cement substance which

shall be unacted on. Four methods of manufacture are given:—

First.—Sifted pieces of pumice stone or coke of from 4 to 8 mm. thick are carefully mixed with natural or artificial cement, such as lime or magnesia cement, in equal proportions, diluted with water to form a thick paste, and put in moulds. After setting, the moulded pieces can be used. The thickness of the pieces of pumice stone or coke depends on the thickness of the moulded pieces to be obtained. The pieces of pumice stone or coke mentioned in this example are suitable for the manufacture of plates of from 12 to 15 mm. thick.

Second.—35 litres of reduced rock-salt are mixed with 65 litres of natural or artificial cement, such as lime or magnesia cement, diluted with water to form a thick paste, and put in moulds. In lieu of rock-salt use may be made of other soluble salts. After setting, the moulded pieces or plates are lixiviated with water.

Third.—50 litres of natural or artificial cement, such as lime or magnesia cement, are intimately mixed with 36 litres of a solution of rock-salt, which contains about 250 grms. of rock-salt per litre, and 14 litres of hydrochloric acid, proceeding as stated in the second example. The solution of rock-salt can be replaced by other solutions of metallic salt, and the hydrochloric acid by other (inorganic or organic) acids.

Fourth.—100 litres of natural or artificial cement, such as lime or magnesia cement, are intimately mixed with 2 kilos. of cow hair or woollen yarn cut to pieces, diluted to form a thick paste and put in moulds. Such moulded pieces or plates possess after they are set such a porosity that in the use of the same a greater resistance to the current does not occur; in use the hair or the woollen fibres are gradually dissolved in the liquor, thereby rendering the plates still more porous.—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Viscosity at Low Temperatures of Black Mineral Oils. Holde. Mitth. Königl. Techn. Versuchs. 1892, 126—130.

See under XXIII., page 941.

The Determination of the Purity of Olive Oils. F. Lengfeld and L. Paparelli. Rev. Internat. des Falsificat. 5, 1892, 98.

See under XXIII., page 943.

PATENTS.

Improved Composition for Treatment of Fibrous Material, either during or after Manufacture, also Applicable as a Household Article for Washing, Cleaning, and other Purposes. G. E. Armstrong, New York, U.S.A. Eng. Pat. 17,325, October 12, 1891.

VEGETABLE oil or grease is saponified with caustic soda of 1·16 sp. gr. From this saponaceous mass the glycerin may or may not be removed. The material is, when cold, cut into slices, thoroughly air-dried, and pulverised. It is then mixed with sodium carbonate and rosin in the following proportions:—sodium carbonate, 41·5 to 65; saponaceous mass, 10 to 33·5; rosin, 25. A solution of the above may be used for washing for household purposes, as a substitute for soda-ash in bleaching, and for imparting certain desirable properties to raw fibre.—A. J. K.

Improvements in Bleaching, Deodorising, and Purifying Fats and Oils, and Apparatus therefor. W. Mills, Peckham, London. Eng. Pat. 18,224, October 23, 1891.

THE inventor purifies and bleaches non-drying fats and oils by means of a mixture of hot air and volatilised sulphuric trioxide (anhydride) which is passed by suitable pumps and in a suitable state of sub-division (by means of perforated pipes) into a "mixer" capable of withstanding a pressure of two atmospheres. The bleaching is said to be specially efficient owing to the decomposition of the sulphuric trioxide into sulphurous acid and oxygen, both of which are acting as *in statu nascendi*. The bleached oils are finally purified by well-known methods. Three sheets of drawings illustrate the apparatus for carrying out this invention.—J. L.

An Improved Fluid Soap. F. G. Haigh and W. C. Haigh, Manchester. Eng. Pat. 18,632, October 29, 1891.

THE patent is claimed for a soap consisting of 20 parts of water, 2 parts of paraffin, 2 parts of resin, 4 parts of fat, and 1 part of caustic potash.—J. L.

Improvements in the Manufacture of Soap. J. Taylor, Leith. Eng. Pat. 19,297, November 7, 1891.

THE inventor combines a mixture of resin soap and sodium sulphate with any ordinary soap, and adds finally borax or sodium silicate.—J. L.

An Improved Cleansing Material. H. E. Walter, Brixton. Eng. Pat. 20,445, November 24, 1891.

THE improved cleansing material consists of ordinary soap with which animal or vegetable fibres are incorporated.—J. L.

A Process of Extracting, Purifying, and Saving the Fat or Grease from Wool, and for Cleaning the Wool by the use of Benzole (Benzene) or any other Spirituous Liquid suitable for Dissolving the Fat or Grease. J. Trent and G. Henderson, Christchurch, New Zealand. Eng. Pat. 15,012, November 26, 1891.

RAW wool is soaked in benzene, &c. and the dissolved fat removed by means of a press or rollers. The solvent used is recovered by distilling off the volatile benzene, &c. from the grease.—J. L.

Improvements in the Manufacture of Soap. E. J. T. Digby, London. Eng. Pat. 20,590, November 26, 1891.

A SOAP of "great hygienic and cleansing properties and much cheaper than ordinary soap" is prepared by mixing with soap, weight for weight, oyster or other shells which have been cleansed by acetic acid, powdered and "boiled with sulphate of potash, or soda, or other equivalent substance into a true paste."—J. L.

Improvements in the Separation of Wool-Wax from Wool-Fat, and in the Preparation of Lanoline from the more Fluid Residue. B. Jaffé and L. Darmstaedter, Charlottenburg, Germany. Eng. Pat. 14,114, August 4, 1892.

THE object of this invention is to separate the constituents of the wool-fat into different groups of varying hardness, the harder wax-like parts being recommended as a substitute for bees-wax, the softer being worked into lanolin by known methods. For this purpose the wool-fat is dissolved in a heavier benzene (paraffin hydrocarbon), benzene, toluene, xylene, ether, chloroform, bisulphide of carbon, or turpentine oil, and to this solution is added methyl- or ethyl-alcohol, which precipitates the harder substances of the wool-fat. The hardness and quantity of

the separated wax-like substances may be varied by the quantity of alcohol added; the smaller the quantity separated, the harder is the product, the harder substances being the first to separate. The softer fats remain dissolved and are recovered by distilling off the solvents. The same result can be obtained in a cheaper way by dissolving the wool-fat in fusel oil, acetone, acetic ether or its homologues, and cooling the solutions a few degrees below the melting point of the hardest substances. Instead of cooling the solutions alcohol may also be used for fractionally precipitating the harder constituents, as described above.—J. L.

Improvements relating to the Desulphuration of Oils. H. H. Lake, London. From O. P. Amend and J. H. Maey, New York, U.S.A. Eng. Pat. 14,405, August 9, 1892.

The patentees recommend the refinement of petroleum oils containing sulphur compounds, as Ohio and Canadian oils, by vaporising the oil, subjecting the oil-vapour, together with the sulphur contained therein, to a temperature above the boiling-point of the latter, and by this means vaporising the sulphur, then exposing the latter to the action of such chemical agents as will act upon or will combine with sulphur, and finally condensing the oil. The patentees prefer, in order to insure the complete vaporisation of the sulphur, a red heat clearly distinguishable in daylight, and have found temperatures between 700 and 1,200° very successful in practice. They recommend the use of a number of chemical substances that will unite with sulphur when vaporised, as for instance, various metals, their oxides, and sub-oxides. The oxides and hydroxides of the alkalis also give good results, but preference is given to the employment of oxidising agents, such as manganese dioxide and other higher oxides of manganese, barium peroxide, the manganates and permanganates, chromates and dichromates, chromic iron ore, and lead dioxide.—D. B.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Investigation of the Properties of India-Rubber and Data for the Establishment of Rules for its Reception in the (Russian) Navy. Lieut. L. Vladimiroff, Morskoi Sbornik, St. Petersburg, 1892, 57; Proc. Inst. Civil Eng. 109, 75—76.

Owing to the want of an established system of testing vulcanised india-rubber, and to the fact that chemical analysis gives no reliable results, the author was induced to make in the St. Petersburg Technical Institute a series of experiments upon the best means of testing this substance. The samples were supplied by the Russo-American factory of St. Petersburg and by the Moscow factory of that city. The experiments were comprised under the following heads:—

- (1) The behaviour of various qualities of rubber at high temperature until the appearance of signs of damage.
- (2) The determination of the extension at the moment of rupture of test-pieces of various sectional area.
- (3) The determination of the percentage of ash.
- (4) The determination of the percentage soluble in carbon bisulphide.
- (5) The determination of the hygroscopic capacity.

The influence of temperature was determined by exposing samples, several cm. long and from 3 to 6 cm. thick, in an air-bath, to a temperature of 125° C. The samples were then bent first to an angle of 45°, and then to 180°, and were examined for cracks. It was shown that the best qualities should withstand an exposure to 125° C. for five hours without any external change.

In the second series of experiments it was proved that the extension did not sensibly vary, for a given quality, with the thickness or sectional area, and that the extension did not in any case exceed 12 per cent. of the original length of the test-pieces.

The amount of ash was found to be independent of the specific gravity and extensibility. The colour of the ash indicated the presence of certain metallic acids.

It was found that the extensibility multiplied by three times the specific gravity gave a constant = 11.1.

The solubility in bisulphide of carbon was determined in Saucote's apparatus, but did not give any practical results.

After drying in a desiccator for three weeks, no samples gave a loss in weight of exceeding $\frac{2}{3}$ per cent.

The author deduces the following conclusions from his experiments:—

(1) India-rubber should not give the slightest signs of superficial cracks on being bent to an angle of 180° after five hours' exposure in a closed air-bath to a temperature of 125° C. The test-pieces should be about 6 centimetres thick.

(2) Rubber containing not more than 50 per cent. by weight of metallic oxides, should stretch to five times its length without breaking.

(3) Pure caoutchouc, free from all foreign matter except the sulphur necessary for its vulcanisation, should stretch seven times its length without breaking.

(4) The extension measured immediately after rupture should not exceed 12 per cent. the original length of the test-piece. The test-pieces should be from 3 to 12 mm. wide, and not more than 6 mm. thick, and 3 cm. long.

(5) The percentage of ash gives a certain indication of the degree of softness, and may form a basis for the choice between different qualities for certain purposes.

Moreover, any excess of sulphur over that required for vulcanisation should be removed at the works, and should not appear on the surface of any object. Also the sulphur should not harden under the influence of frost.—W. S.

The Durability of India-Rubber Hot-Water Pipes. E. Belleruche. Rev. Univ. des Mines, 18, 1892, 25; Proc. Inst. Civil Eng. 110 (iv.), 21.

On the Grand Central Railway of Belgium the warming of the carriages by hot water circulating through pipes connected by india-rubber coupling tubes from carriage to carriage, was introduced in 1882, and from that date observations have been made in order to determine the average duration of the connecting pipes. On the Charleroi and Vireux section of the line, where the first experiments were made, the number of pipes in use increased from 26 in 1883 to 89 in 1891, the ages of which at the end of each year are given in a table, from which it appears that no loss was experienced on the original number of 26 for four years, after which they became worn out in increasing numbers, and were entirely gone at the end of the ninth year. The mean age of the tubes at work at the end of 1891 was 3.5 years. The author hopes the age will be increased by the adoption of a new system of connections which will materially diminish the wear and tear incidental to coupling and uncoupling the carriages.—W. S.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Analysis of Commercial Yolk of Egg. F. Jean. Monit. Scient. 6, Aug. 1892, 561.

See under XXIII., page 941.

PATENTS.

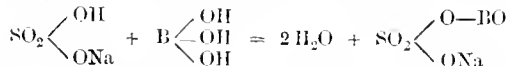
Improvements in or Relating to the Finishing of Leather. B. J. Gibney, Nottingham. Eng. Pat. 18,951, November 3, 1891.

WITH the object of strengthening fragile skins or the thin portion of split skins, a sheet of linen, canvas, paper, or other material is cemented or pasted thereon. Thus prepared the skins may be put through the ordinary finishing operations which otherwise would be too severe.—W. M. G.

A New or Improved Process for the Production of Boron Sulphate Compounds, and the Application of such Products to the Unhairing of Hides or Skins, and to the Prevention of Putrefaction. E. Edwards, London. From H. Bauer and J. Gyiketta, Stuttgart, Germany. Eng. Pat. 19,637, November 12, 1891.

THE new compounds called "borol" are made by adding by degrees an equivalent part of boric acid to an equivalent part of a fused bisulphate—such as bisulphate of potash or soda—and heating the mixture to 500° C. Or under the same conditions heating a borate with a monosulphate and sulphuric acid. Water is expelled, and the new compound "borol" remains as a clear fluid mass, which, on cooling, forms a transparent, glassy, brittle body.

Thus—



The substance is soluble in water, and has an acid reaction and taste. Although containing proportionately a small quantity of boron it has greater antiseptic properties than boric acid. For these reasons it is well suited for unhairing hides and skins, and for preserving animal and vegetable substances from putrefaction.

For unhairing hides, "the pit of the tannery is to be three-quarters filled up with lake-warm water. To this water is added and mixed therewith a proportionate quantity of 'borol,' amounting to from $\frac{1}{4}$ to $\frac{1}{2}$ per cent. of the water." "The hides to be unhaird should first be freed from all impurities by soaking, and then placed so cleansed in the said solution, and allowed to remain in it about a quarter to half an hour according to the kind of leather. The hides are then removed and worked in a fulling trough with water, after which they are ready for tanning. For preserving and disinfecting purposes powdered 'borol' is to be mixed with suitable indifferent substances," such as common salt, Glaubers salt, &c.—H. S. P.

Improvement in the Manufacture of Animal Glue. E. Brand, Rostock, Germany. Eng. Pat. 15,630, August 31, 1892.

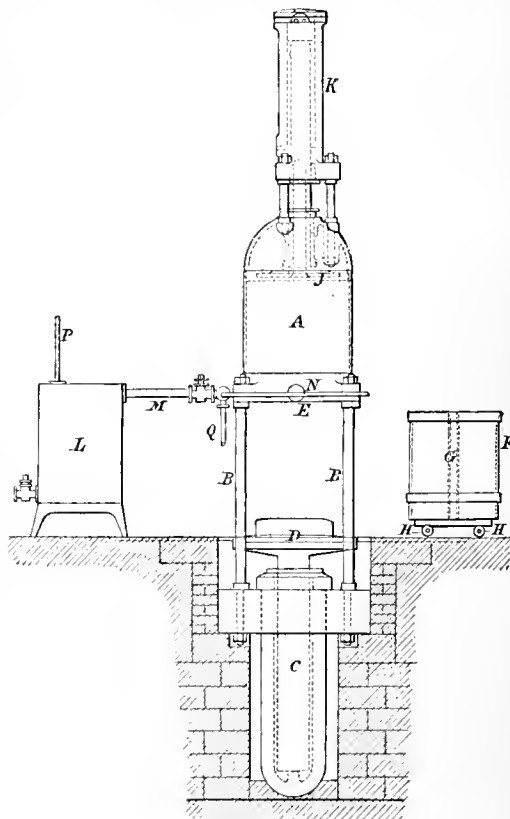
THE inventor adds to the glue a mixture of borax and calcined potash, as borax alone is not sufficiently alkaline to kill the corrupting bacteria in the glue gelatin. The process is performed by dissolving 60 kilos. of ground borax in 100 kilos. of boiling water containing 4 kilos. of 90 per cent. calcined potash, and then pouring this into 1,450 kilos. of hot glue liquor showing 12° by the hydrometer. The product so obtained will keep for a long time without developing any obnoxious smell. Printed work when coated over with this glue is rendered more durable, and it will also be found superior to cake glue in the carpet and leather manufacture, also in bookbinding.—L. de K.

XVI.—SUGAR, STARCH, GUM, Etc.

PATENTS.

Improvements in Apparatus for Extracting Juice from Sugar Canes. D. Stewart, Glasgow, Lanark. Eng. Pat. 16,464, September 29, 1891.

IN the subjoined drawing, A is an open vessel supported by pillars B above an upwardly acting hydraulic press C, the plate D, of which is exactly adapted to the flanged bottom edge E of the vessel A; when D is raised it closes A tightly. F is a perforated shell in which the canes are placed vertically, it may have an inner perforated tube G, thus making the space for the canes annular. The shell is run on to the plate D by a truck, or on wheels H and is thence raised by the hydraulic press C into the vessel A. The piston J of the hydraulic press K is then forced down upon the canes, whereby they are crushed and a large portion of the juice expressed. This juice is then drawn by



means of pumps (not shown) connected with the pipe P, into a closed receptacle L, which communicates with the bottom of the vessel A by pipes M and N—preferably by several connecting branches round the circumference of A. After drawing off the expressed juice, the piston J is raised, and water or syrup of suitable strength (preferably hot) is forced through pipes Q and N into A to extract the remaining saccharine matter from the crushed canes. The crushing operation may be repeated if necessary. This improved apparatus thus consists of an inverted vessel, a hydraulic press arranged for closing the bottom of the vessel and lifting up into it a shell or basket containing sugar canes, a piston moved downwards by hydraulic pressure for crushing the canes, a vessel to receive the juice, pipe connections with pumps for producing vacuum, and pipe connections for injecting water or syrup, the parts being combined, and operating as described.—A. R. L.

Improvements in Apparatus for Separating Impurities from Sugar. J. Drummond, Govan, N.B. Eng. Pat. 20,119, November 19, 1891.

A SERIES of perforated plates are arranged horizontally round a vertical revolving axis. At one part of the circuit the sugar is fed on to the plates and the movement takes it under a horizontal bar which regulates the thickness of the mass on the plates. At further stages the sugar is subjected to the action of compressed air and of washing liquors, and is finally deflected off the plate by a scraper into a hopper.

—A. J. K.

Improvements in Centrifugal Machines or Hydro-extractors for Extracting Sugar Juice and for other Purposes. J. C. Mewburn, London. Eng. Pat. 20,142, November 19, 1891.

By a special design a centrifugal machine is constructed which will work continuously and can be filled and emptied without stopping the machine.—A. J. K.

New or Improved Process and Apparatus for Concreting Sugar or Crystallising Saline or other Solutions. W. P. Thompson, Liverpool. From J. A. Morell and W. R. Stringfellow, New Orleans, U.S.A. Eng. Pat. 8336, May 3, 1892.

See under 1., page 895.

XVII.—BREWING, WINES, SPIRITS, Etc.

The Pentosans (Wood-Gum, Xylan, and Araban) of Lignified Fibre. C. Schulze and B. Tollens. *Annalen.* 271, 1892, 55–59.

DRIED brewers' grains were washed successively with 2 per cent. ammonia and water, and dried. A portion was treated with 5 per cent. soda-lye (6 parts) for two days, when a gelatinous mass was obtained, which, when freed from the liquid portion, and washed with alcohol, hydrochloric acid and ether, left 7 per cent. of the original weight of material employed as wood gum of specific rotatory power $[\alpha]_D = -70.11$; this on hydrolysis with dilute sulphuric acid yielded a mixture consisting mostly of xylose, but containing a little arabinose. Another portion of the extracted grains was boiled for six hours with 4 per cent. sulphuric acid when a mixture of xylose and arabinose, similar to that mentioned above, was isolated from the solution; whilst the residue on digestion with soda-lye partially dissolved, and from the solution a brown gum—identical with Hoffmeister's cellulose gum—was obtained. The residue after this treatment was completely soluble in ammoniacal cupric oxide; it was not, however, pure cellulose, but showed, on warming with dilute hydrochloric acid, the presence of pentoses. It is therefore possible, by the above treatment, to dissolve the lignified cells of the grains, and since xylose and arabinose are found to be invariable products of hydrolysis, the presence of the pentosans, xylan and araban, is demonstrated. The complete separation of cellulose and the pentosans was not, however, accomplished, and the authors believe that these compounds exist in combination in the original material. E. Schulze has, indeed, shown (*Zeits. f. physiol. Chem.* 16, 436) that a cellulose containing both dextrose and xylose groups is present, together with lignin proper, in lignified fibre.—A. R. L.

Note on some Conditions under which the Fluorides exert a Maximum Effect in Solutions of Fermentable Matter. J. Effront. *Monit. Scient.* 6, 1892, 81–85.

As the result of further investigations the author finds that acidity is the most important factor that governs the antiseptic action of fluorides on the lactic, butyric, and acetic

ferments. In a neutral or alkaline medium, fluorides and even hydrofluoric acid, have no retarding influence. In fact, the lactic ferment was found to develop in an alkaline or neutral wort, containing as much as 50–100 mgrms. of a soluble fluoride per 100 cc. The antiseptic action only becomes evident in an acid medium, and is proportional to the amount of acid present. An addition of 3–6 mgrms. of a fluoride to ordinary distillery wort suffices to arrest completely the growth of acid ferments; and the dose may be reduced to 0.005 to 1 mgrm. if the wort contain 3 grms. of acid (calculated as H_2SO_4) per litre. Temperature is another factor, although only of secondary importance, the maximum antiseptic effect being obtained at 50° – 60° C.

As regards the action of fluorides on yeast, the chemical composition of the wort plays a most important part. The author has previously shown that the addition of 6 mgrms. of fluoride to a pure cane-sugar fermentation renders the yeast perfectly inert. In the case of malt wort this experience is completely reversed, a distinct increase in the fermentative and reproductive power of the yeast being observed. This difference in behaviour was eventually found to be due to the phosphates, particularly potassium phosphate, always present in wort. Experiments illustrating this fact were made with molasses. Similar results were obtained when pure yeast was used in the fermentations. The influence of phosphates is less marked when a large excess of yeast is employed. The degree of acidity of a wort when it exceeds a certain limit greatly accentuates the retarding influence of fluorides on yeast. Thus, in a malt wort containing per 100 cc., 540 mgrms. of lactic acid, 0.5 mgrm. of HF produces a distinct effect, whilst in presence of 10 mgrms. fermentation and yeast reproduction are almost completely arrested. In quantities up to 360 mgrms. lactic acid has but little influence. (See this Journal, 1890, 748, 1055; 1892, 50, 626–627.)—H. T. P.

PATENTS.

Improvements relating to the Production and Preservation of Pure Yeast. H. E. Newton, London. From La Société Anonyme "La Levure," Paris. Eng. Pat. 13,088, August 1, 1891.

THE fermenting vessel consists of a closed metallic vessel with the necessary connections, attemperator, &c. Sterilised wort is run in and seeded with a pure cultivation of yeast. Sterilised air is blown through the wort as the fermentation proceeds with the object of increasing the yield of yeast. When the fermentation has ceased, the contents of the vessel are led into a filter, consisting of a conical vessel of perforated sheet iron or wire gauze, and covered with a cloth. The yeast remaining on the cloth is mixed with wort containing 5–15 per cent. gelatin and run into sterilised vessels, which are then sealed and may be kept with unimpaired quality for some time.—A. L. S.

Improvements in the Manufacture of Spirits. H. A. Snelling, London. Eng. Pat. 17,558, October 14, 1891.

THE object is to obtain a spirit with a fine flavour from fermented wort prepared from raw grain.

Before fermentation the wort is mixed with hops, about 10 lb. to every 100 gallons of wort, and the fermented liquor distilled. Before the second distillation, a further amount of 4–5 lb. hops are added to every 100 gallons. The hops are best prepared by first withering in the air for 4–24 hours, and then heated to 240° F. in a "Davidson's sirocco" for 15 minutes.—A. L. S.

Improvements in the Method of and Apparatus for Securing a Continuous Time Record of the Rate of Distillation and Direction of Flow of Distilled Fluids. J. J. McDaniel, Bandon, Co. Cork. Eng. Pat. 17,750, October 16, 1891.

THE condenser discharges into an open receiver, from which pipes lead to the different vessels. The apparatus is so

arranged that the distillate can only escape by one of these pipes at a time. A small open vessel is in communication with each of these pipes, and in it is a float. The movements of the float are communicated by a cord to a pencil, which marks on a rotating cylinder the variations in the height of the float; as this is proportional to the rate of flow from the condenser, a continuous record is thus obtained.—A. L. S.

Improvements in Drying and Calcining Brewers' Refuse and Grains and other Substances and Materials. E. Barlow, Manchester. Eng. Pat. 18,833, October 31, 1891.

THIS is an improvement of the apparatus described in Eng. Pat. 12,535 of 1890, for drying the above-mentioned substances in a rotating cylinder heated in a furnace.

If hot air be supplied to the interior of the cylinder, eaking and burning of the substances are avoided, and a better and more marketable product is obtained.

The air is heated by passing through a tube placed in the upper part of the furnace, and is distributed in the interior of the rotating cylinder by a perforated tube concentric with its axis.—A. L. S.

Improvements in Kilning Malt, and in Structures and Apparatus therefor. R. H. Leaker, Bristol. Eng. Pat. 18,997, November 4, 1891.

THE kiln is very similar to an ordinary malt kiln, and is provided with two floors. The special arrangement is that the heated air after passing through the malt on the lower floor does not pass through the malt on the upper floor, but escapes by a separate flue, and the heated air for the malt on the second floor is conducted from the fire to the malt by a flue, and after passing through the malt escapes through openings in the roof.

The flues are provided with dampers so that either floor may be used separately or both together.—A. L. S.

An Improved Process of Finishing Beer. J. F. Witteman. New York, U.S.A. Eng. Pat. 6531, April 5, 1892.

THE patent relates to the brewing of lager beer. It is proposed to conduct the fermentation under a pressure of air or carbonic acid gas and maintain or increase the pressure until the beer has become brilliant and is racked.

—A. L. S.

Improvements in the Treatment of Hops and their Use in Brewing. B. J. B. Mills, London. From "The Brewing Improvement Company," Maywood, New Jersey, U.S.A. Eng. Pat. 9777, May 23, 1892.

BEFORE using hops in the copper or cask, it is proposed to subject them to the action of dry heat until they are parched. It is claimed that there are many advantages in using hops which have undergone this treatment.—A. L. S.

Improvements in Methods and Apparatus for Carbonating Beer. B. J. B. Mills, London. From "The Universal Carbonating Company," Newark, New Jersey, U.S.A. Eng. Pat. 12,413, July 5, 1892.

THIS relates more particularly to lager beer. The carbonating apparatus consists of a tube through which the beer passes at a pressure of 20 lb. on the square inch, and into which carbonic acid gas is injected. The unabsorbed gas is re-injected into the uncarbonated beer. After filtration the beer is racked at a sufficiently high level to reduce the pressure to 5–8 lb. per square inch.—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOODS.

Note on the Optical and Chemical Analysis of Butter. F. Jeun. Monit. Scient. 6, 1892, 91–98.

See under XXIII., page 945.

The Reaction of Milk to Phenolphthalein. L. Vaudin. Bull. Soc. Chim. 7–8, 1892, 283.

THE milk of all the animals that the author has examined is acid to phenolphthalein when fresh. That of the sheep, goat, and cow, is fairly strongly acid; that of the mare, ass, sow, bitch, and woman, is feebly acid. By the former term is meant an acidity corresponding to about 1 or 2 grms. of phosphoric acid per litre, whilst the quantities included in the latter phrase range from 0.1 to 0.4 grm.

The author has also studied the differences in the acidity of the milk of the cow at various periods before and after parturition; he has found that the acidity diminishes to about one-half when the pregnant animal is on the point of ceasing to give milk, and becomes two or three times as great as usual when calving is about to take place. The influence of fodder is small for the same animal. Evening milk is always less acid than that drawn in the morning or at midday. The variations due to differences of breed or of soil are not great. In short, the greatest effect is that due to individual peculiarities.—B. B.

PATENTS.

Improvements in Apparatus for the Manufacture of Butter. N. Rolland and H. Francois, Brussels, Belgium. Eng. Pat. 15,352, September 10, 1891.

THE invention relates to apparatus for butter-making, and provides improved means for the passing of bubbles of purified air through the milk, which will cause the required agitation and the complete separation of the butter.

The apparatus consists essentially of a suitable generator of an air current, such as a fan or blower, a purifying vessel containing a suitable material for filtering the air, and a churn connected with the blower by a pipe which delivers the air into a perforated box placed in the bottom of the churn, and made of two flanged parts riveted or bolted together, the said air escaping from the box and then rising through the milk.

The cylindrical sides of the box are best extended upwards and connected to an outer cylinder, so as to provide an annular chamber communicating, by means of perforations, with the box below and laterally with the liquid within the upwardly extending sides so that the milk is acted upon both in a horizontal and vertical direction. The air purifier is constructed of a cylindrical vessel provided with a cover fastened by means of a catch, so as to renew the wadding. To prevent particles of wadding from entering the air-pipe, the vessel is provided at each side with a nozzle, in front of which is arranged a sieve or grating allowing of the passage of the air.

—L. de K.

Improved Apparatus for the Production of Dry Extract of Coffee or Tea. P. Meyer, Paris, France. Eng. Pat. 17,363, October 12, 1891.

THE process employed is an improvement on the one described in Eng. Pat. 19,882, December 10, 1889. It is now also extended to the manufacture of dry extract of tea.

The process consists essentially in preparing an extract of coffee or tea and flavouring this with the essential oils derived from the roasting of either coffee or tea.—L. de K.

An Improved Blood-forming Substance and Method of Producing the Same. E. R. Kobert, Dorpat, Russia. Eng. Pat. 19,859, November 16, 1891.

THE invention relates to the preparation of a blood-forming medicine superior to iron albuminates, iron peptonates, and homoglobin preparations on account of the greater proportion of available iron which it contains.

Fresh, defibrinated blood suitably diluted with water is mixed with a reducing agent, such as a saturated solution of pyrogallie acid. A voluminous precipitate is obtained, which is washed first with water and then with alcohol. After drying, the preparation is ready for use; it contains 1 per cent. of iron.

It, instead of pyrogallie acid, other reducing agents, such as zinc, iron, and the like, are used, the precipitate must be subjected to a purification so as to remove the last traces of the reagent used. This is best effected by treating it with a saturated solution of sal volatile, and after filtering off from any deposit, it may be reprecipitated by cautious addition of weak hydrochloric acid. It is thus obtained as a brownish-red precipitate, which must be washed with water and then dried over sulphuric acid or calcium chloride.—L. de K.

Improvements in Fodder Cakes. A. J. Boulton, London. From A. W. Rehnström, Mülhammar, Sweden. Eng. Pat. 10,266, May 30, 1892.

THE object of the inventor is to utilise the whey obtained in dairies after the manufacture of cheese, and to obtain therefrom a substantial, wholesome, and fattening food for calves and other young cattle.

After the whey has been reduced to a small bulk by evaporation, it is mixed in varying proportions with linseed cake, maize, rice, peas, beans, or similar foods, to which a little bone-dust may also be added. The commingled ingredients are then made into cakes of suitable form by subjecting them to pressure. To obtain the cakes in a more porous state, the ingredients may be mixed with carbonate of soda and hydrochloric acid. They are formed without being subjected to pressure, and after being baked in an oven they are ready for use.—L. de K.

Improvements in Soluble Chocolate and the Process of Preparing the Same. S. T. Achon, Brooklyn, U.S.A. Eng. Pat. 13,615, July 26, 1892.

THE inventor has improved a composition which is a confection and at the same time a basis to form a chocolate beverage without boiling.

About 1 lb. of chocolate, 1½ lb. of sugar, and 1 pint of cream or condensed milk is heated and made into a thick paste, and finally stiffened by adding more sugar until it can be handled and moulded into pieces of suitable size. The pieces are then immersed in a thick syrup of sugar and water until they are covered with crystallised sugar, when they are taken out and allowed to dry.

This produces a hard close covering of sugar all over the central mass, excluding the air, and so preserving the preparation indefinitely. The cakes readily dissolve in warm water.—L. de K.

Improvements relating to the Production of Cheese. E. G. N. Salenius, Stockholm, Sweden. Eng. Pat. 13,641, July 26, 1892.

THE liquid designed for making cheese, such as skim milk, fatty milk, or cream, is heated to a suitable temperature and introduced into a continuous butter-making machine. Rennet or a suitable acid should be mixed with it either before or after it is put into the apparatus. In the production of fat cheese it is advantageous to agitate the liquid during the centrifugal action, but this is not necessary when meagre cheese is wanted. Colouring agents or flavouring matters may be added in drops or continuously to the liquid during its treatment in the apparatus. The

curd or cheese mixture is finally treated in the ordinary manner to obtain cheese, the curd and the whey having been removed either together or separately.

The apparatus employed has been already described in Eng. Pat. 21,068, December 24, 1890, but the liquid may also be treated or agitated by other means.—L. de K.

(B.)—SANITARY CHEMISTRY.

The Purification of Waste Water from Works by Alumina. Rev. Ind. 23, 386.

THE waters, which remain clear for some days, contain 500 to 800 grms. of fatty matter per cubic metre. If to 1 litre of this liquid is added 1 grm. of alumina, together with 15 to 20 per cent. of water, the solution turns brown, and a precipitate is formed which, when heated to 100° C., leaves a residue weighing 1.6 grm., and containing 30 per cent. of fatty matter. Also, if to a solution of soap in distilled water to which a few drops of hydrochloric acid had been added, a small quantity of alumina be now added, the liquid is instantly cleared with formation of an abundant precipitate.—G. H. R.

Is Magenta Poisonous? P. Cazeneuve. Monit. Scient. August 1892, 557—560.

See under IV., page 900.

PATENTS.

Improvements in or Appertaining to Disinfectants for Water-Closets and other Places or Things where Water is used. H. B. Thornton, Liverpool. Eng. Pat. 13,262, August 5, 1891.

FOR details concerning this invention consult the inventor's later patent (Eng. Pat. 17,421, 1891; this Journal, 1892, 365).—H. T. P.

Improvements in Apparatus for Filtering Polluted Waters and other such Liquids. F. P. Candy, London. Eng. Pat. 16,604, September 30, 1891.

THE special feature in this apparatus is the facility with which the filtering material can be washed. The apparatus consists of a cylindrical vessel provided with a perforated false bottom on which the filtering material rests. A vertical shaft, which can be rotated from the outside, reaches down to the false bottom, and carries at its lower end a number of agitating blades, corresponding baffling arms being attached to the wall of the cylinder. The filtering material, if very light (cork), is pressed down by means of a perforated cover, which can be raised to the top of the cylinder when necessary. The apparatus is constructed to filter downwards. When it is required to cleanse the filtering medium, the perforated cover is raised to the top of the apparatus, a stream of water is introduced below the false bottom, and the central shaft with vanes is caused to rotate. By this means the filtering material is violently stirred up with a large volume of water, resulting in the rapid elimination of all impurities, which escape through the perforated cover and flow off through a pipe near the upper end of the cylinder.—H. T. P.

The Utilisation of a Certain Waste Oxide of Iron in the Purification of Sewage, and for similar Purposes. H. C. Saceré, Pendleton, and H. Grimshaw, Manchester. Eng. Pat. 17,911, October 20, 1891.

ACCORDING to this invention, the ferric hydrate obtained as a waste product in the purification of zinc chloride is utilised for the production of ferric chloride or sulphate. These salts may be employed in the purification of sewage, coal-gas, and for many other purposes.—H. T. P.

An Improved Process for Oxygenating, Deodorising, and Disinfecting Sewage or other Fermentable or Noxious Matters. A. P. Hope, Mayland, Wellingborough, Norths. Eng. Pat. 17,924, October 20, 1891.

THE sewage, &c., is treated in suitable tanks with a current of "antiseptic" steam until deodorised. The antiseptic steam is generated from a solution of 1 gall. of "Bacillite" (composed of cresylic oil, 8 parts; sulphur, $\frac{1}{2}$ part; hydrate of soda, 2 parts; carbonate of soda, 1 part; resin, 2 parts, boiled for 2 hours) or other suitable disinfectant, in 200 galls. of water. This quantity is said to be sufficient to disinfect 4,000 galls of sewage.—H. T. P.

New or Improved Method in Sewage Precipitation. G. C. Purvis, Edinburgh. Eng. Pat. 18,286, October 24, 1891.

THE sewage is charged with sulphur dioxide or carbon dioxide, or a mixture of the two gases, thorough absorption being secured by effecting the treatment in tanks fitted with baffling plates, or by allowing the sewage to trickle over coke, &c., arranged in towers through which a current of the gas ascends. Milk of lime is then added, and also, if desired, small quantities of aluminium and iron salts. Sufficient lime must be employed to precipitate the dissolved gas or gases as insoluble calcium salts, to decompose any iron and aluminium salts added, and finally, to neutralise the acidity (if any) of the sewage. In treating neutral or faintly alkaline sewage of average composition, the following quantities of the different materials may be employed per gallon:— SO_2 , 7.5 grains; CaO , 7.5 grns.; aluminium sulphate, $\text{Al}_2(\text{SO}_4)_3$ 18 H_2O , 4 grns. In addition to the above, 1—5 grns. of finely-powdered charcoal may be added. Excess of lime should be avoided in order that the effluent from the sewage may be as nearly neutral as possible.—H. T. P.

An Improved Preparation for the Alleviation and Cure of Open Wounds, Cuts, Sores, Burns, Scalds, and the like. A. Roth and A. Roth, London. Eng. Pat. 13,277, July 20, 1892.

THE preparation is made as follows:— $\frac{1}{4}$ lb. of rosin and 3 oz. of clarified beef suet are boiled together for a quarter of an hour; 2 oz. of bees'-wax are then added, and the whole is boiled for half an hour more. Subsequently the mixture is allowed to set, when it is ready for use.—H. T. P.

(C.)—DISINFECTANTS.

PATENTS.

An Improved Fluid Insecticide. H. H. Lake, London. From A. G. Pummerer, Wels, Austria. Eng. Pat. 14,788, September 1, 1891.

THE improved insecticide is intended for the destruction of parasites injurious to plants, vines, &c., particularly the *phylloxera vastatrix* and *dispur monacha*. It may also be used against the *peronospora* and other insects. The preparation is made as follows:—The fruit of the horse-chestnut is crushed to paste and digested with several times its own volume of water. The resulting extract mixed with about twice its volume of a resin solution (resin, 3 lb.; soda crystals, 1 lb.; water, 1 pint) forms the insecticide. It may be employed, either as it is, or diluted with water, and is said to have no injurious action on the health of plants.

—H. T. P.

Improved Disinfecting Compound. M. Syer, London. Eng. Pat. 11,049, June 13, 1892.

PERMANGANATE of potash is mixed with plaster of Paris, or other cement or plaster, and cast into bricks, or balls, or into perforated tin cases, the object being to economise the permanganate.—H. T. P.

XIX.—PAPER, PASTEBOARD, Etc.

Residue of Potato-Starch Works as a Material in Paper-Making. W. Herzberg. Mith. Königl. tech. Versuchs, 1892, 124—126.

THE residues of potato-starch works cannot be used as a substitute for cellulose in paper-mills, but may serve as a "filler," the soft parenchyma of the potatoes not possessing sufficient tenacity to yield a good paper felting. A Cologne firm has used large quantities of potato-starch residues, but mostly for the reason that the pulp from white potatoes imparted to the paper a delicate ivory tint or a beautiful pink hue, when coming from red tubers. The author has examined a packing-paper made from wood-cellulose containing 30—40 per cent. of potato-pulp. Its mean "tearing length" was found to be 2.03 kiloms., the mean "elongation at fracture" 1.1 per cent.; the resistance when crumpled and rubbed could hardly be termed "indifferent." A microscopic examination of the paper easily reveals the origin of the filling material.—J. L.

Safety Paper. W. Herzberg. Mith. Königl. tech. Versuchs, 1892, 114—119.

THE author has examined a new safety paper (for cheques, securities, &c.) which had been submitted for approval and adoption to the Austrian Government. The subjoined table contrasts the results of the examination of this new paper with those of a paper used hitherto for that purpose.

—	Mean		Resistance against Crumpling	Material.	Ash.
	Tearing Length.	Elongation at Fracture.			
Old paper	Km. 3.77	Per Cent. 2.6	Moderately great.	Wood cellulose, cotton, linen.	Per Cent. 6.39
New paper	4.58	4.4	Very great	Linen and cotton.*	2.09

—	Thickness.	Weight.	Sizing.	Temperature and Moisture of Air at Time of Testing.	
	Mm.	Grms. Sq. m.		° C.	Per Cent.
Old paper	0.08	57.0	Strong	19.2	65
New paper	0.13	83.3	Not strong.	19.2	65

* The embedded fibres are of tussur silk.

THE new paper, which is characterised by a pinkish hue and the embedded red silk fibres, is, as will be seen, considerably superior to the old paper. The weaker sizing of the former must be considered as an advantage, inasmuch as the ink penetrates more deeply into the paper, and the strokes of the writing cannot be removed so easily. The reddish hue of the paper is due to a colouring matter which is turned blue by the minutest quantity of an acid, and is probably intended as a protection against malpractice with acids, but the reddish tint can be restored by alkali. A second table, for which the original paper must be consulted, gives a number of experiments made with the purpose of removing written characters by erasure or by washing with water, alcohol, hydrochloric acid, caustic soda, chlorine water, oxalic acid, oxalic acid and subsequently chlorine. The author used for these experiments four kinds of writing ink, viz., alizarin, anthracene, aniline, and gallotannic inks. As a general result it may be stated that the new paper proved also in this series of experiments much superior to the old paper. In the second part of his communication the author reviews the previous attempts that have been made by several inventors to produce a safety paper.—J. L.

PATENTS.

Improvements in the Manufacture of Bookbinders' Cloth. T. A. Sutton and W. H. Suttou, Salford. Eng. Pat. 13,148, August 4, 1891.

See under V., page 903.

Improvements in or Relating to Apparatus for Glazing Paper. A. J. Boulton, London. From A. Bachem, A. Vogelsang, and G. Tischer, Dresden. Eng. Pat. 13,322, August 6, 1891.

INSTEAD of glazing paper by passing it between a number of heated rollers, the inventors cause the web of paper to pass continuously between two zinc plates to which great pressure can be applied. In this way the paper is glazed without being subjected to any strain.—E. J. B.

Improvements in the Manufacture or Treatment of Paper for Cheques, Bank Notes, and the like. A. Schlumberger, Paris. Eng. Pat. 14,897, September 3, 1891.

A VARIEGATED or so-called "splash" paper is made by mixing together white and coloured pulps. The colouring may be done either with colours sensitive to acids and chlorine, such as the aniline colours and wood colours, or resistant to such reagents, e.g., indigo, alizarin, or chrome yellow. Such papers are then printed with gummed water-colours containing mordants or caustic substances.—E. J. B.

Improvements in the Manufacture or Treatment of Paper for Bank Notes, Cheques, and the like. A. Schlumberger, Paris. Eng. Pat. 14,973, September 4, 1891.

By this invention cheques or bank-notes are printed on both sides, the printing corresponding exactly, so that by transmitted light only one print is visible. Each print is made in two or more colours arranged in reverse succession, so that by reflected light two or more colours appear, but by transmitted light only one, the latter being that produced by the combination of the separate colours.—E. J. B.

Improvements in Apparatus for Straining Paper Pulp. J. White, Edinburgh. Eng. Pat. 17,022, October 7, 1891.

THIS invention cannot be properly understood without reference to six drawings which accompany the specification, describing an apparatus for imparting an oscillating motion to the vat, &c.—A. G. B.

Improvements in the Treatment of Rhea to obtain Fibre therefrom, and Appliance to be used in such Treatment. F. J. H. Sampson, Sydenham. Eng. Pat. 17,642, October 15, 1891.

RHEA is treated with a boiling solution of carbonate of soda until the gum and resin are in a "slimy, semi-adhesive" condition. The rhea is then removed from the bath and immediately treated with a jet of boiling water and steam, delivered from a nozzle of peculiar construction.—E. J. B.

Improvements in the Manufacture of Vegetable Parchment. J. Robertson, Staines. Eng. Pat. 8473, May 4, 1892.

THE paper is made to pass through a parchmentising bath of sulphuric acid, then through baths of water to remove the excess of acid, and finally through a bath of glycerin.

—E. J. B.

Improvements in and connected with the Manufacture of Celluloid Balls and the like. P. Humeau, Hanover, Germany. Eng. Pat. 10,675, June 4, 1892.

ACCORDING to this invention a number of hemispherical projections are stamped by means of a die in a sheet of celluloid. By means of another die the flat portions of the resulting sheet are removed, leaving the hemispheres ready to be joined into balls.—E. J. B.

A New or Improved Method of Producing Flat-Reliefs for Wall Papers, Decorative Wall Ornaments, and the like. P. Klinka, Berlin. Eng. Pat. 11,357, June 17, 1892.

ON the inside of a mould made of plaster of Paris treated with shellac sheets of blotting paper damped with a weak solution of casein and milk of lime are placed, and pressed into the form of the mould by means of a hard brush. The inside is then filled up with a putty made by mixing flour paste with sawdust and turpentine.—E. J. B.

An Improved Carbon Product. L. S. Langville, Troy, U.S.A. Eng. Pat. 13,847, July 29, 1892.

IN the manufacture of paper pulp from wood or esparto grass and the like, the raw materials are treated with caustic lye, which dissolves the silica and saponifies the resinous substances. The alkaline solution is evaporated to dryness, calcined ("re-carbonised"), and the residue taken up with water. It is proposed to prepare a new form of carbon from this residue, by neutralising the alkali with weak acid, after which the material is dried and powdered. The product so obtained is said to be pure enough and well adapted for electric light carbons.—H. A.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

On Citronellone, an Unsaturated Fatty Aldehyde. E. Kremers. Am. Chem. Journ. 14, 203—207.

THIS paper is a continuation of the author's work read before the American Pharmaceutical Association in 1887, and the prime object of examining the andropogon oils at present must be to study carefully the chemical characteristics of the substances they contain. Since then two chemists have taken up the subject of these oils: Mr. Frank D. Dodge (Am. Chem. Journ. 11, 456; 12, 553), and Dr. F. W. Semmler (Ber. d. chem. Ges. 24, 208), and the discrepancies between the recorded observations are probably due to lack of uniformity in the materials and processes of manufacture employed. The substance which has furnished the subject for this preliminary paper is the so-called citronellon from the oil of *Eucalyptus maculata*, var. *citriodora*, which was isolated from the oil by the chemists of Messrs. Schimmel and Co., Leipzig. The citronellone from this source is a colourless, oily liquid, of a lemon-like odour not at all disagreeable. Its specific gravity is 0.875 at 17.5°, and 0.871 at 20° (0.873 at 15°). It rotates the ray of polarised light to the right 7.127° in a 1-dm. tube. Hence $[\alpha]_D = +9.18^\circ$.

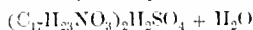
Citronellone and Sodium Acid Sulphite.—The citronellone was separated from the other constituents of the eucalyptus oil by means of its crystallisable sodium acid sulphite compound (Schimmel & Co., "Bericht," October 1890, 21). From this it was regenerated with the aid of sodium carbonate. That the compound had not suffered any change was readily shown by the fact that it again combined with sodium acid sulphite. The observation made by the chemists of Schimmel and Co., that the union of the two compounds is accompanied by a considerable

rise in temperature, can also be confirmed. If molecular quantities of citronellone and sodium acid sulphite are triturated in a mortar the latter will dissolve in the former, and upon the addition of a few drops of water the emulsion-like liquid will congeal. This method of preparing the addition product is not connected with the loss caused by the use of a solution of the sodium acid sulphite. An attempt to add two molecules of sodium acid sulphite failed.

—G. H. R.

The Alkaloids of Certain of the Solanaceæ. O. Hesse. *Annalen*, 1892, **271**, 100—126.

THE author finds that atropine prepared from the pure commercial sulphate (*Pharm. Germ.* 111.) melts at 115.5° , and has a specific rotatory power $[\alpha]_D = -0.4$ ($p = 3.22$; $t = 15^\circ$); whereas Will and Ladenburg believe it to be optically inactive, and Bredig gives its rotatory power as $[\alpha]_D = -1.89$. Atropine sulphate—



is employed for ophthalmic purposes. Of three samples of this salt, which stood the tests of the German Pharmacopœia, two were found to contain hyoscyamine sulphate. Pure atropine sulphate separates on adding ether to its alcoholic solution in lustrous white needles; whilst when it is contaminated with hyoscyamine sulphate dull white crystalline aggregates are precipitated. The anhydrous salt has a specific rotatory power in 2 per cent. aqueous solution at 15° $[\alpha]_D = -8.8$. The platinichloride melts at 197° — 200° , and the aurochloride at 138° .

Hyoscyamine, $C_{17}H_{23}NO_3$, prepared from the seeds of *Hyoscyamus niger* and also from the commercial sulphate forms white needles, melting at 108.5° ; its specific rotatory power in 3 per cent. absolute alcoholic solution at 15° was found to be $[\alpha]_D = -20.3^\circ$. Will gives -21.68 (*Ber.* **21**, 1722). The sulphate crystallises with 2 mols. H_2O , melts at 201° , and the anhydrous salt has a specific rotatory power in 2 per cent. aqueous solution $[\alpha]_D = -28.6$. The platinichloride melts at 206° , and the aurochloride at 159° .

A crystalline alkaloid comes into commerce under the name of *atropinum naturale*; it is prepared from belladonna roots, and most of the samples of commercial atropine sulphate are derived from this alkaloid. The base forms white needles, melts at 109° , and has a specific rotatory power in 2 per cent. absolute alcoholic solution at 15° $[\alpha]_D = -16.2$. An optical analysis of the sulphate, employing the above given constants, showed it to be a mixture of hyoscyamine sulphate 68.2 per cent. and atropine sulphate 31.8 per cent.

Hyosceine was first isolated by Ladenburg from *hyoscyamus niger* (*Annalen*, **206**, 299). The author finds that it has the composition represented by the formula $C_{17}H_{21}NO_3$, and its specific rotatory power in 2 per cent. absolute alcoholic solution at 15° is $[\alpha]_D = -13.7$. When hyosceine is heated with hydrochloric acid or an alkali, *osceine*, $C_{18}H_{23}NO_3$, melting at 104.5° and boiling at 242° , and atropic acid, $C_{17}H_{19}O_3$, are obtained.

The alkaloid obtained by E. Schmidt from *Scopolia atropoides*, and named by him scopolamine (*Apotheker Zeit.* 1890, 30) is identical with hyosceine. The author is in favour of retaining the name hyosceine (compare E. Schmidt, *Archiv. d. Pharm.* **230**, 207).

The remainder of the paper deals with atropamine from belladonna roots (*Annalen*, **261**, 87); belladonnine (*Ber.* **22**, 3183); and apo-atropine, which closely resembles atropamine in its physical characteristics, and those of its derivatives, but is crystalline, whereas atropamine is amorphous. Apo-atropine is obtained by the action of nitric acid on atropine (*Pesci, Ber.* **15**, 530; Ladenburg, *Annalen*, **117**, 102).—A. R. L.

Cincholine and Fluoroline. O. Hesse. *Annalen*, 1892, **271**, 95—100.

CINCHOLINE, $C_{10}H_{21}N$, is a volatile base met with in the preparation of cinchona alkaloids (*Ber.* **15**, 858); it is identical with the base isolated by Weller from paraffin oil (*Ber.* **20**, 2097), and is a highly refractive oil, boiling at 236° — 238° . It is homologous with conine, but appears not

to be poisonous. *Fluoroline*, $C_{12}H_{13}N$, is an oily volatile base obtained by the author in 1887 by the steam distillation of the so-called amorphous alkaloid of Trujillo coca; its solution in water exhibits a strong blue fluorescence. The author has failed to isolate the base from either Trujillo coca or Java coca, using purified solvents as extracting agents, so that its production from Trujillo coca (Gisel, *Pharm. Zeit.*, **36**, 429) was probably due to its presence in the solvent used, viz., brown coal naphtha.—A. R. L.

Oxygen in Glass Manufacture. Eng. and Mining J. **54**, 413.

See under VIII., page 908.

PATENTS.

An Improved Process and Apparatus for the Manufacture of Solid Carbonic Acid (CO₂). C. R. C. Tiebhorne, A. E. Darley, S. Geoghagan, and M. F. Purcell, Dublin. Eng. Pat. 13,684, August 13, 1891.

CARBONIC acid from brewers' vats (this Journal, 1891, 651), or from any suitable source, is liquefied in a series of stage compressors, the liquid cooled down in a surface condenser and admitted in regulated quantities into an expansion chamber. Part of the liquid volatilises here, and in consequence abstracts sufficient heat to cause the remaining part of the liquefied carbonic acid to solidify. The gaseous carbonic acid may be returned to the pumps. The solidifying chamber may be made fixed or moveable; it is provided with a discharging door for the solid carbonic acid, and is coated with non-conducting material. Boxes, bags, or the solidifying chamber itself may be used for transporting the solid carbonic acid.—H. A.

Improvements in the Preparation of Anhydrous Oxide of Barium, or other Substances of Like Properties, for Use in the Separation of Oxygen and Nitrogen of Atmospheric Air. Brins Oxygen Company, Limited, and K. S. Murray, London. Eng. Pat. 17,298, October 10, 1891.

PIECES of fire-clay, pumice stone, or other inert material are saturated with fused barium nitrate at a high temperature, which is maintained for some time to drive off volatile impurities. The pieces are allowed to cool in an air-tight chamber. The barium oxide so produced presents a large surface for subsequent action on air.—H. A.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

PATENTS.

Improvements in Apparatus for Washing Photographic Prints and Negatives. H. Holcroft, Wolverhampton. Eng. Pat. 19,706, November 13, 1891.

THE improved apparatus consists in a cistern in which is fitted a carrier, provided with narrow ledges or corrugations to receive horizontal trays, upon which the negatives or prints to be washed are placed, the carrier is made somewhat shorter than the cistern in order to leave a water space at each end. The trays consist in frames on which a netting is strung. To prevent prints being washed out of the trays, vertical bars are fixed across the outflow end of the carrier, the ends of the trays being notched to correspond. Water is allowed to drip into one end of the cistern, flows over the surface of the prints or negatives, and escapes by an overflow.—J. C. C.

The Use of Aromatic Amido-Compounds and of the Derivatives of Pyrogallol for the Development of Photographic Images. J. Hauff, Stuttgart, Germany. Eng. Pat. 20,690, November 27, 1891.

THE inventor claims the use of the glycines of various amidophenols, which are readily soluble in alkaline carbonates, for developing photographic images, such compounds having the typical formula—



As an example of a developing solution the following is given—

- 100 cc. of water.
- 4.5 grms. of crystallised sulphite of soda.
- 1.5 grms. of glycine.
- 2.5 grms. of potash.—J. C. C.

Improvements in the Art of Producing Coloured Photographs. J. W. McDonough, Chicago, U.S.A. Eng. Pat. 5597, March 22, 1892.

THIS invention may be carried out in several ways, one being as follows:—A glass plate is coated with varnish, which will dry tacky. Coloured particles, consisting of resin or shellac, stained by aniline dyes, &c., are mixed and dusted on the surface. If these coloured particles are mixed in the right proportion, the plate will "reflect or transmit a mixture of these colours, which will be white in proportion to the purity of the colours, cleanliness of the mixture, and the quantity of light." The plate is then heated just sufficiently to melt the shellac. After sensitising in the usual manner it is exposed in the camera, developed and fixed, a coloured photograph resulting.—J. C. C.

Improvements in Magnesium Flash-Light Apparatus. H. J. Haddan, London. From E. Beste, Weimar, Germany. Eng. Pat. 5996, March 28, 1892.

See under II., page 899.

Improvements in the Method and Apparatus for Producing Magnesium Flash Light. N. Browne. From E. Wünsche, Dresden, Germany. Eng. Pat. 6269, March 31, 1892.

See under II., page 899.

An Improved Developing Tray or Dish for Photographic Purposes. A. Desboutin, London. Eng. Pat. 10,023, May 26, 1892.

THIS is a dish in which negatives may be developed in the ordinary light. A sheet of glass of a nonactinic colour is inserted in the bottom of the dish, and a closely-fitting lid, also fitted with a coloured glass, is provided. At one end there is a spout, across which a screen is placed, to prevent access of light to the interior.

In using, the negative is transferred to the dish and the lid replaced by means of a changing bag; the developing solution is then poured in by means of the spout; after the necessary time the solution is poured off, and the negative may be examined by holding the dish up to a candle or lamp.—J. C. C.

Improved Combined Substances for the Development of Photographic Images. J. Hauff, Stuttgart, Germany. Eng. Pat. 14,542, August 11, 1892.

THE inventor claims the employment of ortho-paradiamido-ortho-cresol and ortho-paradiamidometa-cresol in combination with soluble sulphites for developing photographic images, and gives an example—

- 100 cc. of water.
- 0.5 grms. of diamidocresol.
- 5 grms. of the crystallised sulphite of an alkali.

—J. C. C.

XXII.—EXPLOSIVES, MATCHES, Etc.

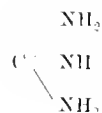
Substitutions in Groups Linked to Carbon and to Nitrogen. Application to Explosives. C. Matignon. Compt. rend. 114, 1197—1199.

BERTHELOT has shown that the replacement of an atom of hydrogen by an alcoholic radicle increases the heat of combustion of the body by about 155 cal. for each CH_3 substituted. The author has recently found that the substitution of an alcoholic radicle linked to nitrogen increases the heat of combustion to a greater extent than when the same radicle is linked to carbon.

In the case of methyl linked to nitrogen the heat of combustion is from 163—165 cal., being an increase of 8 to 9 cal.

Hitherto the nitro-compounds with the NO_2 group linked to carbon have only been studied, and the heat of formation of these mononitro bodies corresponds to 36 cal.

The author has thermally studied Guanidine



and its mononitro derivative, in which the group NO_2 is necessarily linked to nitrogen, and finds that the formation of nitroguanidine liberates 30.3 cal. less than when the NO_2 is linked to carbon, consequently the same law holds good as in the case of alcoholic substitutions, viz. that the introduction of the NO_2 group linked to nitrogen increases the heat of combustion of the body by a larger amount than when the NO_2 is linked to carbon.

This has an interesting bearing on explosives, for the nitro-derivatives linked to nitrogen set free 6 cal. less in their formation by nitric acid than those linked to carbon, consequently they preserve the equivalent of the 6 cal. in the form of potential energy which is transformed into sensible energy at the moment of explosion, and consequently the explosive is more powerful when the NO_2 group is linked to nitrogen. Mononitro-guanidine is an energetic explosive and behaves similarly to gun-cotton when heated.

—W. M.

Jute as a Substitute for Gun-Cotton. O. Muhlhaus-cr. Dingl. Polyt. J. 283, 1892, 48—92, 137—140.

THE crude fibrous material is placed in a solution of caustic soda of 1 per cent. strength; gently heated for two hours; allowed to stand for 12 hours; and finally well rinsed with water. Then the treatment with caustic soda is repeated, the object being to obtain the cellulose as free as possible from foreign matters, &c. Afterwards the fibres are immersed in a mixture consisting of 1 part of nitric acid (of 1.5 sp. gr.) and of 1 to 3 parts of concentrated sulphuric acid. As a result of this immersion the fibres turn brownish-red, and are soon disintegrated into many small hair-like parts which probably represent single cells. These are collected, filtered, washed, and dried, after which they appear as a yellowish fibrous material which is analogous to gun-cotton in all its properties. The author is of opinion that for certain special purposes this "gun-jute" will be able to compete successfully with gun-cotton.—H. S.

Methods Employed for Testing Explosive Substances. P. Vieille. Compt. rend. de l'Assoc. Franç. pour l'Avancem. des Sc. 1890, 53; Proc. Inst. Civil Eng. 107, 124—125.

UNTIL about 20 years ago our knowledge of explosives was very limited, and it has only lately been possible to study explosive phenomena in detail. Delicate chronographic methods have had to be devised registering hundred-thousandths of a second, and apparatus had to be

constructed to withstand pressures of several thousand atmospheres. During combustion the amount of heat produced by various explosives differs greatly; for instance, a platinum wire, which is not fused in the flame produced by burning gun-cotton, melts readily when brought into contact with the flame of blasting gelatin.

The volume of gas produced by the decomposition of explosives is very great. Explosives such as gun-cotton or nitro-glycerol produce gas measuring 1,000 to 1,500 times the volume of the original explosive when reduced to ordinary temperature and atmospheric pressure. At the moment of explosion, however, these gases are heated to a temperature of 2,000 to 3,000°, and therefore occupy a space 10,000 to 15,000 times as great as the explosive from which they are derived. The pressures due to this sudden disengagement of gas are enormous, and it is the utilisation of these pressures for blasting and military purposes which determines the value of each explosive. The theoretical pressure which can be developed by an explosive may be calculated from its chemical composition, but the actual pressure produced can also be ascertained by direct measurement. The most simple method of carrying out the latter operation is to explode a charge of the substance to be tested in a closed space with which a crusher-gauge is connected. The crusher-gauge consists of a piston actuated by the force of the explosion and compressing a small cylinder of copper. The amount of compression of the copper cylinder indicates the force which has been developed. The crusher-gauge is usually fixed in one end of a steel tube. The other end is closed, and the charge of explosive is ignited by means of a platinum wire rendered incandescent by an electric current. After the gases produced by the explosion have cooled, the tube is opened and the copper cylinder removed and measured. The amount of compression produced by a known force having previously been ascertained by direct experiment, it is possible to calculate the pressure of the gases which acted upon the test cylinder.

Numerous experiments made with different explosives have shown that gun-cotton, nitro-glycerol, and melinite are the most powerful explosives at present known. The pressures produced by them are three to four times as great as those attained by black powder, and theoretical considerations render it improbable that any more powerful combinations can be produced. The pressure increases very rapidly in proportion to the increase of the charge, so that the strength of the apparatus fixes a practical limit to the records obtainable. The greatest pressures produced are when the explosives completely fills the cavity in which explosion takes place. With gun-cotton a cavity of 1 litre capacity will contain about 1 kilo. of explosive, while the same space will take 1,600 grms. of nitro-glycerol.

In order to ascertain the duration of the explosive action, the author has constructed a registering crusher-gauge, of which an illustration accompanies the paper. A steel point is fixed to the steel piston or plug, which compresses the copper cylinder, and which is itself actuated by the explosion of the substance under examination. This steel point rests upon a sheet of blackened paper, which is rolled round a revolving cylinder. At the moment of explosion the point follows the crusher-piston in proportion as the copper cylinder is flattened by the pressure of the gases, and a line is described upon the paper. A comparison of the lines thus obtained from different explosives shows the rate at which the pressure increases in each case. The speed of the paper is about 10 metres per second, each thousandth of a second being represented by a length of one centimetre.

By means of this apparatus it has been found that not only the duration, but also the manner of combustion varies greatly. In some cases the rise of pressure is very gentle at the commencement and increases suddenly towards the end of the explosion, while with other substances the reverse is the case. With some explosives, such as gun-cotton and nitro-glycerol, the application of fire alone does not produce an explosive action; for these substances a detonator containing fulminate of mercury is used to initiate the explosive wave. In a tube filled with nitro-glycerol the explosive wave travels at the rate of about 1,000 metres a second, but in its more porous form of dynamite this

substance propagates the explosion at the rate of 3,000 to 4,000 metres a second. With gun-cotton the speed is 5,000 to 6,000 metres.

In firearms, where explosives are used as the motive-power, it is necessary to diminish the velocity of explosion in order to avoid too great a strain upon the metal of which the weapon is constructed.

It is in these cases especially that the apparatus described by the author has been found of great assistance.—W. S.

Coal-Dust Explosions at the Zänckerode Colliery, Max Georgi. *Jahrb. für das Berg-und Hüttenw. in Königr. Sachsen*, 1891, 1; *Proc. Inst. Civil Eng.* 108, 77—78.

THE seam, 3 to 5 yards in thickness, worked at the Zänckerode colliery in Saxony, yields a dust of the class described by Atkinson as especially dangerous. Fortunately the dust is present only in small quantities. Three explosions, however, that have recently occurred, show that under certain conditions this dust may be a source of danger. The methods adopted in order to obviate its disastrous consequences, consist in the employment of flameless explosives, and of appliances for artificially moistening the dust by means of a water-spray.

The flameless explosives in practical use are flameless dynamite (*Wetterdynamit*), roburite, securite and carbonite. The first of these contains, as aqueous salt, magnesium sulphate. The best results with this class of explosive were obtained with flameless kieselsguhr dynamite with 40 to 45 per cent. of nitroglycerol. Experience showed, however, that all flameless dynamites deteriorated with keeping, and all evolved noxious gases. Roburite was found to be uncertain in its action, and it was thought to be not homogeneous, or to be subject to spontaneous decomposition. The use of roburite and of flameless dynamite has been abandoned at Zänckerode; but satisfactory results have been obtained with securite and with carbonite. The latest form of carbonite is a nitroglycerol explosive mixed with a sufficient quantity of carbonaceous matter to prevent the formation of free oxygen or of carbonic oxide. Securite consists, so far as is known, of nitrobenzene and ammonium nitrate. With reference to the storing of these explosives, the same precautions must be taken with carbonite as with gelatin-dynamite. Securite, however, is not affected by changes of temperature, but is very sensitive to the action of moisture. Carbonite can be completely exploded by a detonator with a charge of 0.8 grm. whilst securite requires 1.5 grm. The former is found to act best in coal and in soft rocks, and experience at Zänckerode tends to show that it may be used as a substitute for blasting powder in most collieries, and that it must eventually entirely replace dynamite, which is still used here and there. Securite, as a more powerful explosive, is not adapted for soft coal. Its use is, therefore, confined to hard pyritic coal or to hard rock. The amount of coal got by the miner is less with carbonite than with powder; but in narrow headways the length driven is not affected by the use of flameless explosives. The cost of blasting is in all cases higher than when powder is used.

The second method of obviating coal-dust explosions consists in the employment of appliances for moistening the dust. The installation of pipes was begun in May 1890 in the workings in the vicinity of the Carola shaft, where the air is driest and the dust, as is proved by the explosion that occurred there, most dangerous. The water was taken from a drainage level some 270 feet above the workings in question, and an ample supply was available. With the exception of the east-iron mains, all the pipes are of galvanised wrought iron. The use of the spray, the construction of which is shown in drawings accompanying the paper, is confined to the actual workings. The installation extends to sixty working places, and cost 1,700l.—W. S.

Explosive and Ordnance Material. Stephen H. Emmens. Proc. of the U.S. Naval Inst. 1891, 355; Proc. Inst. Civil Eng. 108, 113—115.

THE explosion of what is known as dynamite No. 1, containing 75 per cent. of nitroglycerol, is found to be more effective than that of pure nitroglycerol itself. The author explains this apparent anomaly by what he calls a ballistic theory of explosives.

He calculates the pressure which would be exerted upon the walls of a shell containing the explosive, which pressure represents the aggregate of the impacts of the gaseous molecules, and is directly proportional to the *vis viva* of the mean molecular movements. But since *vis viva* is composed of two factors, mass and velocity, the determination of gaseous pressure alone fails to indicate the character of the blows by which it is produced. It tells nothing as to whether the walls of the containing vessel have to withstand the shock of heavy molecules moving with comparative slowness or of light molecules moving at relatively high velocity. The author shows that although the pressure upon the walls of the shell is greater in the case of nitroglycerol, both the intensity and velocity of the blows delivered by the dynamite molecules are greater than those of the nitroglycerol, and the ballistic effect obtained in this manner by calculation is in accordance with that found by experiment.

The author describes a method of testing explosives employed by him, which is as follows: A segment of a sphere of lead is suspended in the air with the convex side uppermost. To the flat base is attached a charge of the explosive to be tested contained in a cylindrical cartridge case of paraffined paper, the lead and the cartridge being thus in the form of a mushroom.

The effect is measured by the amount of indentation produced. The metal is scarred and pitted in such a manner as to show that there is no approach to uniformity of pressure produced by the explosion, the gas molecules appearing to strike the lead like a charge of small shot.

When a cannon ball is driven along the bore of a gun by the impact of a column of gas, the pressure sustained by the walls of the gun is much less than that exerted on the base of the shot. The column of gas must be considered as a stream of minute projectiles darting onwards with a common movement of translation and not darting in every direction as in a vessel filled with gas. For utilising high explosives in firearms and ordnance, the author constructs cartridges lined with soft wood. The lining protects the metal of the gun against a disintegrating shock, and by its resilience enables the gaseous molecules to retain their energy in the form of motion and to gradually join the onflowing current along the bore of the gun.

The author gives tables of the comparative strength of different explosive compounds, his method being to first determine how much heat is set free by the re-arrangement of the molecules after deduction of the heat absorbed in breaking up the explosive to start with, obtaining in this way a measure of the total mechanical force rendered available. He then considers the mode in which the explosive develops its strength—whether by a large volume of gas at comparatively low temperature or by a small volume highly heated, and is then in a position to discriminate as to the particular use for which any explosive is adapted. There follows a description of the composition and method of manufacture of a number of so-called smokeless powders, and among them Emmensite and Gelbite, invented and manufactured by himself, together with an account of experiments made upon them in the United States. The article concludes with an account of tests made with different alloys of aluminium bronze, with a view of ascertaining the behaviour of the material under conditions of sudden stress.—W. S.

PATENTS.

Improvements in Fireworks. C. Huelser, London. From G. Gillischewsky, Berlin. Eng. Pat. 18,439, October 27, 1891.

TWELVE parts of steel chips are first dipped into a solution of stearin and benzine in order to coat them with stearin. These coated chips, along with 96 parts of lead nitrate and 12 parts of charcoal, are introduced into an alcoholic solution of shellac. Wooden matches are then dipped into this viscous mass and can be used for producing star fireworks.—W. M.

An Improvement in the Manufacture of Pyroxylines. H. de Chardonnet, Paris. Eng. Pat. 19,560, November 11, 1891.

THIS invention consists in the preparatory treatment of the cellulose material intended for nitration, by heating it for several hours to 150° to 170° C. The application of this high temperature is said to increase the solubility of the subsequently formed pyroxylines.—W. M.

Improvements in the Means for Blasting by Explosives. F. Pfeiffer, Goslar am Harz, Germany. Eng. Pat. 11,753, June 23, 1892.

ACCORDING to this invention the explosive is placed at the bottom of the bore-hole, and water contained in a vessel open at top and fitting the bore-hole is placed in the same. The bore-hole and water vessel are then closed at top by a priming cartridge, the explosion of which causes the explosion of the charge at the bottom of the hole.

The cartridge may also be provided with an additional compartment for containing water or other flame-preventive for use in firing mines.—W. M.

Improvements in Explosive Compounds. H. J. Allison, London. From A. C. Rand, New York. Eng. Pat. 12,744, July 12, 1892.

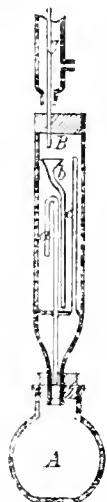
NITROBENZENE, or the light oil of coal tar, nitrated to have a specific gravity of 24° to 34° B., is incorporated with potassium chlorate in the proportion of one part of the former to four of the latter. Instead of pure potassium chlorate equal parts by weight of this substance and manganese dioxide may be mixed with 15 per cent. of nitrobenzene or 60 per cent. of potassium chlorate and 40 per cent. of an inert substance mixed with 15 per cent. of nitrobenzene also forms an effective explosive.—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

Apparatus for Extracting Liquids and Pulpy Substances. Holde. Mitth. Königl. techn. Versuchs 1892, 130—132.

THE working of the apparatus will be easily understood by a glance at the annexed sketch. The substance to be extracted must, of course, be at a sufficient depth below the siphon *a*, so as to prevent the possibility of any particles of the substances being conveyed into the flask *A*. Whilst extracting fats emulsified by soap solutions, the author found that air bubbles rising from the bottom of the soap solution were apt to carry along with them parts of the solution into the ether and therefrom into the flask *A*. An

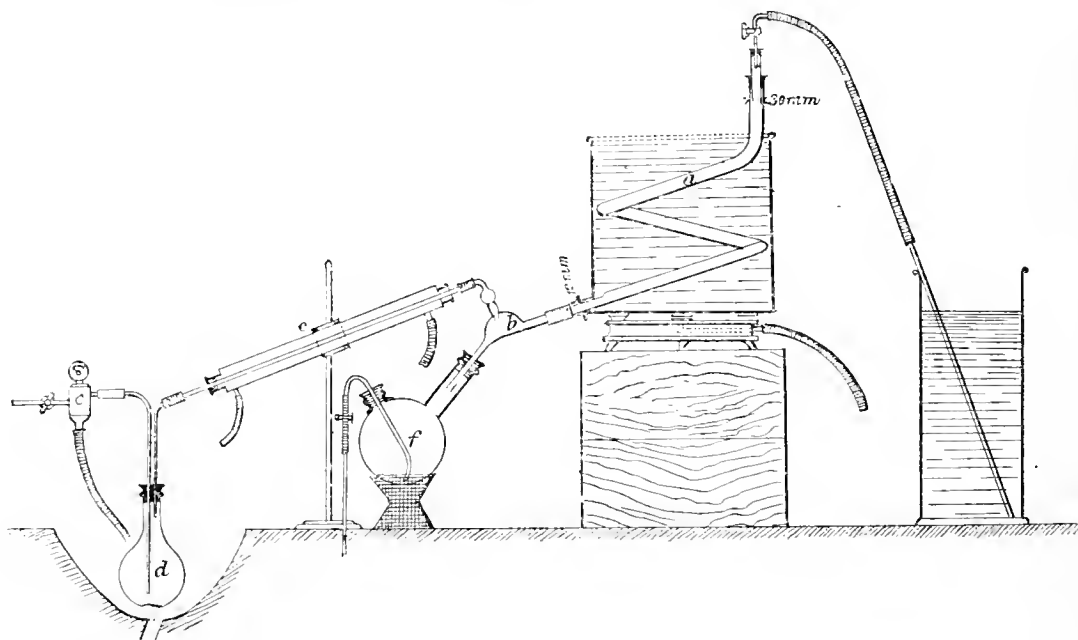


APPARATUS FOR EXTRACTING LIQUIDS AND POLY-
SUBSTANCES.

addition, however, of an easily-soluble salt, as potassium sulphate, did away with this defect of the apparatus.—J. L.

A Simple Apparatus for Evaporating under Diminished Pressure. C. Schulze and B. Tollens. *Annalen* 1892, 271, 46—48.

THE purpose of the apparatus, shown in the Figure, which is similar in principle to Yaryan's vacuum evaporating apparatus (this Journal 1888, 313) devised for the purposes of the sugar industry, is to obviate the long exposure of a solution during its evaporation under diminished pressure, to a high temperature, whereby in some cases decomposition occurs. It consists of a copper tube of 3 cm. inner diameter, bent in the form of a worm, and heated in a water-bath. The liquid to be evaporated is drawn through this tube by means of a water-pump *e*, which latter also serves to maintain a partial vacuum within the apparatus. A piece of wide glass tubing is fixed in the upper end of the copper tube by a perforated rubber stopper, and a narrower glass tube drawn out to a point and provided with a tap to regulate the rate at which the liquid is introduced, is fixed, also with a perforated rubber stopper, into the larger tube. The lower end of the copper tube, which projects beyond the bath, is somewhat narrower than the other portion, and it is attached to a glass tube, which is fused to a bulb at *b*, and connected with a condenser *c*. The concentrated solution falls into the flask *f*, and may be removed by means of the siphon, after admitting air into the flask; whilst the condensed steam is collected in the flask *d*, the uncondensed steam being carried off by the pump. By means of the apparatus 4—5 litres of a dilute solution may be concentrated to 1 litre in the course of an hour.—A. R. L.



SCHULZE AND TOLLENS' APPARATUS FOR EVAPORATING UNDER DIMINISHED PRESSURE.

INORGANIC CHEMISTRY.— QUANTITATIVE.

New Method for the Separation of Iron from other Elements. T. W. Rothe. *Mith. König. tech. Versuchs.* 1892, 132—142.

THE author bases his new method on the solubility of ferric chloride in ether, in which the chlorides of other metals that usually occur in steel are insoluble. The solutions from which the iron is to be extracted must be strongly acid. For convenient extraction, the author has designed an apparatus the main feature of which consists in two cylindrical extractors being connected at the bottom by means of

a three-way tap, which allows of their being brought into communication as well as their being emptied separately. During the shaking out the top parts of the cylinders are also closed by taps. The conditions for a correct determination of the iron are the following:—(a) Suspended substances as, *e.g.*, silica, carbon, fibres of filter-paper, must not be present; (b) the hydrochloric acid solution must contain the iron in the ferric state only; (c) excess of chlorine, nitric acid, and other ether-decomposing substances must be removed; (d) the quantity of a hydrochloric acid present must be so large that the extracted liquid contains 21—22 per cent. HCl (*i.e.*, has the sp. gr. 1.100—1.105 at 13°C.). The author proceeds in the analysis of steel as

follows: 5 grms. are dissolved in hydrochloric acid and the silica separated as usual. The solution of iron is evaporated down, until hydrochloric acid vapours escape, and oxidised with 2-2.5 cc. nitric acid of 1.4 sp. gr., and finally boiled down until basic iron chloride separates. The residue having a volume of about 10 cc. is transferred into the extractor and 55-60 cc. hydrochloric acid, 1.124 (at 19° C.), are added. Two extractions with ether are sufficient to bring the iron into the ether. Minute quantities of copper and cobalt, which sometimes pass into the ether along with the iron, are easily removed by subsequent washing of the ethereal layer with 10 cc. of hydrochloric acid, 1.101 sp. gr. The author has used this new method in the analysis of more than a hundred samples of steel, iron, and ferro-manganese with satisfactory results.—J. L.

A New Method of Assay of Antimony Ores. A. Carnot. *Annales des Mines*, 1, 1892, 303; *Proc. Inst. Civil Eng.* 110 (iv.), 52.

THE ordinary dry way of assaying antimony ore by fusion with soda charcoal and metallic iron, gives a very inaccurate idea of its metallic contents, the author having found differences from the results obtained by analysis which are rarely below 8 or 10 per cent., and in the case of poor minerals may be as high as 20 or 30 per cent. The author has abandoned the dry method of assay, and now substitutes a method of solution and precipitation of the metal by tin, which gives very satisfactory results. In dealing with sulphide ores, from 2 to 5 grms. of the finely powdered mineral are heated with 50 to 60 cubic centimetres of strong hydrochloric acid, but not allowed to boil. When the action ceases the liquid is decanted, and fresh acid is added until the sulphide is entirely decomposed, a few drops of nitric acid being sometimes added towards the end, and the insoluble matter is washed clean with water. The several acid solutions are united, diluted with an equal volume of water, heated to 80° or 90°, and a plate of tin is inserted. The precipitation of the antimony commences at once, and is completed, when the quantity is about 1 gm., in one and a half hours. The precipitated metal is washed by decantation, digested with weak hydrochloric acid to remove tin salts, and is finally collected on a tared filter, washed with water and alcohol, dried at 100°, and weighed. The error of the result, as determined by experiments upon mixtures of native sulphide of antimony and quartz, is below 1 per cent. on the amount found by more exact analytical methods.

In the assay of oxidised ores which are usually mixed with unchanged sulphide, there is often considerable difficulty in getting the antimony completely dissolved, and there is a further chance of loss by volatilisation. This may be avoided by converting the oxidised minerals into sulphide by passing a current of dry sulphuretted hydrogen through it. This is done by exposing about 5 grms. of the mineral forming a thin layer in a flat-bottomed flask, to the action of sulphuretted hydrogen dried by chloride of calcium, which is introduced through a bent tube nearly touching the layer of mineral. The flask is placed on a piece of wire gauze about 2 in. above the flame of a Bunsen star burner, so that the temperature may not exceed 300°. The gas first reduces the oxide and then converts it into sulphide, a small quantity of oxide and sulphur being produced, which condenses in the cooler part of the flask, but there is no loss of sulphide of antimony. The operation is complete in about an hour, and the solution is effected in the manner described above.

Iron and zinc have no effect upon the accuracy of the result; but when the ore contains lead, that metal is partly precipitated as chloride, while part remains in the rotunda, and is deposited in the metallic state upon the plate of tin. This may be estimated in the weighed metallic precipitate by heating it to 50° or 60° in a solution of sodium persulphide (formed by boiling sodium monosulphide with flowers of sulphur) when the antimony is rapidly dissolved, leaving a residue of lead sulphide containing 86 per cent. of lead. As, however, there is invariably some oxidation during the drying of the precipitate, the surcharge will be somewhat

greater, and 90 per cent. of the weight of the sulphide may be taken to be the proper correction to be made for the lead present. Arsenic, when present in the ore, is precipitated with the antimony, and its presence can be determined qualitatively, but no method of estimating the quantity has been devised. This, however, is of less importance, as arsenical antimony ores are comparatively rare.—W. S.

ORGANIC CHEMISTRY.—QUANTITATIVE.

Viscosity at Low Temperatures (Kältebeständigkeit) of Black Mineral Oils. Holde. *Mitth. Königl. tech. Versuchs*, 1892, 126-130.

THE author states that the test prescribed by the rules of the German State Railways, viz., that in which the criterion is the number of mm. an oil will rise in a U-tube of 5 mm. diameter, under an air pressure represented by 50 mm. water at a temperature of -5° C., or -15° C., during one minute, may lead to discordant results for one and the same oil even when repeatedly tested the same day. The discrepancies are due to the fact that at the low temperature solid particles of paraffin, &c., separate out which do not redissolve when the oil is allowed to assume the ordinary temperature.—J. L.

Analysis of Commercial Yolk of Egg. F. Jean. *Monit. Scient.* 6, August 1892, 561-563.

FOR the dressing of hides in the tawing process, a large quantity of salted yolks of eggs is used, unmixed or mixed with borax for preserving purposes. This material, commanding a high price and being of variable composition, it follows that the method of analysis adopted offers considerable interest.

The method adopted is as follows:—

Determination of the Water.—After having thoroughly mixed the sample, a crucible (which can be connected with a small agitator) is tared, and 10 grms. of the material are weighed out, a few drops of acetic acid added, and the whole is well mixed by means of the agitator. The acidified yolk is now dried very slowly, at first at a temperature of 50° to 60° C. (taking care to stir up the mass with the agitator gradually as the substance dries). The drying process is completed at 110°, and the crucible and contents are weighed with due precautions. The loss by drying $\times 10$ = percentage of water. The difference from 100 = dry extract.

Determination of the Fatty Matter.—The extract is carefully removed from the crucible, pulverised, and extracted hot with petroleum spirit. When the extraction is finished, the spirit is removed by distillation, the fatty matter transferred to a tared crucible, dried for one hour at 110° to 115° C., and weighed. The fatty matter thus found = G.

Vitellin.—By passing into the extractor a current of air, the exhausted material is freed from the spirit it contained, and then it is extracted in the same apparatus, after thus replacing the petroleum spirit by distilled water. The aqueous extract evaporated in a crucible, and then dried at 110° C., gives the extractive matter soluble in water, from which the weight of sodium chloride and of other salts which might have been added to the yolk for preservative purposes, has to be deducted.

Ash.—Into a tared platinum crucible 10 grms. of the yolk are introduced, dried, and then calcined at a moderately low temperature, until white ash remains. This residue is weighed.

When testing salted yolk of egg the attainment of white ash is difficult, for if the temperature be raised too much some sodium chloride may be volatilised and lost. To avoid this, carbonisation should be conducted at a low temperature. The char is then treated in the crucible with hot water, taking care not to fracture the carbonised mass, and the aqueous saline solution is collected. The exhausted charcoal is then calcined until white ash alone is left. The

wash-water from the charcoal is then added to the contents of the crucible. The solution is then evaporated and dried at 110°, the ash weighed, and estimated.

In the presence of the boric acid it is difficult to avoid a loss of sodium chloride during calcination, hence preference is given to the weighing of the NaCl not derived from the ash, but by means of a new test.

It was found that the NaCl increases the solubility of the vitellin in water, and that with the salted yolk an extract precipitated by tannic acid in a much higher degree is obtained than is the case with unsalted yolks. As the dissolved albuminoid matter also makes filtration very difficult, the aqueous extract destined for treatment for the estimation of NaCl is first precipitated with a little tannic acid, then filtered and reduced to a definite volume, and the NaCl is determined in this by precipitation with nitrate of silver.

In another portion of the solution the sulphates are determined, also boric acid, nitrates, salicylic acid, &c.

Knowing the amount of water, fatty matter, ash, and the extract soluble in water, there is obtained by difference the amount of the *insoluble vitellin*.

In order to determine exactly the proportions of the different substances contained in the pure yolk, three samples of pure yolk were prepared, which were analysed separately by the method just described.

From the mean of these three analyses were calculated the following factors:—

	Per Cent.
Water and normal ash.....	54.0
Water	52.6
Extract.....	46.0
Fatty matter (G).....	28.0
Vitellin V (including the extract by water)	18.0
Ratio of fatty matter to Vitellin $\frac{G}{V}$	1.5
100 per cent. reduced extract = G = 60 V.....	40.0
100 per cent. reduced extract.....	2.91 normal.

With these data the composition of the yolk of commerce may be found. If, for example, a sample analysis be taken which gives the following results:—

Water.....	50.76
Ashes.....	15.13
Fatty matters ..	19.78
Vitellin	1.46
Normal ashes	1.112
Sodium chloride	13.080
Boric acid, &c.	0.938

Reduced extract 100—(50.76 + 15.13) = 34.11, giving—

G	19.78
V	14.34

The ratio $\frac{G}{V} = 1.375$ instead of 1.5 is abnormal, because for 100 of reduced extract it gives—

G	57.9
V	42.0
instead of $\frac{G}{V}$	
G	60.0
V	40.0

Calculation of the Quantity of Pure Yolk.—The oil obtained from this sample gives with the oleorefractometer + 14 as pure oil. Knowing that 28 G = 100 pure yolk, the content of pure yolk can be calculated, according to the content of the fatty matter G, by means of the formula $\frac{100 \times G}{28}$, i.e., in the example given, $\frac{100 \times 19.78}{28} = 70.6$ for 100 of pure yolk.

Calculation of Albumen in excess.—For calculating this the amount of vitellin is sought that should correspond to the fatty matter found by analysis, supposing the yolk were pure.

Knowing that 28 G = 18 V we would have $\frac{18 \times G}{28} = V$ which means in the present example $\frac{18 \times 19.78}{28} = 12.70$ V

In the analysis there was obtained	V	14.33
And by the calculation according to G.....	V	12.70
Difference.....		1.63

This difference therefore represents the albumen in excess.

If other matters had been added to the yolk they would be found by means of the same calculation.

Knowing the quantity of pure yolk, the albumen in excess and the ash by difference is found the *added water*, and the composition of the analysed yolk could be formulated in the following way:—

	Per Cent.
Pure yolk.....	70.6
Albumen	1.63
Added salts	14.01
Added water.....	13.76

Control of the Quantity of added water.—Knowing that in the pure yolk at 28 per cent. of fatty matters, G corresponds to 52.6 of water, and that the analysed sample contains 50.76 per cent. of water, the formula, $\frac{52.6 \times G}{28}$ is calculated, i.e., $\frac{52.6 \times 19.78}{28} = 37$ per cent. 10 per cent. normal water.

We have therefore—

	Per Cent.
Total water.....	50.76
Normal water	37.10
Added water	13.66

Applying these calculations to the case of samples which have given the following results by analysis:—

Determined Matters.	A.	B.	C.	D.	E.
Water.....	58.84	48.910	52.034	46.60	50.76
Ash	18.50	17.468	18.740	16.91	15.13
Oil.....	14.23	18.840	15.550	18.52	19.78
Vitellin	14.23	13.840	11.460	13.78	12.87
Extract	10.34	0.942	1.556	1.24	1.46
	100.00	100.000	100.600	100.00	100.00

Saline Matters.	A.	B.	C.	D.	E.
Normal ash	1.10	1.112	1.07	1.112	1.112
Sodium chloride..	16.71	14.850	17.80	14.420	13.080
Boric acid, &c. ...	0.78	1.500	17.80	1.478	0.938

	Proportion $\frac{G}{V}$				
—	A.	B.	C.	D.	E.
Pure yolk	1.37	1.29	1.19	1.23	1.37

The following compositions are obtained:—

—	A.	B.	C.	D.	E.
Pure yolk	Per Cent. 50.780	Per Cent. 67.000	Per Cent. 55.00	Per Cent. 65.00	Per Cent. 70.00
Albumen in excess	1.19	0.890	3.01	3.13	1.63
Added salts	17.40	14.782	18.74	15.80	14.01
Added water	30.52	17.328	23.25	15.98	13.76

—M. B.

Estimation of Nitrogen in Inorganic and Ethereal Nitrates, and in Nitro Derivatives, by Kjeldahl's Process. M. L. Chenel. Bull. Soc. Chem. **7—8** (3), 321—327.

The author has obtained satisfactory results in the estimation of organic, ammoniacal, and nitric nitrogen by working Joldbauer's modification of the Kjeldahl process in the following manner:—0.5 grm. of the finely-divided substance is digested in the cold with a solution of 1.2 grms. phenol and 0.4 grm. phosphoric anhydride in 30 cc. of sulphuric acid, and agitated until solution is complete. Zinc powder (3 to 4 grms.) is then gradually added, and the mass kept cool until it is completely reduced, mercury (0.7 grm.) is then added, and the process continued as usual.

The following results were obtained in this way:—

	Total Nitrogen.		Maximum Error.	Mean Error.
	Calculated.	Found.		
Saltetre	13.86	$\left\{ \begin{array}{l} 13.91 \\ 13.82 \\ 13.73 \\ 13.96 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$
Ammonium nitrate .	35.00	$\left\{ \begin{array}{l} 35.31 \\ 34.90 \\ 34.96 \end{array} \right\}$	$\frac{1}{115}$	$\frac{1}{200}$
Barium nitrate.....	10.72	$\left\{ \begin{array}{l} 10.67 \\ 10.62 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$
Methylamine nitrate	29.79	$\left\{ \begin{array}{l} 29.65 \\ 29.68 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$
Nitroglycerol	18.50	18.45	..	$\frac{1}{100}$
Dinitrobenzene	16.67	$\left\{ \begin{array}{l} 16.78 \\ 16.57 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$
Paranitrophenol	10.07	10.03	..	$\frac{1}{100}$
Picric acid	18.34	$\left\{ \begin{array}{l} 18.42 \\ 12.17 \\ 18.43 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$
Ammonium picrate..	22.76	$\left\{ \begin{array}{l} 22.63 \\ 22.67 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$
Picramic acid.....	21.10	$\left\{ \begin{array}{l} 21.00 \\ 20.69 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$
Ammonium picramate	25.90	$\left\{ \begin{array}{l} 25.45 \\ 25.75 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$
Dinitro-ortho cresol..	14.14	$\left\{ \begin{array}{l} 14.10 \\ 13.98 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$
Trinitro-metacresol..	17.28	$\left\{ \begin{array}{l} 17.37 \\ 17.27 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$

The success of the operation appears to depend on the complete conversion of the phenol into the mononitro-derivatives; this takes place whenever the organic nitro-compound forms a clear solution in the cold sulphuric mixture. Substances like collodion or gun-cotton, however, be very finely divided for successful treatment.

The above method cannot be applied to tri- and tetra-nitrated naphthalenes, as these compounds do not dissolve completely in the cold sulphuric acid mixture. Kjeldahl's process may, however, be used if they are previously converted into the naphthylamines. This is readily effected as follows:—12 grms. of iodine are gradually added to a solution of 2 grms. of phosphorus in 15 or 20 cc. of carbon bisulphide contained in a 250 cc. flask, the whole is heated on the water-bath at 100° with constant turning until the last traces of the solvent are expelled; it is then cooled, the iodide of phosphorus detached from the sides of the flask by shaking, the weighed substance (0.5 or 0.6 grm.) introduced, water (8 grms.) added, and the flask turned round two or three times. When the reaction becomes brisk, the flask is shaken. In about a minute after the addition of the water, the reaction is finished; the flask is then cooled, 25 cc. of sulphuric acid (66°) and 0.7 grm. mercury gradually added, and the flask gently heated until the hydriodic acid is expelled. The operation

is continued as in the ordinary Kjeldahl process, except that the flask is heated a little more strongly towards the finish in order to volatilise the phosphonium iodide which condenses in the neck.

This method, which may be applied to the aromatic nitro-derivatives as well as to the nitro-naphthalenes, is especially useful for the analysis of impervious substances like collodion or gun-cotton, which dissolve so slowly in Joldbauer's mixture that loss of nitrogen cannot be avoided. The following results were obtained in this way:—

	Total Nitrogen.		Maximum Error.	Mean Error.
	Calculated.	Found.		
Dinitrobenzene	16.67	$\left\{ \begin{array}{l} 16.70 \\ 16.52 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$
Picric acid.....	18.34	$\left\{ \begin{array}{l} 18.23 \\ 18.18 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$
Ammonium picrate .	22.76	$\left\{ \begin{array}{l} 22.86 \\ 22.63 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$
Picramic acid.....	21.10	$\left\{ \begin{array}{l} 20.90 \\ 21.03 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$
Ammonium picramate	25.90	25.60	..	$\frac{1}{100}$
Dinitro-ortho cresol..	14.14	$\left\{ \begin{array}{l} 14.12 \\ 14.02 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$
Trinitro-metacresol .	17.28	$\left\{ \begin{array}{l} 17.05 \\ 17.26 \end{array} \right\}$	$\frac{1}{100}$	$\frac{1}{100}$

	Total Nitrogen.		Mean.	Maximum Error.	Mean Error.
	By Schloesing's Process.	By the modified Kjeldahl Process.			
Naphthalenes.					
Sample A.	17.36	$\left\{ \begin{array}{l} 17.08 \\ 17.15 \\ 17.22 \\ 17.26 \\ 17.17 \\ 17.11 \\ 17.33 \end{array} \right\}$	17.19	$\frac{1}{100}$	$\frac{1}{100}$
Sample B.	15.08	$\left\{ \begin{array}{l} 15.28 \\ 15.28 \\ 15.21 \\ 15.01 \\ 15.04 \end{array} \right\}$	15.16	$\frac{1}{100}$	$\frac{1}{100}$
Sample C.	16.10	$\left\{ \begin{array}{l} 16.26 \\ 16.11 \end{array} \right\}$	16.17	..	$\frac{1}{100}$
Sample D.	16.96	$\left\{ \begin{array}{l} 16.73 \\ 16.80 \end{array} \right\}$	16.77	..	$\frac{1}{100}$
Sample E.	15.81	$\left\{ \begin{array}{l} 15.73 \\ 15.86 \end{array} \right\}$	15.80	..	$\frac{1}{100}$
Sample F.	16.08	16.14	..	..	..
Sample G.	15.52	15.14	..	..	..

The figures given have been corrected for impurities in the reagents; this correction is obtained by making a blank experiment with each batch of reagents, and may be entirely neglected in the technical analysis of gun-cotton.

—S. B. A. A.

The Determination of the Purity of Olive Oils. F. Lengfeld and L. Paparelli. Rev. Internat. des Falsificat. **5**, 1892, 98.

The authors made a series of tests in order to compare the accuracy of different methods employed for detecting adulterations in olive oils. The oils designated A, B, C, D, E, F, I, K, P, Q, R were of Californian origin, and their purity was beyond dispute. The origin of the samples marked G, H, L, M, N, O was unknown. For comparison some samples of cotton-seed oil and of oil of white and black

mustard were likewise tested. It will be noticed that the iodine number of the pure olive oil samples was between 75.28 and 88.68. The rising of the temperature was

effected by means of a sulphuric acid of 66° B. Among the colour reactions, Bechli's test is especially characteristic for cotton-seed oil. The results are as follows:—

Designation of Oils.	Iodine Nos.	Rising of Temperature by Means of Sulphuric Acid.	Fatty Acids.	Melting Points of the Fatty Acids.	Bechli's Reagent.	Hancheborne's Reagent.	Brulle's Reagent.
		° C.	Per Cent.	° C.			
A.....	80.80	37	94.5	Below 28	No reaction	No reaction	No reaction
B.....	77.28	35	94.0	28—30	"	"	"
C.....	87.15	39.5	95.05	Below 28	"	"	"
D.....	83.35	37.5	95.50	"	"	"	"
E.....	88.68	41	95.65	28—30	"	"	"
F.....	81.15	38	95.43	Below 28	"	"	"
G (union salad oil)....	105.30	72	96.65	35—36	Reaction	Reaction	Reaction
H.....	105.10	"	96.50	"	"	"	"
I.....	79.50	36	91.80	Below 28	No reaction	No reaction	No reaction
K.....	79.53	34.5	95.92	"	"	"	"
L.....	81.70	34	95.77	"	"	"	"
M.....	81.50	35	95.86	"	"	"	"
N.....	78.52	34	94.84	"	"	"	"
O.....	78.51	33.5	95.97	"	"	"	"
P.....	78.42	33.5	95.87	"	"	"	"
Q.....	78.15	"	95.68	"	"	"	"
R.....	85.14	36.5	95.98	"	"	"	"
Cotton-seed oil.....	107.00	70	96.17	37—38	Reaction	Reaction	Reaction
Oil of white mustard..	97.68	49.5	96.70	34—36	No reaction	"	"
Oil of black mustard..	103.07	58.5	"	"	"	"	"

—H. S.

The Determination of Fibrous Materials in a Crude State.
S. Gabriel. Zeits. f. physiol. Chem. **16**, 1892, 370.

This test is a modification of Höngig's method for the determination of crude fibres and starch (this Journal, 1890, 978), and is effected by dissolving caustic potash in glycerol and by heating this solution to 180° C. The details of the test are as follows: 33 grms. of caustic potash are dissolved in 1 litre of glycerol, and 60 cc. of this solution together with 2 grms. of the substance introduced into a flask of 250 cc. capacity, and heated on the wire gauze (not by means of a sulphuric acid bath, as Höngig proposes). The heating has to be carefully managed, as the mixture is inclined to boil over. After the temperature of 180° C. has been reached, the solution is allowed to cool down to 140° C., and then poured into a vessel containing 200 cc. of boiling water. After stirring, the mixture is allowed to stand, and, after some time, the liquid is drawn off from the precipitate which has been formed. The latter is once more treated with boiling water in the above-described manner, and then washed with 200 cc. of boiling water to which 5 cc. of hydrochloric acid of 25 per cent. strength have been added. Finally, the precipitate is washed with ether and alcohol. In many cases the very small amount of nitrogen contained in the substance may be disregarded.—H. S.

The Non-appearance of Multi-Rotation of Carbohydrates in Ammoniacal Solution. C. Schulze and B. Tollens. Annalen, **271**, 1892, 49—51. (Compare this Journal, 1891, 859.)

The authors, having found that when certain carbohydrates, which in aqueous solution exhibit multi-rotation, are dissolved in aqueous ammonia of sp. gr. 0.924, and immediately observed in the polarimeter, showed an optical activity even below the normal one, continued their experiments, using

	Aqueous Solutions.		Ammoniacal Solutions.	
	Time after Preparing Solution.	Specific Rotatory Power $[\alpha]_D$.	Time after Preparing Solution.	Specific Rotatory Power $[\alpha]_D$.
Dextrose (hydrate)	5 10 minutes (20 hours ..	90.69) 48.31)	8 minutes	48.309
Xylose.....	5 9 minutes (20 hours ..	67.14) 18.82)	5 "	18.88
Arabinose.....	5 7 minutes (20 hours ..	143.99) 103.75)	5 "	103.46
Galactose.....	5 12 minutes (20 hours ..	127.93) 79.32)	8 "	78.46
Rhamnose.....	5 7 minutes (20 hours ..	6.17) 7.86)	7 "	7.95
Maltose (hydrate)	5 6 minutes (20 hours ..	95.83) 129.38)	7 "	129.42
Levulose.....	5 15 minutes (20 hours ..	— 32.30) — 30.89)	6 "	— 90.65
Semi-rotating milk sugar.....	5 7 minutes (20 hours ..	37.02) 54.93)	7 "	55.03
Ordinary milk sugar (hydrate).	5 30 minutes (20 hours ..	72.34) 52.01)	9 "	52.01

more dilute ammonia. Their results obtained in aqueous solution and in 0.1 per cent. ammoniacal solution are tabulated above. The solutions were mixed with cream of alumina, when necessary, and after making up to the mark filtered and polarised in a Schmidt and Haensch quartz compensating instrument, the calculations being made by

the formula $[\alpha]_D = \frac{0.246a.V}{p.l}$, in which α = the observed reading on the Ventzke scale, V the volume of the solution, p the weight of dissolved carbohydrate, and l the length of the observation tube. The solutions were all about 10 per cent.

Further experiments with dextrose proved that even with 0.01 per cent. ammonia, the specific rotatory power was $[\alpha]_D = 49.98$ 12–15 minutes after preparation, and $[\alpha]_D = 48.34$ 20 minutes after preparation. To observe abnormal rotatory power with carbohydrates which exhibit these phenomena, it is therefore necessary to employ water free from ammonia as solvent; whilst by the employment of 0.1 per cent. of ammonia as solvent, polarimetric work may be much shortened, inasmuch as the normal rotatory powers are obtained with the freshly-prepared solutions without heating them.—A. R. L.

Note on the Optical and Chemical Analysis of Butter.
F. Jean. *Monit. Scient.* 6, 1892, 91–98.

IN this paper the author replies at length to a number of objections raised against his method (this Journal, 1890, 218, 1072) of applying Amagat and Jean's "oleorefractometer" to the detection of adulteration in butter. Of these the only one of importance is, that perfectly pure butters may in some instances yield oleorefractometer deviations much below the normal (-30°), and would consequently be regarded as impure. Butters which exhibit this peculiarity have been found in all cases to be derived from the milk of cows fed on oil-cake; and there is no doubt that their abnormal behaviour must be ascribed to the presence of unaltered oil in the milk. The author admits that in such cases the oleorefractometer, if exclusively relied upon, will lead to erroneous conclusions; but claims that if employed conjointly with chemical tests it will yield complete information concerning all doubtful samples. The quantity of oil introduced into butter by the use of oil-cake as cattle food is too small to sensibly affect its "saponification equivalent" or the percentage of volatile acids; and it is shown that pure butter possessing an abnormal refracting power will yield a percentage of volatile acids somewhat above the accepted mean value ($27-28$ cc. $\frac{N}{10}$ alkali for 5 grms. of butter). On the other hand, in impure butters the volatile acids will be found below the mean value. The application of chemical tests, is, however, by no means necessary in every instance. Very many butters, especially of French origin, exhibit normal optical properties, and a number of samples may be rapidly sorted by means of the oleorefractometer into different classes, thus:—Deviation observed, $32^\circ-36^\circ$, purity of butters, doubtful; may contain palm or cocoa-nut oil; $31^\circ-29^\circ$, pure butters; $29^\circ-25^\circ$, purity doubtful. Volatile acids must be determined. Below 25° , impure butters. In the following table are given the analyses of a number of pure and adulterated butters. The letters above the columns represent:—A., oleorefractometer deviation; B., saponification equivalent in mgrms. of KOH per 1 gm. of butter; C., the number of cubic centimetres of $\frac{N}{10}$ alkali required to neutralise the volatile acids in 5 grms. of butter. (Determined by the Reichert-Meissl-Wollny process) (this Journal, 1887, 831); D., the percentage of fixed fatty acids; E., solubility of the butter-fat in glacial acetic acid (see this Journal, 1890, 113).

Sample.	A.	B.	C.	D.	E.
Pure Touraine butter	36	..	31.47	..	73
Butter containing cocoa-nut oil ..	34	..	21.4	88.2	..
Isigny butter plus 10 per cent. cocoa-nut oil.	33	..	26.8	..	66.66
Jersey butter	31	..	31.9	..	..
Butter plus cocoa-nut oil	32	..	22.3	88.6	..
Carantan butter	30	..	28.9	87.2	63.33
Isigny butter	30	229	..	..	63.33

Sample.	A.	B.	C.	D.	E.
Eure butter	30	229	29	..	63.33
Brittany butter	50	225	26	..	63.33
Charente butter	30	2.9	28.5	..	..
Gournay butter	30	227	28.6	..	63.33
Gâtinais butter	30	230.8	..	..	..
Loiret butter	30	231	28.4	..	..
Indre-et-Loire butter	30	..	28.9	..	63.33
Normandy butter	30	..	29.6	..	63.33
Normandy butter	30	231	28.4	..	..
Ardenne	29	227	28.9	..	63.33
Rennes	29	..	27.5	..	63.33
Unknown butter	29	229	30	..	..
Unknown butter	29	226	28.2	..	..
Unknown butter	29	..	31	..	..
Loiret butter	28	230	30.8	..	63.33
Loiret, No. 1	27	225	26	..	..
Loiret, No. 2	27	228	29	..	..
Loiret, No. 3	27	..	24.8	..	..
Loiret, No. 4	27	..	26.4	..	..
Ardenne butter	27	..	..	..	58
Unknown butter	26	..	28.1	..	63.33
Indre-et-Loire butter	26	..	25.7	..	51.66
Brittany butter	26	..	22	..	60
Unknown butter	26	..	27.7	..	..
Isigny butter, 4 lbs. per pound ..	25	229	30	..	63.33
Dairy butter	25	229	26	..	..
Suspected butter	25	..	14.7	..	..
Loiret butter	25	231	28.8	..	..
Unknown butter	25	224	24.5	..	..
Unknown butter	25	222	26	..	..
Suspected butter	25	215	9.85	..	..
Suspected butter	25	..	20.1	..	..
Suspected butter	25	..	24	..	60
Rennes butter, $\frac{1}{2}$ salt	25	..	23.9	..	60
Rennes butter	25	..	..	..	60
Unknown butter	24	..	25.7	..	..
Suspected butter	24	..	26.3	..	..
Suspected butter	24	..	25.3	..	..
Suspected butter	23	..	23.1	..	..
Suspected butter	23	216	21.8	..	..
Suspected butter	23	..	25	..	..
Suspected butter	20	..	23.6	..	..
Suspected butter	19	213	14	..	..
Suspected butter	19	217	15.4	..	..
Suspected butter	15	..	14.3	..	..
Margarine, Mouriés	13	..	3.24	..	31
Crème, Mouriés	15	..	4.78	..	..
Oleomargarin	17	..	0.3	..	26.64

—H. T. P.

Investigation of the Properties of India-Rubber and Data for the Establishment of Rules for its Reception in the Russian Navy. Lieut. L. Vladimiroff. Morskoi Flotnik, St. Petersburg, 1892, 57; Proc. Inst. Civil Eng. 109, 75.

See under XIII., page 929.

ANALYTICAL AND SCIENTIFIC NOTES.

Persulphuric Acid and its Salts. Berthelot. Bull. Soc. Chim. 7—8, 1892, 497—522.

MARSHALL'S researches (this Journal, 1891, 1004) have provided a method of preparing certain of the persulphates in tolerably large quantity, and have enabled the author to determine some of the more important thermo-chemical constants. The following are some of the results obtained:—

	Cal.
Heat of dissolution of potassium persulphate in 100 parts of water at 9.7° C. per gram. molecule	—14.36
Heat of dissolution of ammonium persulphate in 125 parts of water at 10.5° C. per gram. molecule	—9.72
Heat of dissolution of barium persulphate in 75 parts of water at 12° C. per gram. molecule.....	—11.38
Heat of neutralisation of persulphuric acid by barium hydrate	13.8
Heat of neutralisation of persulphuric acid by potassium or sodium hydrate.....	13.7
Heat of neutralisation of persulphuric acid by ammonia	12.4
Heat of decomposition of persulphuric acid according to the equation:	
$\text{H}_2\text{S}_2\text{O}_8$ (dilute) + $\text{H}_2\text{O} = 2\text{H}_2\text{SO}_4$ + O (free) ..	34.8
Heat of formation of persulphuric acid:	
S_2 (octahedral) + O_2 + H_2 + water = $\text{H}_2\text{S}_2\text{O}_8$ (dilute) ..	316.3
S_2 + O_2 + water = $\text{H}_2\text{S}_2\text{O}_8$ (dilute)	247.2

From these figures it appears that the decomposition of persulphuric acid involves an exothermic reaction. It occurs spontaneously in solution. The same remark applies to the salts. The potassium salt being anhydrous can only decompose with the formation of potassium pyrosulphate and oxygen, provided moisture be absent, and as this reaction gives rise to the evolution of only half the quantity of heat that is produced when an excess of water is present the dry salt is sensibly stable. The contrary tendency is exhibited by the barium salt as it contains four molecules of water of crystallisation, one of the products of decomposition being in consequence sulphuric acid, which acts on the remainder of the salt and forms a further quantity of sulphuric acid, so that the decomposition increases in geometrical progression. With regard to the mechanism of the formation of the persulphates, it may be said that as they are the products of an endothermic reaction they are necessarily formed by the intervention of external energy, which may result directly from the electric current employed or may be obtained from the effect of secondary reactions which are normal and exothermic. Hydrogen peroxide, for example, may be an agent of the kind. In dilute solution the reaction $2\text{H}_2\text{SO}_4 + \text{H}_2\text{O} = \text{H}_2\text{S}_2\text{O}_8 + 2\text{H}_2\text{O}$ is impossible because it involves the absorption 13.2 cal., but when the solution is concentrated its occurrence is no longer out of the question as the heat of hydration of sulphuric acid is 36.4 cal. for the two molecules required to effect the reaction indicated in the equation quoted above. Experiment confirms this surmise, as on treating barium peroxide with strong sulphuric acid in a vessel cooled with ice and pouring the product into water, a solution of persulphuric acid is obtained. If barium peroxide be added little by little, the mixture being kept cool, a point is reached at which the whole mass gives off vapours, the odour of which resembles that of ozone and hydrochlorous acid (possibly persulphuric anhydride?). If the residue be treated with water no persulphuric acid is found, and only a little hydrogen peroxide, the reaction resulting in the production of the former only taking place within certain limits of concentration.—B. B.

The Oxidation of Nickel Carbonyl. Berthelot. Bull. Soc. Chim. 7—8, 1892, 434.

NICKEL carbonyl can be preserved under water, but if contained in a bottle with an ordinary ground-in stopper becomes slowly oxidised, and a layer of apple-green nickel hydrate is formed, which the author has found to be free from carbon. A portion of it, however, makes its way out of the bottle and is oxidised, forming a fume which is deposited on adjacent objects. In order to examine the product of oxidation the author kept a bottle of nickel carbonyl in a double casing of tin-plate and succeeded in collecting a few decigrammes of a complex oxide, which appeared white in small quantity, but had a greenish tinge when viewed in mass. It was found to be the hydrated oxide of an organo-metallic compound of nickel, and upon analysis gave figures corresponding to the formula $\text{C}_2\text{O}_3\text{Ni}_3 \cdot 10\text{H}_2\text{O}$. It therefore appears to be the oxide of a complex radical analogous to croconic and rhodizonic acids.—B. B.

New Books.

TASCHENBUCH FÜR DIE SODA-, POTASCH-, UND AMMONIAK-FABRIKATION. Herausgegeben in Auftrage des Vereins Deutscher Sodafabrikanten und unter Mitwirkung der Commissions. Mitglieder J. Stroof, Dr. Jacobsen, Dr. E. Richters, Dr. L. C. Schwab and Dr. Siemann. Von Dr. G. LUNGE. Professor der techn. Chemie am eidgenöss. Polytechnikum in Zürich. Zweite, umgearbeitete Auflage. Berlin: Verlag von Julius Springer, 1892. London: H. Grevel and Co., 33, Covent Garden. 7s.

This is the 2nd German edition of the work known in this country as Lunge and Hurter's Pocket-Book for Alkali Makers. It is a small 8vo. volume, bound in leather, and sufficiently strong and limp to go easily into the pocket. The 14 engravings embellishing the text are beautifully executed. In this second edition the author expresses his indebtedness to the valuable contributions of Dr. Hurter which, reproduced from the English edition above referred to, appear here. Where any alteration in the methods and numerical values given in the 1st edition have been made Dr. Lunge states, that this has only been effected after a complete understanding with all the members of the German Verein deutscher Sodafabrikanten. The number of the alterations is, however, somewhat great, and still greater are the additions. A number of new tables, many estimations of new materials, and several new chapters (Zinc blende, Chlorate of Potash, Recovery of Sulphur (Chance), Beetroot molasses residue, Gas liquor, &c.). For the three acids and for ammonia, the new Tables constructed by Lunge and his students are given.

In these Tables the Baumé's hydrometer values in the first column are replaced by the actual specific gravities, and side by side are given the Baumé degrees, and also the Fleischer's Densimeter degrees, in the hope that ere long the latter will quite replace the Baumé degrees. These densimeter degrees are at once in close relationship with the actual specific gravities and with the English Twaddell degrees, since degrees Densimeter $\times 2 =$ degrees Twaddell, whilst on striking out the unit in specific gravity, the remainder $\times 100 =$ degrees Densimeter, or more concisely $n \text{ D} = 1 + 0.01n$.

Several improvements have also been made in the portion relating to Gasometrical estimations.

JAHRBERICHT UEBER DIE LEISTUNGEN DER CHEMISCHEN TECHNOLOGIE, MIT BESONDERER BERÜCKSICHTIGUNG DER GEWERBESTATISTIK, FÜR DAS JAHR. 1891. VON DR. FERDINAND FISCHER. Mit 193 Abbildungen. Leipzig: Verlag von Otto Wigand. 1892. London: H. Grevel and Co., 33 King Street, Covent Garden. 24s.

This work, already long known in this country through certain earlier translations, as "Wagner's Technology," has now for years past been conducted by Dr. Ferdinand Fischer of Göttingen. The present volume is the Annual Report or Jahresbericht for 1891, of the progress of Chemical Technology, and forms an 8vo. volume in paper cover, which contains Table of Contents, subject-matter extending over 1,187 pages, and Alphabetical Indexes of authors and subjects, and finally a Register of all the German patents referred to in the pages of the work, with the pages on which such references are made. The text is illustrated by 193 engravings referring to apparatus and plant, and the treatment of the whole subject is gathered from the following epitome of the sub-divisions of the same. GROUP I. CHEMICAL TECHNOLOGY OF FUEL (pages 1-123). Wood, Peat, Coal, and Coke. Petroleum. Ozokerite; Paraffin. Illuminating Gas. Illumination. Water- and Generator-Gases. Furnaces and Furnace Arrangements, &c. Heating and Ventilation. Processes of Investigation. Calorimetry. Photometry. Statistics. GROUP II. CHEMICAL METALLURGY (pages 124-312). Iron, Slags, their formation and utilisation. Preparation of Pig iron. Casting Iron. Purification of Iron; Steel. Manganese, Cobalt, Nickel, Chromium. Aluminium. Sodium and Potassium. Copper, Lead, and Silver. Gold. Zinc and Cadmium. Other Metals. Alloys and Metal plating. New Books. Statistics. GROUP III. CHEMICAL MANUFACTURES: INORGANIC (pages 313-577). Sulphur and Bisulphide of Carbon. Sulphuric Acid. Ammonia. Salt and the Salt Industry. Potash Salts. Soda. Hydrochloric Acid and Chlorine. Bromine and Iodine. Nitric Acid, Nitrates, and Nitrites. Phosphorus, Phosphoric acid. Phosphates. Explosives. Magnesium, Strontium, and Barium Compounds. Aluminium Compounds. Chromium and Lead Compounds. Antimony and Arsenic Compounds. Other Compounds. Oxygen and Hydrogen. Water and Ice. New Books. Statistics. GROUP IV. CHEMICAL MANUFACTURES: ORGANIC (pages 578-754). Alcohol preparations. Organic Acids. Aromatic Compounds. Organic Colouring Matters. Naphthalene and Anthracene Colours. Azo Colours. Other Organic Colouring Matters. Alkaloids. Etheral Oils. Other Organic Compounds. New Books. GROUP V. GLASS, EARTHENWARE, CEMENTS, ARTIFICIAL STONE, &c. (pages 755-810). GROUP VI. FOODSTUFFS (pages 811-1108). Flour and Bread. Starch and Dextrin. Sugar. Statistics. FERMENTATION INDUSTRIES. A. Fermentation and Yeast. B. Wines. C. Beers. D. Spirits. Milk, Butter, and Cheese. Meats. Coffee, Tea, and Cocoa, &c. Fodders. New Books. Statistics. GROUP VII. CHEMICAL TECHNOLOGY OF FIBRES (pages 1109-1160). Fibrous Materials. Bleaching. Dyeing and Printing. Paper. New Books. GROUP VIII. OTHER ORGANIC CHEMICAL INDUSTRIES (pages 1161-1187). Fats, Oils, and Lubricants. Fatty Acids, Soaps, Glycerin. Varnishes, Resins, Paints. India Rubber, &c. Tanning, Glues. Manures, &c. Preserving Wood.

COMMERCIAL ORGANIC ANALYSIS. A Treatise on the Properties, Analysis, &c. of Organic Chemicals and Products used in the Arts, Manufactures, Medicine, &c. with concise Methods for the Detection and Determination of their Impurities, Adulteration, and Products of Decomposition. By ALFRED H. ALLEN, F.I.C., F.C.S. Second Edition, Revised and Enlarged. Vol. III. Part II. Amines and Ammonium Bases, Hydrazines, Bases from Tar, Vegetable Alkaloids. 1892. London: J. and A. Churchill, 11, New Burlington Street. 18s.

This work having grown through the recent extraordinary development of the subjects treated of, the author has been compelled to divide his Vol. III. into three parts, each of which fills a good sized volume. The present book is Part II. of Vol. III., and it takes the form of an

8vo. volume, bound in cloth, and containing Preface, Table of Contents, and subject-matter filling 572 pages. Two beautifully executed plates illustrate the appearances of photographs of various leaves of the tea and coffee plants and also of others which are sometimes used to adulterate teas and coffees. The book is completed by an Alphabetical Index of subjects and a list of Errata.

The subjects treated of are as follows:—AMINES and AMMONIUM BASES. Monamines. Ammonium Bases. HYDRAZINES. Hydrazine. Substituted Hydrazines. BASES FROM TAR. Classification of Tar Bases. Aniline and its Allies. Naphthylamines and their Allies. Pyridine Bases. Quinoline, Acridine. VEGETABLE ALKALOIDS. Character and Classification of Alkaloids. General Reactions. Isolation and Purification. Constitution and Synthesis. Volatile Bases of Vegetable Origin. Aconite Bases. Atrophine. Tropeines. Coca Alkaloids. Opium Alkaloids. Strychnos Alkaloids. Cinchona Alkaloids. Berberine, &c. Caffeine.

Under the head of the various poisonous as well as medicinal bases, &c. not only is the chemistry of these bodies treated of, but the best methods of preparation, analytical reactions, toxicology and descriptions of medicinal preparations, are given in considerable detail. The classified and systematically treated articles on Tobacco and Opium are of much interest, and the subject of Morphimetry alone covers upward of 10 pages, if we include also the extract of opium and its assay. With regard to the cultivation and use of opium in smoking and eating in the East, &c., the author quotes Dr. W. Moore of Bombay, who compares excess in opium to that in the use of "spirits, of roast goose, or even of fruit." The subject of the Cinchona Barks, their assay, and the separation of the Bases, &c. covers some 21 pages. The treatment of Tea, Coffee, and Cocoa occupies no less than 73 pages, which are illustrated by many tables, analytical and otherwise.

EXPLOSIVES AND THEIR POWER. Translated and Condensed from the French of M. Berthelot by C. NAPIER HAKE and WM. MACNAB. With a Preface by Lieut.-Col. J. P. CUNDILL, R.A. With Illustrations. London: John Murray, Albemarle Street. 1892. 24s.

LARGE 8vo. volume, bound in cloth, containing Preface, Table of Contents, Subject-matter containing 553 pages, and Alphabetical Index. The subject-matter includes, from page 543-553, an Appendix on detonating gaseous mixtures, on the rapidity of propagation of detonation in solid and liquid explosives, and on the different modes of explosive decomposition of picric acid and nitro-compounds. The work is illustrated with between 40 and 50 wood cuts, and is classified into three books, viz., Book I. General Principles. Book II. Thermo-Chemistry of Explosive Compounds; and Book III. Force of Explosive Substances in Particular. These comprise the following courses of subdivision:— I., Chap. i. The force and work done by explosive substances. ii. Products of explosive decomposition, &c. iii. Heat and energy disengaged. iv. Pressure of gases, temperature, &c. v. Duration of explosive reactions, &c. vi. Explosion by influence, &c. vii. Explosive wave. II. Chap. i. General principles of thermo-chemistry of Explosives. ii. Calorimetry. iii. Heat of formation of oxygenated compounds of nitrogen, &c. iv. Heat of formation of the nitrates. v. Origin of the nitrates. vi. Heat of formation of hydrogenated nitrogen compounds. vii. Ditto of nitrogen sulphide. viii. Ditto of compounds of nitric acid with organic substances, &c. ix. Diazo-compounds. x. Heat of formation of mercury fulminate. xi. Ditto of cyanogen series. xii. Oxygenated compounds of chlorine, bromine, and iodine. Thermal formation of chlorates. Combustion effected by potassium chlorate disengages more heat than by free oxygen, &c. xiii. Metallic oxalates. Conditions under which they are explosive. III. Chap. i. Classification of explosives. Definition, &c. ii. General data respecting employment of given explosive. iii. Explosive gases and detonating gaseous mixtures. Their maximum work, &c. iv. Definite non-carburetted explosive compounds. v. Nitric ethers, &c. vi. Dynamites, &c. vii. Gun-cotton

and nitro celluloses, &c. viii. Pieric acid and pierates, &c. ix. Diazo-compounds. x. Powders with a nitrate base, &c. xi. Powders with a chlorate base. Dangers of chlorate powders, &c. xii. Conclusions. Summary.

JAHRBUCH DER CHEMIE. Bericht über die wichtigsten Fortschritte der reinen und angewandten Chemie, unter Mitwirkung von H. Beckurts, R. Benedikt, C. A. Bischoff, E. F. Duire, J. M. Eder, E. Valenta, C. Häussermann, G. Krüss, M. Mareker, L. Bähring, W. Nernst, F. Röhmman. Herausgegeben von RICHARD MEYER. Erster Jahrgang, 1891. Frankfurt a/M. Verlag von H. Bechhold. London: H. Grevel and Co., 33 King Street, Covent Garden. Bound in cloth, 12s. Elegantly bound, 13s. 6d.

This new Chemical Jahresbericht gives a resumé of the advance of Chemistry and Chemical Technology during the year 1891, and thus a kind of retrospect is afforded of the advance, both of pure chemistry and its principle applications. The work commences with a preface by Professor R. Meyer, a list of his collaborators, and a Table of Contents. The subject-matter covers 518 pages and the work concludes with Alphabetical Indexes of subject-matter and authors. The sub-division of the work indicates the mode of treatment of the whole subject and is as follows:—I. Physical Chemistry. II. Inorganic Chemistry. III. Organic Chemistry. IV. Physiological Chemistry. V. Pharmaceutical Chemistry. VI. The Chemistry of Foods, &c. VII. Agricultural Chemistry. VIII. Metallurgy. IX. The Technology of Inorganic Chemistry. X. Explosives. XI. Technology of the Carbohydrates and of Fermentation. XII. Technology of Fats. XIII. The Chemistry of Coal Tar and Coal Tar Colours. XIV. Photography.

The book is handsomely bound in cloth, and is of 8vo. size.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

FRANCE.

Customs Decisions.

The following decisions affecting the classification of articles in the French Customs tariff have recently been given by the French Customs authorities:—

"Carbonated crystal."—Category 247. Duty 4 francs 10 cents, per 100 kilos.

Tin precipitate, in fine powder, for the manufacture of "silver" papers, is dutiable as colours not distinguished.

Japanese varnish, consisting of acetate of amyl, methylic alcohol, benzine, and pyroxyline or gun-cotton; liquid preparation consisting of acetate of amyl, methylic alcohol, and benzine, used for diluting the above-named varnish.—Category 298, 2nd paragraph, duty, 30 francs per 100 kilos.

Oil-paper for tracing plans and drawings, and used for the same purposes as sulphurised paper.—Category 461 *ter*, duty 20 frs. per 100 kilos.

ITALY.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220·4 lb. avoirdupois. Lire = $9\frac{16}{100}$ d.

The following decisions affecting the classification of articles in the Italian Customs tariff have recently been given by the Italian Custom authorities:—

Glass bottles with stoppers for druggists' use.—Category 258b. Duty 15 lire per quintal.

Glass phials, polished with emery.—Category 258b. Duty, 15 lire per quintal.

Demijohns of sheet iron, tinned, containing glycerin. The recipients are charged separately from the goods which they contain.

Sheets of metallic alloys not distinguished. Assimilated to metallic alloys in the raw state.—Category 221a.

Powder of jalap.—Category 62. Duty, 120 lire per quintal.

Sulphate of barytes made up with water.—Category 43b. Duty, 1 lire per quintal.

Extract of quebracho.—Category 30c. Exempt from duty.

UNITED STATES.

A case involving the basis of the duty on certain copper ores was heard by the General Appraisers in New York October 27th. The special point involved was the duty on Rio Tinto pyrites imported by certain sulphuric acid manufacturers. Expert testimony was taken, and the Secretary of the Treasury will decide upon the question. The present duty on copper ores is one-half cent. per pound of fine copper contained. The importation of copper ore reckoning on the basis of fine copper contained, for the seven months ending July 31st, 1891, was 6,270,003 lb., and for the same period in 1892, 3,819,446 lb.—*Eng. and Mining Journal*.

GENERAL TRADE NOTES.

THE JAPANESE CAMPHOR TRADE.

The following particulars respecting the Japanese camphor trade are extracted from a recent report by the United States Consul at Osaka:—

The camphor tree, from which the resinous gum is distilled, is a species of the laurel, and is found in the provinces of Tosa, Hiuga, and Satsuma, in the south of Japan. Large groves of the trees are owned by the Japanese Government, the wood being very desirable for shipbuilding. The districts in which the camphor tree is found are mountainous and situated far from the sea. No reliable information can be obtained as to the cost of producing the gum before being transported in junks to Hiogo. The peasants who engage in distilling the roots and branches of the trees are said to be poor, and employ the rudest machinery.

The market value of crude camphor gum and of oil of camphor per picul (133½ lb.) during the past year was as follows:—Drained, 38·25 dols.; wet, 37·00 dols.; old dry, 43·50 dols.; average, 36·50 dols.; camphor oil, 5·25 dols.

The highest and lowest prices during the same period were as follows:—Highest, 40·00 dols.; lowest, 33·00 dols.

Camphor gum is exported in tubs measuring about 6½ cubic feet; oil in kerosene tins and cases. The grades are from old dry down to new wet, and the various grades depend upon the quantity of adulteration. In oil there are two grades—white and brown.

Adulteration is practiced for the most part by adding water and oil just as far as the buyer will tolerate. In some cases 20 lb. of water will run out of a tub in 12 hours. The unadulterated article, known as the good old dry, can sometimes be bought. The only system of tests in determining value of the different qualities is by burning and by absolute spirit. The percentage of pure camphor which the crude yields when refined varies accordingly to the quality of the crude. The average percentage of gum produced from the wood as compared with the original weight of the wood cannot be accurately ascertained here, the only foreigner known to have visited the camphor districts having declined to furnish any information on the subject.

The total exports of camphor from Hiogo during 1891 in cattiees of 1½ lb. each amounted to 3,850,400 cattiees consigned to the following destinations; Europe (countries not specified), 1,777,300 cattiees; London, 335,600 cattiees; Germany, 209,200 cattiees; United States, 1,277,000 cattiees; China, 51,900 cattiees; France, 199,400 cattiees.

As regards the manufacture of camphor, the following particulars are extracted from a report by the United States Consul at Nagasaki.

Camphor is found alike on high elevations and in the valleys and lowlands. It is a hardy vigorous, long-lived tree, and flourishes in all situations.

Many of these trees attain an enormous size. There are a number in the vicinity of Nagasaki which measure 10 and 12 feet in diameter. The ancient temple of Osuwa, at Nagasaki, is situated in a magnificent grove of many hundred grand old campher trees, which are of great age and size, and are still beautiful and vigorous. It is stated that there are trees at other places in Kin Shin measuring as much as 20 ft. in diameter. The body or trunk of the tree usually runs up 20 and 30 ft. without limbs, then branching out in all directions, forming a well-proportioned, beautiful tree, ever green and very ornamental.

The leaf is small, elliptical in shape, slightly serrated, and of a vivid dark-green colour all the year round, except for a week or two in the early spring, when the young leaves are of a delicate tender green. The seeds or berries grow in clusters and resemble black currants in size and appearance. The wood is used for many purposes, its fine grain rendering it especially valuable for cabinet-work, while it is used also for shipbuilding. The roots make excellent knees for ships.

In the manufacture of camphor the tree is necessarily destroyed, but by a stringent law of the land, another is planted in its stead. The simple method of manufacture employed by the natives is as follows:—

The tree is felled to the earth and cut into small pieces, or more properly speaking, into chips.

A large metal pot is partially filled with water and placed over a slow fire. A wooden tub is fitted to the top of the pot, and the chips of camphor wood are placed in this. The bottom of the tub is perforated so as to permit the steam to pass up among the chips.

A steam-tight cover is fitted on the tub. From this tub a bamboo pipe leads to another tub, through which the enclosed steam, the generated camphor and oil flow. This second tub is connected in like manner with a third. The third tub is divided into two compartments, one above the other, the dividing floor being perforated with small holes, to allow the water and oil to pass to the lower compartment. The upper compartment is supplied with a layer of straw, which catches and holds the camphor in crystal in deposit as it passes to the cooling process. The camphor is then separated from the straw, packed in wooden tubs of 133½ lb. each, and is ready for market.

After each boiling the water runs off through a faucet, leaving the oil, which is used by the natives for illuminating and other purposes.—*Board of Trade Journal*.

EUROPEAN MINERAL PRODUCTION IN 1891.

Country.	Copper.	Lead.	Zinc.	Steel.
	Tons.	Tons.	Tons.	Tons.
England	76,000	69,000	..	3,500,000
Spain	71,000	235,000	..	..
Germany .....	..	100,000	135,000	1,309,000
Belgium .....	..	..	82,000	210,000
Holland .....	..	..	29,000	..
France .....	..	..	..	529,000
Russia .....	..	..	..	225,000
Sweden .....	..	..	..	220,000

Country.	Iron.	Coal.	Silver.	Gold.
	Tons.	Tons.	Kilos.	Kilos.
England	8,500,000	180,000,000	..	..
Spain .....	..	..	60,000	..
Germany	3,000,000	85,000,000	102,000	..
Belgium	1,000,000	20,000,000	..	..
France	1,600,000	24,000,000	80,000	..
Russia .....	..	..	..	35,000

—U.S. Consular Reports.

EXPORTS FROM UNITED KINGDOM TO UNITED STATES OF AMERICA DURING 1891.

Articles.	1891.	1890.
	Dols.	Dols.
Antimony.....	68,575	..
Beer, ale, and stout	190,218	138,365
Blacking	2,015	..
Bricks and tiles.....	98,409	..
Cement.....	284,442	371,824
Chalk.....	18,401	..
China clay.....	95,187	90,371
Coal and coke.....	309,286	210,777
Cocoa and chocolate	47,004	53,019
Colours, paints, and varnishes.....	202,388	129,563
Drugs and chemicals.....	3,093,759	3,010,684
Fullers' earth.....	19,436	..
Glass, china, and earthenware	1,232,778	1,071,437
Glue and gelatin.....	82,101	..
Grease.....	67,937	..
Guns.....	70,785	..
Leather.....	235,770	454,710
Matches	4,250	..
Metals other than iron and steel.....	154,000	..
Oils.....	84,349	..
Paper.....	100,100	..
Paper stock.....	668,118	139,941
Perfumery	17,001	..
Pitch and tar	105,695	..
Plumbago.....	1,505	..
Quicksilver.....	320,361	..
Rubber, raw	674,737	344,688
„ manufactured.....	41,985	..
Soaps	64,330	..
Tin	401,316	376,559
Tin plates.....	2,834,026	6,947,195
Total of all goods.....	42,407,671	44,174,692

Ibid.

CHEMICAL TRADE OF THE TYNE WITH UNITED STATES OF AMERICA DURING 1890 AND 1891.

Imports from United States of America.

Articles.	1890.	1891.
	Tons.	Tons.
Soaps.....	5	..
Chemicals (unenumerated).....	..	28
Glucose	127	594
Sugar and molasses.....	256	786
Drysalts' stores.....	41	35
Cotton seeds and linseed cake	728	103
Glass.....	..	1
Hides, leather, and skins.....	16	4

Imports from United States of America—cont.

Articles.	1891.	1891.
Colours and litharge .....	..	8
Phosphates	14,607	5,733
Copper ore and copper	11	..
Oils: Petroleum	7,583	12,153
" Other	18	6
Paper	4	2
Tallow, fat, and grease	757	399
Bark, tanners'	10	..
Resin	2,420	3,618

Exports from Tyne.

Articles.	1890.	1891.
Alkali and soda ash	Tons, 4,501	Tons, 2,362
Alum and alum cakes	206	72
Ammonia salts .....	..	340
Barytes, carbonate and sulphate	300	647
Baryta manufactures	1	33
Bleaching powder	4,340	1,831
Caustic soda	4,744	3,232
Copperas	142	58
Hyposulphite of soda	143	128
Manganate of soda .....	..	2
Manure	2,016	969
Magnesia	19	19
Nitrate of soda and potash	42	11
Pearl hardening	1,670	1,653
Soda crystals	4,714	2,623
Sulphate of soda	1,495	28
Unenumerated chemicals	15	107
Cement	19,801	14,676
Fire bricks	4,765	5,435
Fire clay	77	245
Glass	6	114
Ferro-manganese	108	242
Antimony	504	320
Litharge	13	18
Pig lead	500	..
Red and white lead	125	126
Sheet and pipe lead	17	..
Leather and skins	152	15
Paper .....	..	1
Plaster of Paris .....	..	23
Brown and yellow ochre .....	..	2
Venetian red	859	32
Vinegar and acid	47	12
Wood pulp .....	..	16

—*Ibid.*

A NEW OIL SEED.

The *Kew Gardens Bulletin* for October publishes the following notice:—

Amongst the numerous oil seeds that are constantly being received at Kew, for the purpose of naming, from Liverpool brokers and seed crushers, were some that made their first appearance at Liverpool from the West Coast of Africa in February 1891. They appear to have attracted a considerable amount of attention, judging from the fact that they were received at Kew from several different brokers about the same time, and a month later, in March 1891, samples were also received from Germany. Quite recently the same seeds have again appeared, having been sent to Kew by a seed-crushing firm at East Greenwich. The interest attached to them from a commercial point of view is probably due to the quantity of oil their kernels seem to contain, rather than to its quality or properties, for up to the present these appear not to have been tested; they may, however, become an important source both of oil and oil-cake, for though nothing definitely is known as to the plant producing them, inasmuch as no other material than the fruits themselves, without the fleshy coverings, have been received at Kew, it is clear from these alone that the plant belongs to the natural order *Oleaceæ*, and probably to the genus *Heisteria*. The fruits as received are hard and woody, requiring some force to break them; they are ovate in form, above 1 in. long and $\frac{3}{4}$ in. in diameter, of a dull earthy brown colour, marked by irregular longitudinal striations, the inside being filled with a whitish, fleshy, and very oleaginous kernel. From the fact that the plants constituting this order are free from any poisonous or deleterious properties, and that the fruits of some of the species are edible, it may be inferred that this new oil seed may prove of some commercial value. No locality has been given whence the seeds have been obtained, the only information on that head being, as before stated, that they were imported from the West Coast of Africa.

A NEW VARIETY OF SUGAR CANE.

The *Kew Gardens Bulletin*, referring to a new variety of sugar cane which is stated to have been discovered in the Upper Niger region of Central Africa, says:—

"It is described as a giant variety possessing great saccharine richness, and capable of being readily reproduced from seed which in this variety is well developed. Several inquiries have already been addressed to Kew in regard to this cane, and it may be well to state at once that there are grounds for believing that the plant mentioned is not a sugar-cane at all, but the ordinary guinea corn or sorghum (*Sorghum vulgare*), which is widely distributed over Africa. This plant, it is well known, yields a useful syrup, and strenuous efforts are being made in the United States at the present time to extract a granulated sugar from it. Should the Niger plant prove to possess any special merits as a sorghum we shall, no doubt, hear more about it. It can have, however, little or no interest to the tropical sugar-planter."

PETROLEUM IN UPPER BURMA.

Dr. Fritz Noetling, Geological Survey of India, has written a very interesting account of the petroleum industry in Upper Burma. Dr. Noetling estimates that there are now 602 wells, an increase of 92 since 1888. These produce about 17,700 viss (viss is equivalent to $3\frac{1}{2}$ lb. avoirdupois) per day, but there are, in Dr. Noetling's opinion, distinct signs of exhaustion. The fact that the aggregate production of the richer wells has fallen off, while that of the poorer ones has increased, although many new wells have been opened, is regarded as the surest indication of the approaching decline in the industry. The drilled wells worked by the Burma Oil Company and the Burma Oil Syndicate have given very satisfactory results. In 1890 the total out-turn amounted to over 3,670,000 viss; but the rate of progress during 1888, 1889, and 1890 has not been maintained during the past two years. The history of the industry shows that the production of the oil-field steadily increased from the beginning of the century till about 1873,

when it began to decline, rising again in 1885, and coming practically to a standstill in 1891. — *Board of Trade Journal*.

SOAP LAKE, WASHINGTON.

Professor J. C. Russell, of the United States Geological Survey, gives the following information concerning the water of Soap Lake in Douglas county, and compares it with that of other alkaline waters. The sample analysed contained sediment amounting to four parts in 1,000,000. He says: "The absence of calcium carbonate is of interest, since deposits of that salt are now taking place on the lake bottom through the agency of low forms of plant life. Compared with other alkali lakes of the West, Soap Lake contains but a small quantity of the alkaline metals, as the following analyses show:—

Constituents in Parts Per thousand.	Great Salt Lake, Utah, 1869.	Soda Lake, near Rye-town, Nev.	Mono Lake, California.	Owen's Lake, California.	Soap Lake, Washington.
Sodium, Na.....	49'630	41'632	18'100	21'650	10'5011
Potassium, K.....	2'407	2'290	1'111	2'751	..
Calcium, Ca.....	0'255	..	0'278	Trace	Trace
Magnesium, Mg...	3'780	0'245	0'125	Trace	0'0108
Lithium, Li.....	Trace	..	..	Trace	..
Chlorine, Cl.....	83'946	41'496	11'610	13'440	3'5262
Carbonic acid, CO ₂	..	15'650	11'440	13'140	9'6246
Sulphuric acid, SO ₄	9'853	11'771	6'120	9'362	1'3624
Nitric acid, NO ₃ ..	..	..	..	..	..
Boric acid, B ₂ O ₃	Trace	0'285	0'153	Trace	..
Silicic, SiO ₂.....	..	0'275	0'268	0'164	0'1130
Hydrogen in bicarbonates.	..	..	..	..	0'0534
Totals.....	149'936	113'644	49'630	60'507	28'1945

—*Engineering and Min. Journal*.

THE IODINE CONVENTION.

We hear from an official and neutral source in Iquique (Chili) that, although the Iodine Convention is still in force at this moment the agreement will not remain tenable for long (the report was penned about two months ago), because under the operation of the Convention the stock of iodine is accumulating to such an extent that there will soon be enough for three years' consumption. It is, therefore, sought to arrive at an understanding upon a new basis, upon which it is proposed either to stop the production altogether for a period, or at any rate to limit it to such an extent that the accumulated stocks will have a chance of absorption by the ordinary consumption. The exports of iodine from Iquique in 1891 were 9,144 quintals, of which 1,823 went to Liverpool, 5,147 to Hamburg, 1,764 to New York, and 399 to other ports. The producers who do not belong to the Union exported 74 quintals. The nitrate combination, which was formed in 1891, will, so far as the present arrangements go, remain in force until the end of 1892. There is hardly any doubt that it will be renewed.—*Chemist and Druggist*.

ARTICLES OF INTEREST TO TECHNOLOGISTS AND MANUFACTURERS.

The following articles, which appear in the *Board of Trade Journal* for November, will repay perusal.

"Foreign Competition with Great Britain in trade with Uruguay"	p. 536
"Trade Requirements in Guatemala."	p. 540
"New Customs Tariff of Porto Rico"	p. 553

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

	Month ending 31st October	
	1891.	1892.
	£	£
Metals.....	1,803,088	1,127,118
Chemicals and dyestuffs.....	431,685	175,438
Oils.....	709,008	539,259
Raw materials for non-textile industries.	4,038,042	4,272,368
Total value of all imports	36,873,829	34,726,858

SUMMARY OF EXPORTS.

	Month ending 31st October	
	1891.	1892.
	£	£
Metals (other than machinery)	3,179,014	2,775,161
Chemicals and medicines	798,180	755,144
Miscellaneous articles.....	2,899,960	2,497,840
Total value of all exports.....	21,166,113	18,725,490

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Alkali..... Cwt.	10,487	5,075	5,786	4,102
Bark (tanners, &c.) ..	11,340	13,905	20,086	3,538
Brimstone..... "	18,183	31,388	6,096	8,072
Chemicals..... Value £	..	..	115,775	146,765
Cochineal Cwt.	827	487	5,101	2,911
Cutch and gambier Tons	2,370	1,538	63,892	32,381
Dyes:—				
Aniline Value £	..	..	18,304	21,786
Alizarine ..... "	..	..	32,260	37,039
Other ..... "	..	..	188	434
Indigo Cwt.	308	1,967	4,654	30,114
Nitrate of soda.... "	107,304	139,113	47,954	59,046
Nitrate of potash . "	17,990	24,503	16,729	21,887
Valonia Tons	562	650	10,281	9,346
Other articles... Value £	..	..	87,579	98,017
Total value of chemicals	..	..	434,685	475,438

IMPORTS OF METALS FOR MONTH ENDING 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Copper:—			£	£
Ore..... Tons	8,896	8,676	57,122	56,866
Regulus	5,099	8,246	210,632	181,606
Unwrought "	4,124	2,823	213,645	132,623
Iron:—				
Ore..... "	212,206	279,931	150,140	191,605
Bolt, bar, &c. "	6,642	10,238	61,716	91,644
Steel, unwrought.. "	620	248	6,768	3,018
Lead, pig and sheet ..	16,651	11,286	209,785	115,489
Pyrites	31,913	40,535	58,833	67,502
Quicksilver..... Lb.	94,256	30,975	9,235	2,665
Tin..... Cwt.	39,253	46,162	184,212	214,639
Zinc	5,161	3,872	119,037	73,873
Other articles ... Value £	..	..	491,963	295,588
Total value of metals	..	..	1,803,088	1,427,118

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Bark, Peruvian .. Cwt.	9,635	9,041	19,231	15,932
Bristles..... Lb.	105,038	280,844	26,543	39,205
Caoutchouc..... Cwt.	22,949	21,919	245,494	210,351
Gum:—			£	£
Arabic..... "	6,578	8,256	14,760	22,280
Lac, &c..... "	7,879	5,976	32,572	24,269
Gutta-percha "	3,125	3,033	41,843	27,766
Hides, raw:—				
Dry..... "	34,410	21,156	95,270	55,498
Wet..... "	55,540	48,254	124,866	111,708
Ivory..... "	1,717	1,061	83,812	56,002
Manure:—				
Guano..... Tons	3,644	2,634	25,880	12,880
Bones..... "	5,063	2,870	22,843	12,686
Paraffin..... Cwt.	39,725	39,306	60,262	51,443
Linen rags..... Tons	2,745	519	28,000	4,247
Esparto..... "	15,260	16,744	76,172	85,430
Pulp of wood "	9,026	12,859	82,163	104,090
Rosin..... Cwt.	63,124	58,186	16,831	11,980
Tallow and stearin ..	69,598	97,024	91,865	121,528
Tar..... Barrels	16,961	19,899	14,535	15,669
Wood:—				
Hewn..... Loads	230,321	259,684	516,743	503,140
Sawn..... "	566,035	739,783	1,176,145	1,559,003
Staves..... "	15,660	17,036	70,883	58,981
Mahogany Tons	3,512	4,651	32,409	41,137
Other articles.... Value £	..	..	1,139,830	1,105,683
Total value .....	..	..	4,038,042	4,272,368

Besides the above, drugs to the value of 69,020*l.* were imported, as against 70,539*l.* in October 1891.

IMPORTS OF OILS FOR MONTH ENDING 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Cocoa-nut..... Cwt.	35,081	11,891	£ 47,003	£ 13,967
Olive	1,159	1,186	46,629	47,682
Palm	110,123	90,343	129,238	91,916
Petroleum..... Gall.	12,112,813	12,693,704	251,290	204,385
Seed	1,968	2,450	56,664	57,351
Train, &c..... Tons	1,616	1,856	44,353	36,444
Turpentine Cwt.	51,118	9,498	69,975	10,655
Other articles .. Value £	..	..	64,756	77,459
Total value of oils ...	..	..	709,908	539,259

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Brass..... Cwt.	11,146	8,504	£ 49,500	£ 35,425
Copper:—				
Unwrought..... "	65,947	69,693	179,962	171,061
Wrought..... "	39,911	24,247	102,037	72,233
Mixed metal "	27,008	37,265	75,820	88,526
Hardware Value £	..	..	236,823	189,688
Implements..... "	..	..	121,276	107,237
Iron and steel..... Tons	287,685	256,507	2,151,734	1,865,121
Lead	3,557	2,705	49,106	33,868
Plated wares... Value £	..	..	42,894	35,151
Telegraph wires, &c. "	..	..	38,167	31,198
Tin..... Cwt.	11,079	12,221	52,832	58,694
Zinc	10,908	15,969	11,753	14,352
Other articles .. Value £	..	..	77,110	72,607
Total value .....	..	..	3,179,014	2,775,161

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Alkali..... Cwt.	664,721	640,884	£ 250,486	£ 227,485
Bleaching materials ..	136,563	158,480	43,523	66,506
Chemical manures. Tons	25,551	24,483	133,546	138,211
Medicines..... Value £	..	..	99,491	88,394
Other articles ... "	..	..	246,524	234,548
Total value .....	..	..	798,480	755,144

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH
ENDING 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Gunpowder..... Lb.	958,700	427,600	£ 24,050	£ 12,194
Military stores.. Value £	..	..	127,821	101,875
Candles..... Lb.	1,381,800	1,150,400	27,170	26,901
Caoutchouc Value £	..	..	120,936	102,849
Cement..... Tons	46,141	43,544	90,410	76,795
Products of coal Value £	..	..	133,276	113,773
Earthenware ... "	..	..	203,302	181,758
Stoneware ..... "	..	..	11,912	14,122
Glass:—				
Plate..... Sq. Ft.	375,981	159,760	25,083	9,210
Flint..... Cwt.	11,264	7,109	23,363	18,545
Bottles..... "	71,581	66,785	33,521	32,216
Other kinds.... "	19,766	21,817	17,184	18,665
Leather:—				
Unwrought "	11,093	11,519	106,535	105,818
Wrought Value £	..	..	49,285	34,386
Seed oil..... Tons	6,008	6,043	126,586	114,986
Floorcloth Sq. Yds.	1,658,400	1,119,700	67,862	49,043
Painters' materials Val. £	..	..	143,681	116,657
Paper Cwt.	83,889	74,180	148,384	126,539
Rags..... Tons	4,842	6,335	32,108	43,879
Soap..... Cwt.	45,974	49,086	49,754	49,861
Total value .....	..	..	2,899,960	2,497,810

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND
MACHINERY.

APPLICATIONS.

18,793. F. J. R. Carnila. Improvements in apparatus for concentrating and evaporating liquids. October 20.

18,879. T. Thorpe and T. G. Marsh. Improvements in or connected with gas condensers. October 21.

18,891. T. G. Webb. See Class VIII.

18,941. W. A. Swain. See Class XVII.

19,147. H. H. Lake. —From O. B. Stillman, United States. Improvements in evaporating apparatus. Complete Specification. October 25.

19,149. H. W. Rappleye. Improvements in drying apparatus. Complete Specification. October 25.

19,213. I. Levenstein. See Class VII.

19,558. A. Lappin. Improvements in distilling apparatus. October 31.

19,611. A. Gray and J. W. Newall. Improvements in the production of steam. November 1.

19,653. P. M. F. Laurent. A method and apparatus for use in the manufacture of ice. November 1.

19,755. A. G. Glasgow. Improvements relating to pressure gauges. November 2.

19,789. A. Boake and F. G. A. Roberts. Improvements in vessels for containing sulphur dioxide. November 3.

19,837. A. H. Wendt. Improvements in apparatus for controlling the flow of acid or other liquid to and from casks or other receptacles. November 3.

20,299. W. W. Pope. Improvements relating to vessels for containing gas under pressure. November 10.

COMPLETE SPECIFICATIONS ACCEPTED.*

1891.

17,886. H. H. Lake. —From La Société Anonyme du Compresseur Jourdan, France. Apparatus for expressing liquids from vegetable, animal, or mineral substances. October 26.

19,486. D. B. Morison. Improvements in apparatus for heating or evaporating liquids. October 26.

19,780. C. J. Schofield. See Class VII.

20,125. G. Y. Blair. Apparatus for evaporating, condensing, and the like. October 26.

20,904. C. H. Fitzmaurice. Apparatus and appliances for softening, purifying, and filtering liquids. November 16.

21,507. J. Brotherton. Bottles or holders for the storage and conveyance of quicksilver, gas, and other fluids under high pressure, and method of manufacture thereof. November 2.

22,248. J. Pullman and H. S. Elworthy. See Class XVII.

22,607. D. Rylands. Furnaces, retort chambers, and the like. November 2.

22,655. H. Williams. See Class VII.

22,656. H. Williams. Method and apparatus for drying malt, hops, grain, pulse, and other substances. November 2.

22,870. J. Pullman and H. Lane. Construction of compressing machinery or apparatus for the condensation and liquefaction of gases. November 16.

1892.

138. E. Brook. Furnaces. November 9.

765. S. Fox. Furnaces for the application of water-gas for heating and welding purposes. November 16.

15,122. W. H. Beek. —From B. de Lissa, Australia. See Class II.

15,698. F. W. Golby. —From B. Jardin. Apparatus for heating air. October 26.

16,308. W. Maybach. Apparatus for effecting a continuous circulation and cooling of cooling liquids employed in motors and compressors. October 26.

16,403. C. W. Cooper. Apparatus for evaporating liquids. November 16.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

18,581. D. Terrace. An improved apparatus or appliance for heating inclined gas retorts. October 17.

18,605. G. Hüttemann and G. Spieker. Improvements in the manufacture of blocks or briquettes of fuel from small coal, slack, coal-dust, and coke-dust. October 18.

18,615. W. Fiddes. Improvements in the method and apparatus for charging gas retorts. October 18.

18,680. J. Yonge. An improvement in night lights, candles, and similar means of illumination. October 19.

18,904. J. Hodges. See Class III.

18,990. L. H. Armonr. Improvements in the manufacture of illuminating gas. October 22.

19,078. L. Chapman. Improvements in and apparatus for the production of oxygen and nitrogen from atmospheric air. October 24.

19,477. R. Caupion. The employment of certain ingredients and means for the manufacture of fire-lighters therefrom. Complete Specification. October 29.

19,483. A. W. Wells.—From F. Verrue, Belgium. A new or improved apparatus for carburetting gas and air for illuminating and heating purposes. Complete Specification. October 29.

19,630. H. Galopin. Improvements in and connected with apparatus for using liquid fuel for lighting and heating purposes. Complete Specification. November 1.

19,655. H. G. O'Neill. Improvements in and relating to a method of and means for heating by electricity. Complete Specification. November 1.

19,753. A. G. Glasgow. Improvements relating to apparatus for the manufacture of water-gas. November 2.

19,997. J. Goetz. Improved apparatus for separating tar and ammonia from gas. November 7.

20,341. P. A. Fichet and R. Heurtey. Improvements in the production and the use of gaseous fuels. November 10.

20,373. W. G. Hay. Improvements in and connected with the manufacture of fire-lighters. November 11.

20,429. A. J. Eli.—From M. A. Braconnier, France. A new or improved process for utilising the waste heat of zinc works. November 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

20,573. J. Hargreaves. Feeding fuel to gas producers and generation of combustible gas. November 2.

21,563. W. Bagley. Apparatus for feeding coal to gas producers. November 16.

22,106. C. E. Bell. Improvements in coke ovens to facilitate the cooling of the coke before drawing. October 26.

22,292. J. A. Yeadon and W. Adgie. Heating retorts or furnaces for the distillation of coal or other analogous purposes. November 16.

22,340. J. Pullman and H. S. Elworthy. Process for the manufacture of carbonic acid gas and hydrogen gas, and for the separation of the two gases, and apparatus therefor. October 26.

1892.

24. H. Williams. Gas purifying apparatus. November 9.

15,122. W. H. Beck.—From B. de Lissa. Apparatus for making and storing a mixture of inflammable gas and air. November 16.

17,262. R. M. Bidelman. Manufacture of gas. November 2.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATION.

18,904. J. Hodges. Improvements in the treatment of paraffin scale and other crude paraffins. October 21.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

18,721. R. J. Friswell and F. H. Leeds. Improvements in the manufacture of copyable inks. October 19.

18,762. H. S. Elworthy. An improved method of and apparatus for oxidising indigo liquor. October 19.

19,246. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new colouring matters. October 26.

19,411. R. W. E. Melvor and A. Cruickshank. A process for the production of blue ultramarine from the material known as green ultramarine. Complete Specification. October 28.

19,557. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new colouring matters. October 31.

19,743. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new azo-colouring matters. November 2.

19,820. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. A new manufacture of red colouring matter. November 3.

19,826. J. Sniechowski. Improvements in the production of black and brown colours. November 3.

19,891. Brooke, Simpson, and Spiller, Limited, and A. G. Green. Improvements in the manufacture of azo-colouring matters. November 4.

20,423. J. Rohner. Manufacture of new colouring matters of the series of the indulines by the action of the diamido-di-alkylthioureas on the aromatic amines. Complete Specification. Filed November 11. Date applied for April 14, 1892, being date of application in France.

20,506. B. Willecox. — From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture and production of dyestuffs, suitable for dyeing vegetable fibre with or without a mordant. November 12.

20,512. G. M. Keevil. A new or improved manufacture of ink. November 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

22,641. B. Willecox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of new colouring matters. November 2.

22,641A. B. Willecox.—From The Farbenfabriken vormals F. Bayer and Co. Production of azo colours on fibre. October 26.

1892.

277. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of new colouring matters. November 9.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

18,572. P. Jensen.—From E. Stierner and M. Ziegler, Germany. Process of and apparatus for working up organic fibrines for producing sheets, roofing and wall felts, matches, torches, and the like. Complete Specification. October 17.

19,737. H. W. Godfrey, C. F. Leake, and C. E. Lucas. Improvements in the manufacture of floor-cloth. November 2.

19,770. E. Ostlere and W. F. Denholm. Improvements in the manufacture of tessellated or inlaid floor-cloth. November 3.

19,776. F. Doller and R. Wolfenstein. Process and apparatus for waterproofing woven fabrics. Complete Specification. November 3.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

18,470. C. G. Hagemann. Manufacture or production of cellular substance and textile fibre. October 26.

19,135. L. E. Vial. Treatment of China-grass, and other plants adapted for employment in the textile industry. November 16.

1892.

477. G. Hagemann. See Class XIX.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

18,843. J. E. L. Roche. An improved process of dyeing, dressing, and waterproofing fabrics. Filed October 20. Date applied for March 21, 1892, being date of application in France.

18,975. D. Jackson. Improvements in the method of and apparatus for hank dyeing. October 22.

19,079. F. Schreurs. A new process and apparatus for printing and dyeing fabrics. Complete Specification. October 24.

19,359. L. Ettl. A new or improved process and apparatus for dyeing, bleaching, and boiling. Complete Specification. October 28.

19,796. J. Rhodes, sen., and J. Rhodes, jun. Improvements in machinery for dyeing, washing, or treating with liquids, hanks or skeins of yarn, slubbing or other fibrous material. November 3.

20,444. P. A. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the production of fast colours on fibres by means of dyeing and printing. November 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

20,103. P. G. Wild, G. Bentley, J. B. Jackson, and A. A. Whitley. Method of stamping and tinting textile fabrics and apparatus for effecting same. October 26.

22,538. E. Zillessen, sen. Dyeing silk or half silk goods. October 26.

22,641A. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. See Class IV.

1892.

148. A. Dreze. Dyeing vats. November 9.

4278. H. Thies and E. Herzig. Bleaching. November 9.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

18,598. F. P. Candy. Improvements in and in connection with the manufacture of iron sulphate, and of materials for use in the filtration and precipitation of sewage and polluted waters. October 18.

18,810. H. Steinem. Improvements in the manufacture of carbonic acid gas. October 20.

18,871. J. Hargreaves and T. Bird. Improvements in the manufacture of alkali and in apparatus therefor. October 21.

18,900. C. H. W. Hæpfner. Improvements in the manufacture of cuprous oxide. October 21.

18,917. O. J. Steinhart. Improvements in the production of cyanides of the alkali and alkali-earth metals. October 21.

19,143. J. S. MacArthur, R. W. Forrest, and W. Forrest. Improvements in obtaining cyanogen compounds. October 25.

19,180. J. M. Milnes and A. Milnes. A new process or means for the production of chloride of lime. Complete Specification. October 25.

19,213. I. Levinstein. Improvements in the method of and apparatus for concentrating sulphuric acid and other liquids. Complete Specification. October 26.

19,447. R. Ashton. Improvements in the preparation of compounds for making vinegar. October 29.

19,812. L. Mond. Improvements in obtaining ammonia, chlorine, and hydrochloric acid from ammonium chloride. November 3.

20,055. W. J. Fraser and L. McGregor Fraser. Improvements in the manufacture of bleaching powder and like compounds, and in apparatus therefor. November 7.

20,070. W. T. Thorp. Manufacture of improved substances from salt. November 8.

20,202. T. Hyatt and T. Rickett. Improvements in the preparation of acids and alkalis, and in baking powders and self-raising flour prepared therewith. November 9.

20,269. M. P. Hatschek. Improvements in the manufacture of sulphurous acid and its compounds, sulphites and bi-sulphites of lime, soda, and the like. November 10.

20,284. P. de Wilde, A. Reyckler, and F. Hurter. Improvements in apparatus for the manufacture of chlorine. November 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

18,482. J. E. Bott. Manufacture of caustic alkalis. October 26.

19,780. C. J. Schofield. Apparatus for concentrating sulphuric and other acids. November 16.

22,340. J. Pullman and H. S. Elworthy. See Class II.

22,655. H. Williams. Method and means for recovering salts from brine and solutions, and for concentrating solutions.

22,828. J. J. Meldrum and T. F. Meldrum. Supplying liquor to ammonia stills. November 9.

1892.

2604. J. Morris. Process for the production of crystals and crystalline masses. November 16.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

18,891. T. G. Webb. Improvements in the manufacture of open glass retorts or vessels used in the concentration of sulphuric acid, and in apparatus therefor. October 21.

19,361. A. S. Ford. See Class X.

19,395. P. A. Moreau. Improvements in the production of ornamental stones artificially coloured. Complete Specification. October 28.

19,970. J. A. Yeadon and W. Adgie. Improvements in the manufacture of fire-bricks, retorts, crucibles, and other analogous articles. November 5.

20,441. S. D. Pochin and H. D. Pochin. Improvements in the manufacture of tiles. November 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

46. R. F. Yorke. Earthenware pipes. November 16.

117. D. Rylands. Jars and similar receptacles for sterilised milk and similar preparations. November 9.

16,792. F. Shuman. Apparatus for manufacturing sheet glass having wire or wire netting embedded within it. November 9.

17,848. P. Sievert. Process for producing flat objects of glass, and means for carrying out such process. November 16.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

18,575. H. J. Haddan.—From F. D. Cummer, United States. Improvements in the process of drying and disintegrating clay and similar materials. Complete Specification. October 17.

18,803. K. Alsdorff. Improvements in fireproof walls and ceilings. Complete Specification. October 20.

19,009. J. Thomlinson. Improvements in the manufacture of non-efflorescent white cements from calcined sulphate of lime. October 22.

19,622. J. A. Yeadon and W. Adgie. Improvements in the manufacture of cements or other analogous materials. November 1.

19,716. J. L. Rawbone. An improved compound or treatment of clay to produce a compound for modelling designs. November 2.

19,813. O. Böklen. Improved process for making cement or cement mortar. Complete Specification. November 3.

19,908. C. G. Pickling. Improvements in or relating to fireproof buildings. Complete Specification. November 5.

19,947. W. Gutmann de Gelse. Process for preserving timber. Complete Specification. November 5.

20,132. H. D. E. Earl. Improvements in paving for streets, roads, and other places. November 9.

20,414. P. A. Moreau. The manufacture of variegated or veined artificial stone and imitations of natural marble. Complete Specification. November 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

22,111. E. Nelson. Material for use as a damp course in building foundations. November 2.

1892.

16,911. E. Edwards.—From K. Goetz. Process for producing liquid clay or slip for casting in moulds. October 26.

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

18,892. F. O'Connor Prince.—From J. Dixon, F. J. Blades, W. S. Douglas, and D. Garlick, South Australia. Improvements in and connected with the smelting of the sulphurets or sulphides of certain metals, and in apparatus to be used therewith. October 21.

18,928. G. L. Morris and J. Williams. Improvements in machinery and appliances for coating metal sheets with tin, terne, and other metals or alloys. October 22.

19,125. J. Kirkwood. Improved process and apparatus for separating iron, silicon, and such like impurities from other metals and alloys. October 25.

19,155. W. A. Baldwin and F. G. Wheeler. An improved method of and apparatus for decarbonising iron. Complete Specification. October 25.

19,175. A. J. Boulton.—From F. Grassmann, Belgium. Improvements in or relating to the fining of pig or crude iron. October 25.

19,215. C. M. Pielsticker. Improvements in the method and apparatus for coating metal with a protective covering. October 26.

19,330. N. J. F. Romanet du Caillaud. An alloy for use in textile machinery. October 27.

19,361. A. S. Ford. An improved process of electroplating glass, china, &c. October 28.

19,371. W. P. Thomas and R. Davies. Improvements in coating metal plates or sheets with tin, terne, and other metals, and apparatus therefor. October 28.

19,467. J. Clark and G. W. Clark. Improvements in or relating to the manufacture of steel and iron. October 29.

19,600. J. Buchanan, jun. Improvements in apparatus for charging furnaces with metal. Complete Specification. November 1.

19,727. H. J. Phillips. A process for the elimination of sulphur and phosphorus from molten iron or steel. November 2.

19,769. E. Hunt.—From B. Hunt, Mexico. Improvements in cyanide processes for extracting precious metals from ores. November 3.

19,801. W. S. Rawson and Woodhouse and Rawson United, Limited. Improvements in and in connection with pickling and preparing iron or steel plates for tinning or galvanising. November 3.

19,844. H. S. Denny and J. T. Garrick. Improved process for the recovery of gold and silver and utilisation of by-products from ores containing the sulphides of antimony, arsenic, tin, zinc, lead, and copper, either individually or collectively. November 3.

19,845. H. S. Denny and J. T. Garrick. Improved process for recovery of gold and silver from their ores. November 3.

20,014. H. Pidot and H. Charlier. A new process for hardening cast iron, and manufacturing cutting tools or other articles of tempered cast iron. November 7.

20,025. F. G. Fuller. Improvements in the treatment of ores and recovery of metals contained therein, and appliances therefor. November 7.

20,040. C. H. Ridsdale and The North-Eastern Steel Co., Ltd. Improvements in the manufacture and treatment of ingot iron and steel. November 7.

20,151. H. H. Lake.—From R. W. F. Abbé, United States. An improved process for treating oxidised or corroded lead, and apparatus therefor. Complete Specification. November 8.

20,189. F. Feldhaus and J. C. Ollaguiet. A process for augmenting the resistance of iron, steel, and other metals. November 9.

20,208. W. A. Briggs.—From J. W. Richards, United States. An improved solder for aluminium. Complete Specification. November 9.

20,318. A. Guthrie and R. F. Macfarlane. Improvements in the treatment of complex ores containing sulphides of zinc, lead, iron, copper, silver, gold, or other metals. November 10.

20,419. Woodhouse and Rawson United, Lim., and W. S. Rawson. Improvements in pickling iron and steel plates and apparatus therefor. November 11.

20,430. I. J. Monger and R. Monger. Improvements in means or apparatus for use in smelting copper or copper-producing materials. November 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

19,573. G. Selve. A process of separating cobalt from nickel. November 2.

1892.

1443. R. B. Thomas. Coating sheets or plates of iron and steel with lead. November 9.

8612. E. H. Saniter. Purification of iron or steel. November 2.

16,168. K. Wittgenstein. Process for manufacturing thin steel or iron sheets direct from ingots or welded faggots. November 9.

17,908. W. Smethurst. New or improved furnace for the reduction or smelting of zinc, lead, silver, gold, and other ores. November 16.

17,928. C. H. Hubbell. Manufacture of mineral wool. November 16.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

18,807. E. Andreoli. Electrodes for secondary batteries. October 20.

18,817. J. A. McMullen. Improvements relating to galvanic batteries. October 20.

18,844. H. Koller. Improvements in dry cells or galvanic batteries. October 20.

18,966. Siemens Bros. and Co., Lim.—From Siemens and Halske, Germany. Process for the electrolytic decomposition of compounds of metals and sulphur. October 22.

19,170. H. Blackman. Improvements in the production of chlorine, soda, and other products by electrolysis, and in apparatus employed therein. October 25.

19,220. E. Freund.—From E. Freund, Austria. Improvements in electric batteries. October 26.

19,236. G. Wilkinson. Improvements in and relating to the generation and distribution of electrical energy. October 26.

19,282. W. Walker. An improvement in or connected with galvanic batteries. October 27.

19,393. T. Froggatt. Improvements in electric battery apparatus. October 28.

19,451. H. F. Joel. Improvements in voltaic batteries, electrodes, and connections. October 29.

19,655. H. G. O'Neill. See Class II.

19,880. T. Parker and A. E. Robinson. The manufacture or production of an improved anode for use in electrolytical processes. November 4.

19,953. J. C. Richardson. Improvements relating to the construction of electrodes for electrolytical purposes. November 5.

20,348. R. J. Black. Improved electric-battery cells. November 10.

20,489. A. B. Woakes. Improvements in apparatus for sterilising and oxidising liquids by electricity. November 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

18,477. O. Schlesinger. A depolarising liquid for galvanic batteries. October 26.

21,959. E. Hermite and A. Dubosc. Apparatus for the manufacture of alkaline or earthy alkaline bases and of their salts or compounds by electrolysis of saline solutions. November 2.

22,339. N. Wladimiroff. Primary and secondary batteries. November 9.

22,708. W. Helesen. Manufacture of porous carbon for galvanic batteries and for filters. November 2.

1892.

372. N. Benardos. Soldering, melting, and coating metals by the aid of electricity. November 16.

16,461. W. Main. Secondary batteries. October 26.

16,822. T. Craney. Electrolytic apparatus. November 16.

17,222. W. P. Thompson.—From C. L. Coffin. Electric metal working or welding. November 2.

17,223. W. P. Thompson.—From C. L. Coffin. Welding or working metals electrically. November 2.

17,225. W. P. Thompson.—From C. L. Coffin. Method and apparatus for electrically welding metals. November 2.

17,226. W. P. Thompson.—From C. L. Coffin. Method or apparatus for working or heating metals electrically. November 2.

ERRATUM.

20,312 of 1891 (p. 861). Erroneously announced as completed in Official Journal, 28 September 1892. Please cancel.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

18,527. J. Brown. Improvements in the manufacture of soft soap. Complete Specification. October 17.

18,533. J. Brown. Improvements in the manufacture of hard soap. Complete Specification. October 17.

18,744. A. Teal. An improved method of and apparatus for brightening rape, linseed, and similar oils. October 19.

18,918. I. R. Burns. Improvements in the manufacture of lubricating grease. October 21.

19,191. J. W. Chenhall and W. S. Chenhall. Improvements in effecting the solidification of mineral, vegetable, and animal oils and fats. October 25.

19,745. C. H. Freyer.—From F. Korn, Germany. The "Excelsior" oil-purifying apparatus. November 2.

COMPLETE SPECIFICATION ACCEPTED.

1892.

16,527. W. R. Lake.—From W. T. Cutter. Cleansing or extraction of fatty substances from wool and the like, and method of clarifying the solvent used therefor. November 15.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

15,735. H. H. Lake.—From L. Enricht, United States. An improved manufacture of paint or cement. October 19.

19,453. J. E. Hartley and H. E. Hartley. A new or improved dead or non-glossy coating or varnish. October 29.

19,536. C. H. J. Donnadien. An improved process of manufacturing turpentine. October 31.

19,539. J. F. Thompson and C. F. Baker. An improved colouring and burnishing composition for boots and shoes. Complete Specification. October 31.

20,456. H. P. T. Denny and W. L. L. Grant. An anti-fouling and protective paint for preserving the bottoms of iron or wooden vessels and other submerged surfaces. November 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

22,334. W. R. Harp. Material which may be used in arts and manufacture in the steel of india-rubber, gutta-percha, and other similar substances, and process for making the same and for the utilisation thereof of waste liquors from tanneries. November 3.

1892.

17,655. J. Birbridge. Preparing variegated rubber for manufacturing purposes. November 9.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATION.

29,351. C. S. Roy and C. S. Sherrington. A new and improved process for obtaining blood albumen for commercial purposes. November 11.

COMPLETE SPECIFICATION ACCEPTED.

1891.

21,527. T. J. Haslam. Substitute for whalebone. November 16.

XV.—AGRICULTURE AND MANURES.

APPLICATION.

18,648. J. Carter. Improvement in manufacturing manure from sewage. October 19.

XVI.—SUGARS, STARCHES, GUMS, Etc.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

19,762. R. Morton and T. Morton. Pans for boiling or heating sugar or compounds thereof or similar substances. October 26.

20,887. D. Stewart. Evaporating or concentrating saccharine liquids and apparatus therefor. October 26.

1892.

15,816. C. M. Lafontaine. New or improved process and apparatus for the treatment and purification of raw sugar, and its conversion into blocks or ingots. October 26.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

15,697. G. Morris and J. H. Howell. Improvements in attenuators and skimming appliances for use in brewing and fermenting vessels. October 19.

19,814. C. F. H. Hallett. An improved refrigerator or heater for cooling or heating wort or other liquid. October 20.

18,911. H. Gardner.—From Van Laer, Belgium. Improvements in or connected with apparatus for the cultivation of pure yeast. October 21.

15,941. W. A. Swain. Improvements in strainers for the purification of malt liquor or other liquids. October 22.

19,254. A. Brin. An improved process of flavouring, impregnating, or modifying alcoholic liquids. October 26.

19,260. A. Brin. An improved process of distilling and rectifying alcoholic liquids. October 26.

19,261. A. Brin. Improved apparatus for distilling, rectifying, flavouring, or modifying alcoholic liquids. October 26.

19,535. B. Dukes.—From E. Briesemeister and W. A. Seyblich, Germany. Improvements in the manufacture of grape sugar. October 31.

20,295. W. S. Squire. Improvements in the manufacture of yeast. November 10.

20,317. A. Kerchbaum, F. J. Z. B. Strassnick, and R. Schmiedel. Improvements in the manufacture of malt liquor. Complete Specification. November 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

22,248. J. Pullman and H. S. Elworthy. A method of and appliance for the collection, purification, and utilisation of carbonic acid gas given off during fermentation of saccharine and other substances. October 26.

22,399. W. P. Thompson.—From O. E. Nycander. Preparation of extracts for use in the manufacture of yeast and spirit. November 2.

1892.

301. H. Prior. Apparatus for cooling and attenuating beer during fermentation. November 2.

17,254. E. Adam. Malt beverages. November 2.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

18,535. R. W. Leftwich. Improvements in cocoa and chocolate. October 17.

20,095. C. H. R. Christie.—From C. J. Christie, Argentine Republic. Improvements in and connected with the treatment of milk. November 8.

20,202. T. Hyatt and T. Rickett. See Class VII.

B.—Sanitary Chemistry.

18,598. F. P. Candy. See Class VII.

19,198. R. Stanley. An improved method for the purification of sewage waters and waters from chemical and other manufactures. October 26.

19,247. W. D. Scott-Moncrieff. Improvements in or relating to the treatment of sewage. October 26.

19,587. F. P. Candy. Improvements in the treatment of sewage and polluted waters, and in connection with the manufacture of materials for use in the treatment of sewage and polluted waters. November 1.

19,783. A. S. Ramage. Utilisation of human excreta. November 3.

19,785. W. Oldfield. Improvements in the method of purifying sewage and trade effluents. November 3.

19,829. L. Archbutt and R. M. Deeley. Improvements in apparatus for purifying water. November 3.

19,830. R. M. Deeley and L. Archbutt. Improvements in apparatus for purifying water. November 3.

19,866. J. Hanson. Improvements in means or apparatus for cooling and purifying liquids discharged from works or the like. November 4.

C.—Disinfectants.

18,957. S. P. H. Statham. A new or improved disinfecting and deodorising paper. October 22.

19,277. W. G. Daniell. A new or improved composition for preserving articles of food, and for disinfecting and purifying purposes. October 27.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1891.

20,694. B. Corrick. New or improved manufacture of substances or compositions for use as condiments. November 9.

1892.

16,548. C. Blackmore. Process for incorporating malt, or the aroma therefrom, with coffee, tea, and similar substances used as a beverage or food. November 2.

B.—Sanitary Chemistry.

1891.

17,844. A. Wollheim. Plan for the construction of works for the treatment of sewage and other foul or waste liquids. October 26.

20,682. J. Price. Treatment of sewage. October 26.

1892.

16,333. W. F. Goodhue and C. Paulus. Apparatus for filtering and purifying sewage or other matters. November 2.

C.—Disinfectants.

1892.

16,202. G. S. Yingling, J. K. Pfaltzgraff, and G. K. Pfaltzgraff. Chemical compound for treating tobacco. November 9.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

19,675. F. Greening, jun. Improvements in the manufacture of compositions and treatment of the base nitro-cellulose or pyroxiline for various commercial uses. November 1.

20,290. P. Smith. Improvements in apparatus for the manufacture of paper. November 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

19,135. L. E. Vial. See Class V.

1892.

477 G. Hagemann. Manufacture or production of cellular substances suitable for paper-making and fibre suitable for spinning. November 16.

XX.—FINE CHEMICALS, ALKALOIDS ESSENCES, AND EXTRACTS.

APPLICATIONS.

19,329. L. F. Riedel. A new compound or derivative of para-tolyldimethyl pyrazolon, and process for obtaining the same. Complete Specification. October 27.

19,648. L. F. Riedel. Manufacture of para-phenetol-carbamide. November 1.

19,878. H. Thoms. Process for obtaining *p*-phenetol-carbamide. Complete Specification. November 4.

20,497. P. A. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new pharmaceutical compounds. November 12.

20,498. C. D. Abel.—From The Haarmann and Reimer Vanillin-Fabrik, Germany. Manufacture of β -cymidine, $C_9H_3(CH_3 \cdot NH_2 \cdot C_3H_7) \cdot (1:2:4)$ from the orims (oximes) of certain camphor species. November 12.

20,499. C. D. Abel.—From The Haarmann and Reimer Vanillin-Fabrik, Germany. Manufacture of mono-carbon acids having the composition of $C_9H_{14}O_2$, of di-carbon acids having the composition $C_9H_{14}O_4$, and of anhydrides of the latter having the composition $C_9H_{12}O_3$. November 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

361. C. D. Abel.—From C. F. Boehringer and Söhne. Manufacture of vanillin. November 9.

16,942. W. P. Thompson.—From R. Campani. Process for extracting iodine from natural saline waters, mother-liquids, or other liquids containing iodine. November 2.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATION.

19,531. H. J. Shawcross. Improvements in or connected with the production of sepia or like coloured photographic pictures and sensitised paper films and other media therefor. October 31.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

18,548. J. Somerville and D. Morrison. Improvements in and relating to matches for lighting purposes. October 17.

18,572. P. Jensen.—From E. Stiemer and M. Ziegler, Germany. See Class V.

19,322. C. H. Wolf. A process for the manufacture of fuses, such as firework fuses, and apparatus in connection therewith. Complete Specification. October 27.

20,231. R. W. Sedgwick and C. Lamm. Mode of exploding high explosives without the use of fuses, and also apparatus therefor. November 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

19,068. C. H. Curtis and G. G. André. Manufacture of gunpowder. November 9.

1892.

12,415. W. E. Gedge.—From The United States Smokeless Powder Co. Explosive compound. October 26.

PATENT UNCLASSIFIABLE.

COMPLETE SPECIFICATION ACCEPTED.

11,174. W. Read, jun. Solvent compounds, and method of making same. October 26.

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SESSION 1892-93.

1893:—

Monday, Jan. 9th:—

Mr. Arthur G. Green, F.I.C. "Quantitative Analysis of Artificial Colouring Matters."

Mr. Bernard Dyer, D.Sc., F.I.C. "Notes on the Proportion of Fatty Acids in Oil Cakes."

Mr. Watson Smith, F.I.C. "Further Notes on the Preparation of Nitrous Oxide."

Monday, Feb. 6th:—

Mr. Oscar Guttman. "The Manufacture of Nitric Acid."

Mr. C. C. Hutchinson, F.I.C. "A New Form of Laboratory Filter Press."

Meeting held Monday, 5th December 1892.

MR. WM. THORP IN THE CHAIR.

ON THE ELECTROLYTIC PRODUCTION OF CHLORINE AND SODA.

BY C. F. CROSS AND E. J. BEVAN.

THE electrolytic production of caustic soda and bleaching powder has of late years occupied a good deal of attention. The subject is one of very considerable technical interest, and the commercial future of electrolysis in this direction of application being at the present time under serious discussion, we have availed ourselves of an opportunity of bringing the matter before the Society.

The problem of the economical manufacture of alkali and bleach by the electrolysis of salt solution is a very enticing one, and for many years past it has attracted the attention of inventors. It is, however, only within the last few years that any considerable advances have been made.

The chief difficulties have hitherto been (1) the devising of a diaphragm of such low resistance as would allow the electrolysis to proceed with a reasonably low electro-motive force, and which would at the same time effectually prevent the recombination of the products of electrolysis; and (2) the construction of an anode which would stand wear and tear.

These difficulties have, we venture to think, been very largely overcome, and we think there is a fair prospect of success in the near future.

We do not propose in the present communication to advocate any one of the many processes that are before the public, but to discuss the problem in general terms in the hope that we may be able to show the feasibility of an economical electrolytic process.

We shall, however, have occasion to describe somewhat in detail two processes with which we have had some practical experience. These are the Greenwood and the Le Sueur processes, and their essential features are shown in the diagrams on the wall.

In the former, the electrolyser consists of a rectangular tank of slate or other suitable material divided into compartments by means of diaphragms. These are made of a number of V-shaped shelves of glass or slate placed in a mahogany frame. The spaces between the shelves are filled with asbestos. On one side of the diaphragm is the cathode made of iron, and on the other side is the anode. This is of peculiar construction, being built up of a number

of pieces of hard retort carbon cemented together by first impregnating with tar and subsequently heating to a high temperature. The inside is filled with type metal. The cathodes and anodes in every electrolyser are connected together in parallel, the electrolysers themselves being in series. Arrangements are made by means of pipes for allowing the salt solution, which is about half saturated, to flow through all the anode and cathode sections respectively.

The chlorine which is evolved passes into the chlorine main. The caustic solution, after passing through a sufficient number of electrolysers, is evaporated, and the excess of undecomposed salt removed. The subsequent treatment of the chlorine calls for no special remarks.

In the Greenwood process no arrangement is made for the renewal of diaphragms or anodes, as both are believed to be practically indestructible. Time, however, can alone settle this point.

In the Le Sueur process the arrangements are very different.

The electrolysers consist of an iron tank fitted with a sloping floor, on which rests the cathode. This is formed of a ring of iron filled with several pieces of iron wire gauze. Several small holes are drilled in the top part of the ring to allow of the easy escape of the hydrogen. The floor of the tank is also sloped for this purpose. The diaphragm rests on the cathode. It consists of two parts, viz., a sheet of ordinary parchment paper and a double sheet of asbestos cemented together by means of coagulated blood albumen.

The diaphragm being placed in position, the inner vessel of earthenware is placed on it, and by its own weight makes a watertight joint. There are usually 6-12 electrolysers in each tank. Inside the vessel has been previously placed the anode. This consists of pieces of ordinary retort carbon imbedded in a mass of lead, through which electrical contact is obtained.

The object of the lutes is of course to prevent escape of chlorine. The lute, which is made of porcelain, is in order that any one electrolyser can readily be electrically disconnected from the others in the same tank. Without this it would be necessary to remove the cell entirely if anything happened to go wrong with it.

The cell being in position, a saturated solution of salt is run into the outer vessel until it reaches just above the upper edge. The anode section is filled with similar solution to a level about half an inch above that of the solution in the cathode section. The object of this is to prevent any transference of solution from the outer to the inner vessel, this being more harmful than the reverse.

The diaphragms are renewed every 48 hours; to effect this the whole of the inner vessels in any tank are simultaneously raised.

As the carbon of the anodes wears away they are lowered by means of the screws, so as to bring them as near as possible to the cathodes. After working for 6-8 weeks they have to be renewed. For this purpose the cells are taken to pieces and the lead melted and recast.

When the electrolysis has been continued long enough for the solution of caustic to reach a strength of about 10 per cent., the liquor is run away and the alkali precipitated as bicarbonate.

Having now briefly described the Greenwood and Le Sueur apparatus, we will proceed to discuss the problem from the point of view of cost. In doing this we shall base our estimates on figures obtained from the actual working of the Le Sueur system on a scale of half a ton of bleaching powder per day.

With the exception that the cost of plant would vary with every process, the figures may be taken as fairly representative of other processes.

In calculating the cost, the most important item is the power. Opinion varies considerably as to the cost of a horse-power; we believe, however, that it may fairly be taken at not more than $\frac{1}{4}$ d. per hour. We arrive at this estimate in the following way:—

Taking as our basis an output of 2,400 indicated horse-power hours, employing two engines of 1,200 horse-power each.

Cost of power per 24 hours:—

1. Coal.—Thus, with modern engines, we may safely take at 2½ lb. per horse-power hour.	£	s.	d.
2,100 × 2½ × 24 hours = 64 tons at 10s.	32	0	0
2. Labour.—8 day men and 8 night men, at 30s.	1	0	0
3. Depreciation at 10 per cent, for 300 days on			
Engines	10,000	0	0
Boilers	7,000	0	0
	£17,000	0	0

4. Oil, waste, &c.	1	0	0
	£42	10	0

12l. 14s. 08. = 10,392 farthings, which, divided by 24 hours and again by 2,100 horse-power gives us 0.771 of a farthing as the cost of one horse-power hour.

At this point it may be interesting to quote the estimate given by Dr. John Hopkinson. In an address recently delivered to the Junior Engineering Society, this authority states his opinion that a Board of Trade unit (1,000 watts) can be produced at a cost of one-third of a penny, which is as nearly as possible equal to 1 farthing per horse-power hour.

Now this 2,400 horse-power when converted into electrical energy and delivered at the terminals of the electrolyzers will be equivalent to only 2,000 electrical horse-power on the basis of a loss in conversion and leakage of 17 per cent.

We now have to consider what amount of electrical energy can be got from 2,000 electrical horse-power. This, of course, will depend on the electro-motive force at which the current is employed. In practice, it has been found that with arrangements, such as the Greenwood and Le Sueur processes offer, the decomposition of the salt can be effected with a current working at 4½ volts. As a matter of fact, 3 volts or less is sufficient, but in that case the amount of decomposition per unit of plant, if we may use the expression, is small, and the saving of power thus effected would probably be more than counterbalanced by the standing charges on the extra plant required. 2,000 electrical horse-power × 746 = 1,492,000 watts. Dividing this by 4½ volts we arrive at a current of 331,555 amperes equal to 7,957,320 ampere hours.

Each ampere hour is theoretically capable of producing 0.00292 lb. of chlorine, therefore 7,957,320 × 0.00292 = 23,235 lb. of chlorine per 24 hours. Taking a practical efficiency of 80 per cent, we find that our current of 331,555 amperes will yield 18,588 lb. or 8.3 tons of chlorine per 24 hours, equal to 22.43 tons of bleaching powder containing 37 per cent. of chlorine.

Each ampere hour will yield 0.0033 lb. of caustic soda (NaOH). Going through a similar calculation we get a yield of 9.378 tons of caustic soda or 12.426 tons of ash per 24 hours.

These products at present selling prices would be worth—

22.43 tons bleach at 7l. 10s.	£	s.	d.
9.378 tons caustic at 12l.	168	4	6
	112	10	0
	£280	15	3
22.43 tons bleach at 7l. 10s.	168	4	6
12.426 tons ash at 5l. 15s.	71	9	0
	£239	13	6

Now as to the cost of production. This we arrive at in the following way:—

Cost of production of 23 tons bleaching powder and 9.378 tons of caustic or 12.426 tons ash per 24 hours:—

18 tons salt at 12s.	£	s.	d.
12 tons lime at 12s.	10	16	0
Power, 2,400 × 24 = 57,600 horse-power hour at ½d.	7	4	0
Labour	60	0	0
Casks and packages	10	0	0
Depreciation at 10 per cent, for 300 days on—	18	0	0
Electrolysers	£	s.	d.
Dynamoes	12,000	0	0
Tanks, pumps, buildings, &c.	8,000	0	0
	10,000	0	0
	£30,000	0	0
	10	0	0
Superintendence	1	0	0
General expenses	1	0	0
	£121	0	0

Where the diaphragms and anodes require renewal, as in the Le Sueur system, a further sum must be added. This will amount to 30l. The carbonic acid for converting the caustic into carbonate, we may put at the outside figure of 2l. We arrive at a total cost of production of 153l.

When caustic soda is the product required it will be necessary to increase the cost of production by the expense of evaporation. This should not amount to more than 1l. per ton. It is probable that even with the most perfect anodes and diaphragms a certain sum will have to be put aside for renewals. What this should be experience only can tell. Where the rate of disintegration is known, as in the Le Sueur system, it can be fully discounted.

It must also be borne in mind that caustic soda obtained by evaporation of solutions of salt and soda still contains a certain amount of salt, which will render it less valuable than purer products. The margin of profit is, however, sufficiently large to allow for such contingencies.

Such then is briefly the present position of electrolytic soda and bleach. We have tried to show that under by no means extravagant conditions they can be produced at a price which at the present selling prices leaves ample margin for profit.

It may be of interest to members of the Society to know that the Le Sueur process is now in operation at Rumford Falls, U.S.A., on a scale of 3 tons of bleach per day. We may also mention that the Hermite Electrolytic Bleaching Process, which we had the honour of bringing before the notice of the Society in 1887, and to prove the utter absurdity of which a considerable amount of energy was devoted by a distinguished authority, has proved itself highly successful on the Continent. At the present moment it is replacing 3,000 tons of bleaching powder per annum.

Notwithstanding the very confident predictions of certain authorities as to the utter impossibility of an electrolytic soda process paying, we venture to think it is destined to play a very important part in the future development of the alkali industry.

DISCUSSION.

Mr. W. T. Reto said that he had taken a good deal of interest in this subject. He had watched the operation of the Greenwood process, and the result of his observations was this, that he knew alkali was produced. He had heard it said that it could not be made by the electrolytic method. But there was no doubt that it was produced chemically by the process described. There were, however, some points not mentioned in the paper, which he had observed, and he thought it would be well if these points were discussed. One of them was the by-products which were produced. This was a very important matter. During the electrolysis of chloride of sodium a considerable percentage of other matters than caustic soda was produced, especially chlorate of soda. Another by-product which was produced to a considerable extent was hydrogen. As soon as the current was turned on they saw a very copious evolution of hydrogen, so copious that it might be used as a source of heat to evaporate the liquors afterwards. Still at the same time this would involve a loss of power, as they could get that heat by a very much better process. They saw on the table before them one of the anodes used, and it was a very ingenious way of getting over the difficulty. Such anodes lasted a long time, but they did not last for ever. They had in one process a certain amount of retort carbon which lasted a definite time, he thought it was mentioned as being from six to eight weeks. A certain percentage should be allowed for the renewals of these anodes. The diaphragms were as perfect as they could be made. They worked extremely well, and the asbestos stood very well indeed. With regard to the diaphragm in the Le Sueur process, it was rather troublesome to change it so frequently as once in the 48 hours. It added to the cost of production and seemed to be a great disadvantage. Then again, the outer vessels in that process were rather liable to be acted upon. He did not think the cast iron would be a permanent substance in connection with these liquids. Then it had not been mentioned in connection with

extracting caustic soda how that soda could be got in a commercial form. The liquid was rather dilute and there was with it not only the residual chloride of sodium but also the chlorate of soda and other substances, and they had to boil all these substances down and extract the chloride from them before they could make use of it. The chlorate of soda and other by-products would be concentrated in that solution as they returned it for electrolysis again; so that there would be a continual accumulation of the by-products. With regard to the strength of current, he thought that although Mr. Greenwood had said that a certain current was the best under certain conditions, the whole question had got to be worked out. He thought any estimate as to the cost of energy based on present data would be, to a certain extent, hypothetical. There was no doubt in his mind that the cost of producing caustic soda by the electrolytic process would be very much less than that of producing it by any other process. Given electrical energy at a cheaper rate, and electrolytic soda would completely supplant soda produced by the ammonia process and other methods.

Mr. BERTRAM BLOUNT said that the impression made on his mind when he inspected the process at the beginning of the year was that the diaphragm was a very ingenious apparatus, and that the anode had been devised with great care; but he remembered asking Mr. Greenwood at that time whether he made any attempt to deal with one of the by-products mentioned by the last speaker, viz., the hydrogen. By the production of that body part of the energy was lost; and if it could be suppressed and the restitution of the energy accomplished, or if some industrial use could be found for it, it would be a distinct advantage. Whether this was possible or not he could not say, but possibly the authors, who had been intimately connected with the process for some time, would be able to give them some information on the point. He would, therefore, ask them to say whether any attempt had been made to use the hydrogen or suppress it.

Mr. W. CROWDER inquired whether the process was at work in London, and whether on an experimental or a practical scale.

Mr. BEVAN replied that it was in operation in London on an experimental scale at present, but that a company was being formed to work it on a large scale.

Mr. P. MACEWAN said that when he saw the process at work he understood from the gentleman who had explained it to him that 10 per cent. only of the salt was decomposed; therefore, they had to add 90 per cent. of waste to the figures which had been given in the paper. The expense of working it was very great, for he was informed that a man was engaged in doing nothing else but plying a small brush to keep the joints of certain parts of the machinery cleared; and he wished to know whether that would be the case in actual working. He might remark that he was not interested in any of these electrical enterprises. He understood that the process before them was likely to be adopted only by paper-makers and other people who used caustic soda in solution. In fact, the expense of removing the salt, and evaporating the solution after in order to get caustic soda for commercial purposes, would be quite equal to the ordinary cost of producing it by the Leblanc process. Where, therefore, was the advantage? He thought that the figures on the tables before them were hardly reliable, and must be taken with a good deal of reserve, especially in view of the fact that the selling prices quoted were the prices of bleach and caustic in London.

Mr. CROWDER said that if it was a fact that a certain quantity of soda, and certain products, were made by the process in America, he wished to know whether this was done under the circumstances described, and at the cost quoted, or under those which Mr. MacEwan had spoken of.

Mr. SYDNEY EVERSLED wished to call attention to one or two features of the paper from the point of view of an electrical engineer. The authors had referred, as one or two of the speakers had done, to the economy of production

of electrical energy. He did not think there was very much hope of the production of electrical energy at a lower rate than as carried on now in many of the central stations supplying the electric light in London, and he must say that the figures given on the blackboard seemed to him very fair and reasonable. He would point out that engines might be produced, and were being produced now, to give an indicated horse-power for considerably less than $2\frac{1}{2}$ lb. of coal per hour; he believed he might say at 1.8 lb. per indicated horse-power. They had to transform that indicated horse-power into electrical energy, and that was being done at the central stations in London at an efficiency of 85 per cent. When they came to deal with the consumption of that energy, it was rather astonishing to him to find that the inventor of the process willingly sacrificed more than 50 per cent. of the power (Mr. Cross: "No, no"). He thought that the author of the paper said that $4\frac{1}{2}$ volts were used in the electrolyser. He was speaking off-hand, but he thought that the electromotive force of decomposition of the solution was something like 2 volts. He would like to be informed whether that was so or not (Mr. Cross: "Yes"). He need hardly remark that the electromotive force of decomposition multiplied by the force of the current gave the useful energy of the current, while the remaining energy was spent in overcoming resistance, and it certainly seemed possible that the energy so spent might be looked to in future for reducing that amount of 60% which figured so largely in the authors' estimate.

Mr. A. SHEARER wished to know on what data the figures given had been arrived at, whether the process had been carried out to the extent of actually making a ton of caustic soda—working to the bitter end—or whether they had assumed from certain short experiments that the desired end could be attained. If so, they were entirely wrong. If they took certain periods of time, for example, they would find that for the first six hours everything went on swimmingly; but if they carried on the process they would discover that at the fourth period of six hours they consumed nearly three times as much electrical energy as they used in the first; so that it was important to know whether these figures had been made up from one run of six hours or from the results extending over a period of time. If they had to make only a ton of caustic it would no doubt be a very different thing from carrying on the process continuously.

Mr. C. F. CROSS thought that the last speaker was the victim of the "practical" superstition. The high officials of Alkali Union were not people likely to trifle with a matter of this kind. He himself had the running of an official test of the Le Sueur process before their chemists, who were present, and they were asked to do such things as would satisfy those gentlemen. The only tests which they asked to be applied were as to the percentage of chlorine in the gases liberated and the contents in alkali and salt of the resulting solution, showing the absence of hypochlorites and similar bodies. He ran that test for 12 hours. Their efficiency curve was a straight line, showing that there was no falling off. They ran up to 5 or 6 per cent. of sodium hydrate and the test was at an end. Dr. Hurter never criticised them on any other hypothesis than the cost per unit of power. They knew that with a solution containing 6 or 7 per cent. of sodium hydrate and a definite proportion of common salt, the total cost of preparing a ton of caustic soda therefrom was a matter of simple calculation.

The CHAIRMAN thought that the figures on the blackboard showed a very comfortable margin indeed, but some doubts had been expressed as to whether that margin existed or not. It was a process that would require much working out, and it was in one sense, therefore, in the experimental stage. It had occurred to him that from a mixture of caustic soda and chloride of sodium containing only 10 per cent. of caustic it was very doubtful whether it would pay to separate the former. Perhaps the authors would be able to give some information on the point. Although it was pointed out that the prices given were the London prices of bleach and caustic, still they probably would not differ very materially from the prices in places where coal was cheaper. It was obvious, however, that the price quoted for coal was not a London price.

Mr. BEVAN, in reply, said, referring to Mr. Reid's remarks as to by-products, with a properly constructed diaphragm only a small quantity of hypochlorite or chlorate would be formed. After many hours' running of the Le Sueur process, the solution gave no reaction with starch paper. Eventually some hypochlorite might be formed, but this was not a very serious matter after all, because it was all accounted for in the 20 per cent. loss which they estimated. As regards the accumulation of the by-products as the salt went round and round, it would pay to throw away the salt occasionally; it was not a large item in the total cost. He did not know whether Mr. MacEwan was serious when he put his questions, but that gentleman had got an utterly erroneous idea as to the 10 per cent. decomposition. If the salt was not decomposed, it was there to be used again, and it was absurd to talk about 10 per cent. only being used. They had made every allowance for waste. Mr. Reid seemed to think that the evolution of hydrogen was a loss of power. There was no doubt about it. It must be. There was no other way, so far as he knew.

Mr. BLOUNT: It has been suppressed, I believe?

Mr. BEVAN replied that it had been suppressed in the Richardson process, and no doubt if arrangements could be made for utilising it, it would be a very considerable set-off against the cost of coal and the cost of power. Mr. Reid had mentioned that some allowance ought to be made for the disintegration of the anodes. He had not said they would last for ever. What he had said was that this anode as constructed was a very ingenious apparatus, and there was a strong probability of its lasting much longer than any anode that had ever yet been made; and as he had pointed out, in the Le Sueur system a very large allowance was made for this, and also for the diaphragms. Every loss was thoroughly accounted for, and the renewal of a diaphragm like this was made perfectly simple. He did not think there was any danger of the caustic solution acting on the outer vessel. As to the cost of electrical energy, Mr. Evershed had stated that the figures given in the paper were very fair. He (the speaker) was very glad to hear this from one who had given so much attention to the subject. That gentleman had spoken of 50 per cent. of the power being wasted. He (the speaker) pointed out that decomposition would take place at very much less than $4\frac{1}{2}$ volts, but in that case a very large plant would be necessary to produce a certain amount of caustic. They must have plant two or three times the size that they would have if they worked with $4\frac{1}{2}$ volts, so that it was found in practice that a current of $4\frac{1}{2}$ volts was the most economical to work with. As regarded the basis of calculation, certain of the numbers were of course hypothetical, because they had not—and nobody had—made 22·43 tons. The process was being worked at present at the Rumford Falls in America, on a scale of 3 tons of bleach per day, and arrangements were being made for working the Greenwood process. It was obvious that if they could make 3 tons at a profit they could make three millions. If they could do it on a big scale they could do it on a bigger, until they reached a gigantic enterprise. So far as he knew, 1 ton of electrolytic caustic soda had never been made in this country, but it was not necessary to show from the facts which he had given already that it might be done. Mr. Thorp had spoken of the process as being in the experimental stage. As he (the speaker) had said, it was being worked on a much larger scale than an experimental one, and no doubt as the work proceeded various improvements would be made. The process was sufficiently well developed now to induce large financial gentlemen in America to invest their money in it and to put up the works he had mentioned. With regard to the utilisation of a solution of 10 per cent. of caustic soda, he did not think that was a difficult matter. They must not forget that in the production of caustic by the Le Blanc process the solution was not much stronger, and a very large quantity of water must necessarily be evaporated. The caustic soda as it was made at present was at one time in a state of weak solution. He therefore did not think it was a difficult thing to deal with a 10 per cent. solution when the bulk of it—99 per cent.—could be thrown down as bicarbonate. With

regard to the prices quoted, he had taken them from the Chemical Trade Journal of that day, and they did not represent the prices in London; but then they did not propose to establish a manufactory in London. If London were in a less favourable position for working, they would go wherever local circumstances favoured them.

ON THE PRODUCTION OF ACETIC ACID FROM THE CARBOHYDRATES.

BY C. F. CROSS, E. J. BEVAN, AND J. F. V. ISAAC, B.A.

The chemistry of the carbohydrates has been greatly advanced in recent years, and the constitutional relationships of the members of this group are being rapidly elucidated.

While the finer points of molecular structure are being brought into the field of clear vision, and all the refinements of modern theory and method are being applied to the work of differentiating them, there is still much to be learnt in respect of the more general questions of molecular equilibrium common to the group. Thus the alcoholic fermentation of dextrose, which may be regarded, in a sense, as a property of the carbohydrate molecule itself, remains unexplained, as well as many other instances of molecular rupture of a similar character, similar in this respect, viz., that they may be regarded as determined by a migration of hydrogen atoms in the one, and of oxygen atoms in the other direction within the molecule. The production of lactic acid and of acetic acid from dextrose by the action of alkalis in dilute aqueous solution are decompositions of this order, and although they may be expressed, after the manner of text-books, by the simplest equations, viz.,—



it is known that they are very much more complex in fact.

To the latter of these changes, as a subject for investigation, we have been attracted on the ground of technical as well as theoretical interest.

During the progress of our research work on the general question of the formation of acetic acid in various decompositions of the ligno-celluloses, our friend Mr. W. H. Higgin, B.Sc., who had been independently investigating the subject from the technical point of view, took out a patent* for the production of acetate of soda from the alkaline waste liquors from straw and esparto boiling, and in the work of developing this process we have joined Mr. Higgin, and we shall have a few words to say on this new, or rather newly recognised, by-product of paper manufacture.

It will simplify the work of recording our investigations if we note a few of the theoretical considerations which have guided us.

The simpler carbohydrates appear to owe their characteristic properties to the one oxygen atom which they contain united to carbon atoms only, i.e., either as CO or C—O—C. If we take, as a general case, the following as the constituent groups of a molecule, CO(CHOH)₄CH₂, we should assign variable functions to the OH groups, according to proximity to the CO or acid grouping, or the CH₂ or basic grouping, and the equilibrium of such a body, or its hydrate, in aqueous solution would be somewhat similar to that of the salt of a weak acid and weak base. There are many reactions of dextrose and the carbohydrates generally in aqueous solution, or otherwise, which correspond with this view of their constitution. Thus dextrose combines in aqueous solution with bases such as lime, magnesium, lead oxide, and zinc oxide, giving well-defined compounds. It combines with acid radicles under dehydrating conditions, i.e., to form acid ethers or esters, and it also shows a tendency to combination with acids in aqueous solution. This is perhaps better seen, at least more easily demonstrated, in the case of the complex carbohydrates such as

* Eng. Pat. 13,469, 1891.

cellulose and its allies, which withdraw both acids and alkalis from aqueous solution, evidently as a result of reaction with the OH groups of the fibre substance, acid and basic. Direct evidence of combination of such carbohydrates as dextrose with acids in aqueous solution is afforded by the phenomena of acid hydrolysis, *e.g.*, the inversion of cane sugar. A. Wohl (Ber. 1890, 2086) has recently shown that this anhydride can be completely 'inverted' by treating with $\frac{1}{20,000}$ th of its weight of hydrochloric acid, and this result cannot be explained without assuming the occurrence of combination between the acid and the sugar molecules.

Lastly, we may cite the 'molecular' compounds which dextrose forms with neutral salts such as the chlorides and bromides of the alkali metals. These compounds are of the nature of double salts, and in their formation the saline character of dextrose in aqueous solution is apparent.

If we adopt this view, we may regard these carbohydrates in aqueous solution as under a species of electrolytic strain, and this is perhaps the simplest explanation of the mobility of oxygen and hydrogen within the molecule which we notice in the presence of exciting causes of such different character as the living yeast cell on the one hand and the alkaline oxides on the other. It is the latter condition with which we are concerned in the investigations we are about to describe.

We have subjected a number of typical carbohydrates to treatment with the caustic alkalis under various conditions with the object of determining—

A. The maximum yield of acetic acid.

B. Whether this maximum has reference to the constitution of the compound, and if so,

C. Whether the result confirms the view above elucidated.

Before describing our experiments in detail, we would premise that the method adopted for determining the acetic acid formed is exhaustive distillation and titration. The result was controlled in many cases by conversion of the volatile acids into silver salts in which the Ag was determined, and in all cases by examination of the distillate for the presence or absence of other bodies. The method of carrying out the decomposition was as follows:—The substance, generally in quantities of 2 grms., was mixed with the alkali dissolved in the minimum of water, and treated as described. The product was dissolved in water, the solution carefully acidified with sulphuric or phosphoric acid, and distilled.

A.—THE MAXIMUM YIELD OF ACETIC ACID.

1. Digestion of the Carbohydrates with Alkalis at 110° C.

The digestion of the carbohydrates with alkalis at a low temperature has already attracted the attention of several observers, but more especially from the point of view of the formation of lactic acid. Thus Kiliani (Ber. 15, 699) obtained lactic acid by heating together invert sugar and soda to 70° C. (see also Nencki and Sieber, J. Pr. Chem. 24, 498), and yields of 25 per cent. to 40 per cent. of this acid have been obtained under various conditions of digestion with weak alkali. The mechanism of this reaction does not appear to have been investigated. The reaction is complex, and the formation of other products has been noted. Amongst these we find acetic acid. Several experiments were made with cane sugar and with hydrocellulose at 100–110° C. Of these we give the results of two as typical.

Substance.	Potash.	Percentage, $C_2H_3O_2$.
Sugar	3:1	7.5
Hydrocellulose	3:1	14.0

Continuing these observations at 120°–150° C, and extending them to other substances, we obtained the following results, the alkali used being sodium hydrate (3:1):—

Substance.	Percentage, $C_2H_3O_2$.
Cane sugar	9.0
Cellulose (bleached cotton)	7.0
Hydrocellulose (cotton)	11.0
Jute	37.0
Pine wood ("wood-wool")	18.0

The formation of the relatively large quantities of acetic acid from the more complex, *i.e.*, the fibrous carbohydrate, is especially noteworthy.

It should also be noted, as of technical interest, that the alkaline liquors from linen cloth boiling, the temperature of which does not exceed 110° C., has been found to contain acetic acid, of which we have observed as much as 7 per cent., calculated on the organic matter in solution.

Experiments at 150° C.

The conditions of our next series of observations were as before, but potassium hydrate was employed as the alkali, and the temperature of digestion was kept constant at 150° C. The duration of the experiment was 48 hours. The yields obtained were as follows:—

Substance.	Percentage, $C_2H_3O_2$.
Cane sugar	16.0
Hydrocellulose	19.5
Jute	15.0
Wood	18.0

We must note here the bearings of these observations upon the general questions of the action of alkalis upon cellulose.

Thus Lange has proposed (Zeit. Physiol. Chem. 14, 217) as a method of estimation of cellulose in ligno-cellulose, *e.g.*, woods, a process of digestion with strong solutions of caustic alkalis at 185° C. Amongst the products of decomposition other than cellulose, which he assumes to be unaffected by the treatment, he notes the formation of formic and acetic acids. It is, however, quite clear, from our observations, that the cellulose molecule may be entirely decomposed under alkaline treatment of a certain degree of severity, and cannot remain unaffected under the conditions of treatment prescribed by Lange. As a method of estimating cellulose, it may therefore be dismissed.

Experiments at 200°–250° C.

The process of treating the ligno-celluloses (wood, sawdust, &c.) with the alkaline hydrates at this temperature is, as is well known, one of the standard methods for the commercial production of oxalic acid. An exhaustive investigation of the method was made some years ago by W. Thorn, and the influence of the several factors, time, temperature, nature of alkali, and proportion of alkali to organic substance, carefully determined in regard to yield of oxalic acid (Dingl. Polyt. J. 210, 24).

In this paper we find only a passing reference to the formation of acetic acid as a product of their decomposition. The greater number of our experiments have been made at this temperature. The heating in some cases was carried out on a sand-bath, in others we employed the form of air-bath described by Chorley and Ramsay in their recent paper (this Journal, May 1892).

At this temperature the decompositions are rapid, and the probable effect of atmospheric oxidation may be regarded as excluded. Under these conditions the maximum yields

from the several carbohydrates examined are approximately 33 per cent., as the following table shows:—

Substance.	Percentage, $C_6H_{12}O_6$.
Cane sugar	33
Milk sugar	31
Hydrocellulose	29
Jute.....	37
Pine wood	28

It appears in fact from these experiments—which are only a few from amongst the very large number carried out—that from all these carbohydrates we obtain about one-third of the molecule as acetic acid. Assuming these to be made up of C_6 units, each containing a CO_2CH_3 "residue," and the acetic acid to be a product of resolution, rather than of more complex reactions, the percentage yield would in effect be approximately 33 per cent. The results therefore are a satisfactory confirmation of the *à priori* view from which we started.

With regard to the remaining products of decomposition they are for the most part bodies of low molecular weight. Hydrogen is evolved in quantity, as is well known. In order to see whether this gas was accompanied by gaseous carbonic compounds, we carried out two experiments, in which the gaseous products, after passing through tubes filled with calcium chloride, were led over heated copper oxide, and the products collected in the usual way. In these experiments we employed cane sugar, 2 grms., KOH, 6 grms., water, 4 grms. Temperature 200–250° and we obtained—

	I.	II.
H_2O	0.610	0.434
CO_2	0.100	0.104

from which we get the approximate atomic ratios—

	I.	II.
$H:C$	30:1	20:1

and the conclusion that gaseous carbon compounds (CH_4 or CO) are only formed in relatively small quantity:—

It will be noted that the hydrogen evolved is about 2–3 per cent. the substance or from one-third to one-half the total.

Oxalic acid we found present in some quantity, much more being formed from the complex than from the simplex carbohydrates.

Thus, on heating for eight hours at 250° in a closed vessel, using three parts KOH to one of substance, we obtained the following yields:—

Substance.	Per Cent. $C_6H_{12}O_6$
Sugar	12.5
Hydrocellulose	41.7
Jute.....	59.3
Beechwood	58.0

Of bodies of higher molecular weight formed in the reaction one only appears to be specially characterised, that

is a compound dissolving to a strongly (orange-green) dichroic solution, of which we shall have more to say in a subsequent communication.

In the course of these experiments we have in certain cases obtained exceptionally high yields of acetic acid, which appears to be due to two causes:—(1) the prolonged duration of the heating; (2) to atmospheric oxidation. We have made a number of experiments in which oxidising agents have been added to the alkali-carbohydrate mixture. The results of these additions, of which we may mention potassium ferricyanide and ferric oxide have been, an increase of yield from the complex carbohydrates (fibre-substances) at the lower temperatures, *i.e.* 150° and below. Then in one experiment we took with 1.8 grm. hydrocellulose, 4 grm. NaOH and 4 grm. Fe_2O_3 in the form of the precipitated hydrate, and obtained after 48 hours heating at 150° 42 per cent. of its weight of acetic acid; whereas on heating with the alkali alone under similar conditions we obtained 20 per cent. only.

We mention this result as of some technical importance. The "terdering" of textiles produced by the joint action of alkali and iron oxide is a common experience of linen and cotton bleachers, and it finds some explanation in these observations.

In addition to the above we have also investigated the effect of addition of alkaline nitrates:—The mixture of cane sugar (2 parts) potassium hydrate (4 parts) and potassium nitrate (2 parts) with sufficient water to bring about an intimate mixture of the reagents, deflagrates at 140–150° if rapidly raised to that temperature.

If, however, the mixture be heated for some hours at 130°–140° the decomposition may then be finished at 200–250° without any explosive manifestations.

In this way we obtained 40 per cent. of its weight of acetic acid, and 2.5 per cent. of hydrocyanic acid. This transfer of nitrogen to carbon under the conditions of the experiment is its most noteworthy feature. The yield of acetic acid does not appear to be affected.

We have given our experimental evidence for regarding the acetic acid as formed in the primary decomposition of the carbohydrate; but it is obvious that there are secondary reactions which may contribute in this direction. To throw light on this point we have subjected other bodies having a "carbohydrate" formula ($C_nH_{2m}O_m$), *e.g.* lactic acid and phloroglucol, to alkaline fusion under the conditions described above.

"Fermentation" lactic acid in the form of the purified zinc salt heated at 250° for 6 hours with three times its weight of KOH gave 28 per cent. of acetic acid. Phloroglucol, similarly treated, gave 34 per cent. of its weight of acetic acid, and from the products of the fusion we recovered 33 per cent. of the original quantity unaltered. The yield of the acid, therefore, upon the weight decomposed is very high, as of course might be expected from other decompositions of this "aromatic carbohydrate."

The experiment was repeated, substituting sodium for potassium hydrate and the same yield of acetic acid, *viz.*, 34 per cent. was obtained.

With regard to the question of the oxidation of the alcoholic groups $CHOH$ and CH_2OH , we have so far investigated only one of the polyhydric alcohols of low molecular weight, *viz.*, glycerin. From this body, heated with three times its weight of sodium hydrate at 150° for 16 hours, we obtained but a small quantity of volatile acid, which gave none of the reactions of acetic acid; and the silver salt was found to contain 45 per cent. Ag (acetate = 64.7 Ag); evidently therefore an acid of much higher molecular weight (or a polybasic acid).

Experiments in the higher alcohols will be undertaken in due course, as the comparative evidence to be drawn from such observations is required to show conclusively the influence of the CO_2CH_3 residue—not present in these bodies—in determining the acetic decomposition.

To draw conclusions as to the influence of the several factors of the decomposition is, of course, one of the purposes of this investigation, but these we reserve for subsequent communications, in which also the carbohydrates of known constitution will be compared in regard to

yield of acetic acid. In regard to the influence of the alkalis, we may say, however, that our results confirm, for the production of acetic acid, those obtained by Thorn and others for oxalic acid, *i.e.*, the yield of acid is increased as the proportion of alkali to carbohydrate increases from 1 to 3. The yield is greater, *ceteris paribus*, with potash than with soda, and intermediate yields are obtained with mixtures of the alkalis. Generally the "potash fusions" are more fluid than with soda, and the molecular disintegration of the organic substance takes place at a lower temperature.

In conclusion, we have to say a few words upon the technical departure in the direction indicated by these results, independently initiated by Mr. W. H. Higgin. This chemist has patented the process of preparing acetate of soda from the waste liquors from pulp boiling in the paper works. Esparto liquor, for instance, is evaporated by any of the ordinary methods, and charred by heating on a floor, finishing the process by heating at 350°–400°. Acetate of soda is formed during this process, chiefly at between 150° and 200°, but the higher temperature, which does not affect the acetate under these conditions, is necessary for the complete carbonising of the fatty and waxy bodies, the presence of which interferes with the lixivation.

The course of the decomposition may be seen from the following statistics of the process:—

100 of esparto give:—

46 parts soluble with	
16 parts caustic	
62	Total solids.

100 of evaporated extract charred according to the process give:—

37.2 water, gas, and volatile	
38.0 soluble extract	
24.8 spent char	

The soluble extract contains the acetate, with a certain proportion of carbonate. The yield of the former is 5–6 per cent. ($\text{Na}_2\text{C}_2\text{H}_3\text{O}_2$) of the weight of the original esparto.

The spent char is composed of:—

Ash (50 per cent. NaO)	40
Sodium acetate	16
Carbon, &c.,	44
	<hr/> 100 <hr/>

This process has been worked experimentally on the large scale with satisfactory results, and the yields of acetate have been several times confirmed by independent observations.

Difficulties have, of course, been experienced in the working details of the process, but these are in a fair way towards being overcome.

With acetate of soda ($\text{Na}_2\text{C}_2\text{H}_3\text{O}_2 \cdot 3\text{H}_2\text{O}$) at 16l. to 18l. per ton, the unfortunate paper-maker of these latter days has a new objective opened out for the increase of profits, and we hope to see the recovery of this product established as a part of the routine of the paper mill.

DISCUSSION.

The CHAIRMAN said that he would like to ask Mr. Cross whether the presence of oxide of iron increased the bleaching action. He did not think that Mr. Cross had pointed out exactly the reason for this. Again, it seemed curious to him that such a substance as jute or cellulose should be treated as if it were a homogeneous body of definite composition. It might be uniform in composition, but the authors had seemed to deal with it as if it were a definite chemical substance. Further, with regard to the distillation of the acetates, was that process likely to be remunerative, apart from geographical considerations? He understood that it might be under certain conditions, but he wished to ask whether it would be a matter of general application?

Mr. WATSON SMITH thought that as acetate of soda cost 16l. to 18l. per ton, it would be interesting to know at what price these chars could be produced, containing acetate of soda at so much per cent., because then an idea would be given to the acetic acid manufacturer as to what he would be likely to have to pay for such residue at so much per cent. He would like to know whether Mr. Cross had experimented with the sulphite cellulose liquors obtained in the manufacture of paper pulp. A large quantity of such liquors was produced, and created an intolerable nuisance. They were generally allowed to run down the brooks, giving off most unpleasant odours. If these liquors could be evaporated down, he knew that they would yield a rich sort of gum of mixed character, having strong adhesive properties, though smelling disagreeably. He had never been able to discover an economical method of deodorising them. He thought it possible that by charring, acetic acid would be obtained.

Mr. F. G. ADAIR ROBERTS asked what was the percentage of the residue left after evaporation. Mr. Cross had mentioned that 37 per cent. was water and that there was 38 per cent. of soluble substances; but he did not state whether he examined what the residue consisted of, or whether he had examined it.

Mr. Cross, in reply, said that with regard to the Chairman's first question as to the bleaching action of ferric oxide, it was obviously due to a transference of oxygen to the fibre constituents, extending to the cellulose itself, and that amounted to disintegration, or as the bleacher called it "tendering." With regard to the complexity or simplicity of jute, he begged to refer the Chairman to papers in the Journal of the Chemical Society, 1880–1892. No doubt jute was an aggregate, but it was not complex in the ordinary sense of the term. It was not a mixture; it was an aggregate of bodies of varying molecular weights, but remarkably constant, and for all practical purposes it might be regarded as a homogeneous body. With regard to the Chairman's third question as to the general applicability of this process, what he had said was that the form in which the paper-makers would ultimately produce acetic acid would depend on local circumstances.

Mr. Watson Smith had asked about the cost of production. If they could get acetate of soda they could sell it for 16l. to 18l. per ton. The cost of producing it could be easily calculated by individual makers. It depended, of course, upon variable circumstances, upon the method of evaporation, and the price of coal, which might be 6s. or 16s. a ton. It was a question of circumstances; but taking into consideration the cost of evaporation and other matters, and the value of the product obtained, anyone would be enabled to arrive at something like the net return. With regard to sulphite liquors, Tollens had shown that these liquors were definite sulphonates containing the group OCH_3 . Of course anything like a distillation process was necessarily a complex matter; but the conditions were there for acetic acid being formed. It was a question for investigators; it was not for them to lay down any general *à priori* idea as to what might be got from destructive distillation of the mixture. With regard to the composition of the char, he had given a typical case. He had said that in the spent char a great deal of the soda remained in association with the carbonaceous residue. When that carbon was burned off they got pure ash, or carbonate of soda, and the percentage of anhydrous acetate in the char was 16, and of these 16, 15 were dissolved out by the lixiviating process.

Liverpool Section.

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F. Hurter.	

Hon. Treasurer: W. P. Thompson.

Hon. Local Secretary:

Dr. Chas. A. Kohn, University College, Liverpool

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892-93.

1893:—

Wednesday, January 11th.—Mr. Chas. A. Kohn, Ph.D., B.Sc., and Mr. A. F. Fryer, B.Sc. "The Cause of the Red Coloration of Phenol."

Meeting held Wednesday, December 7th, 1892.

MR. HENRY BRUNNER IN THE CHAIR.

CRITICAL NOTES ON THE CHEMICAL TECHNOLOGY OF INDIA-RUBBER.

BY HUBERT L. TERRY, F.I.C.

It is perhaps superfluous to say that the greater part of our imports of rubber, especially from South America and West Africa, come to Liverpool. No doubt the strange-looking lumps of material which come under more or less barbarous names to the auctioneer's hammer, are familiar to many business men. The natural history of this raw rubber does not materially concern the merchant but rather the manufacturer, though it must be confessed that it would not take the merchant long to learn all that the average manufacturer knows on the subject. To begin with, the question of future supply, it may be asked whether this is inexhaustible, or whether there is any danger of the raw material failing us. This may be answered by the statement that although 20 years ago there was a feeling akin to anxiety on this score the discovery in recent years that the basin of the Orinoco in Northern Brazil contains vast forests of unworked trees has served to dissipate this anxiety. The steps also taken by the Indian and Colonial officials in conjunction with Kew at home in interesting our Consuls and Colonial Governors in the matter have been, to some extent, instrumental in averting the threatened calamity. Forests of trees are no longer decimated, but are tapped in a methodical manner, and young trees are everywhere being planted. The acclimatisation of the *Hevea Brasiliensis*, of Para, is being carried out in East Africa, and notably in the Chardnar Forest in Upper India. Colonial-grown rubber does not as yet enter into competition in the open market with the ordinary product, yet samples of rubber from young trees have been received for examination. It struck me that there was a lack of tensile strength about a sample of Para grown in Mergui, and I shall await future samples with interest. It is important that where rubber trees are transplanted the climatic conditions should coincide as nearly as possible. Some doubt has been expressed as to whether the South American tree will ever come to maturity in Ceylon, where it has been planted. How are we to explain the difference between "island" and "up river" Para rubber, except as resulting from climatic

conditions. The same species of tree yields them both, but while the trees yielding the former grow on partially submerged land in the neighbourhood of Para, the latter is derived from trees growing on the hill sides of the Amazon tributaries. No doubt such instances might be multiplied in the case of other trees. Undertakings in forestry are not as a rule expected to yield any immediate return, but even if Colonial-grown rubber does not turn out the success anticipated, the matter is certainly of sufficient importance to warrant the attention it has received. Of course should any partial stoppage of supply occur through failure of trees, "trade corners" or otherwise, it would seriously cripple not only an important industry itself, but also the numerous trades—and are they not legion?—where rubber in some form or other finds application. It has been suggested that should the supply from South America fail, we have still the vast forests described by Stanley as existing in Central Africa to fall back upon. Anyone, however, proposing this must be set down as being lamentably deficient in knowledge of the subject, for there is very little rubber to be obtained in Africa that can compare at all with that from Brazil. That there are good and dry qualities obtained from Madagascar, Mozambique, and the Gambian coast I do not deny, but the majority of the African rubber, especially that from certain districts of the Congo basin, is sadly deficient in tensile strength, and contains impurities in the shape of resins and albumen which are almost entirely absent from the rubber of the Amazon and Orinoco basins. Why this should be, why the rubber milk of different species of trees should vary so much in its physical properties, when the hydrocarbon itself is always of similar composition, has not yet been explained, and the explanation is likely to be retarded owing to the difficulty of keeping the milk in its natural condition after its arrival in civilised parts. The following analyses of rubber-milk may be of interest.

I.

PRODUCT OF THE *Hevea brasiliensis*, PARA.

	Per Cent.
Caoutchouc.....	31.9
Resin.....	1.5
Albumen.....	0.5
Water.....	66.1
	100.0

II.

PRODUCT OF THE *Ficus Vogelii*, LAGOS COAST.

Mark.	Rubber per Cent.	Resin per Cent. on the Dried Rubber.	Yield of Rubber per Gallon of Milk.
			Lb. oz.
No. 1	30.0	31.5	2 13½
No. 2	28.5	32.1	2 11
No. 3	24.5	32.0	2 7½
No. 4	24.0	33.0	2 5
No. 5	21.0	31.0	2 0½

No. 1 milk had been sent in bottles from Para, having been previously mixed with some ammonia. It was liquid on arrival but soon coagulated when the bottle was opened.

No. 2 milk came to me through the Colonial Office two years ago, having been collected by the then Governor of Lagos, Sir Alfred Moloney, who wished for a report on the same. Altogether 15 ginger-beer bottles of this milk were received, representing five varieties of the *Ficus vogelii*, a tree growing extensively on the Lagos coast. Although nothing had been mixed with the milk to prevent coagulation it was liquid in all but three cases.

There was a considerable pressure of carbonic acid gas in the bottles, and the milk had a very acid reaction. It contained a small quantity of tannin, glucose, and albumen.

It should be mentioned in respect to the above figures, that the milk was collected at the wrong time of year and would therefore be under strength.

Owing to the large percentage and low melting point of the resins contained in this rubber, I could not but form an unfavourable opinion of it, and this was borne out by a practical trial in the works. Of course some uses might be found for it, but it certainly could not be looked upon as anything like a good quality, which the Colonial authorities had supposed it might be.

The question may be asked what is the probable value of the rubber forests discovered by Stanley. Are the trees the *Vakea* of Madagascar, the *Landolphia* of the Congo, or the *Ficus Vogelii* of the Lagos coast? If the latter the discovery is of little value. Putting aside, however, the actual worth of the rubber, the question of transport is really the crucial point. At present prices it would not pay to bring rubber thousands of miles before shipping it. All things considered, any great augmentation of our rubber supply from Central Africa need not be looked for in the immediate future. The concession of a licence to work rubber forests in West Africa on Government lands to Mr. Meiter of London claims some attention. Mr. Meiter is himself superintending the gathering of the rubber, which is a step in the right direction, as there is room for improvement in the whole system of rubber collecting and exporting in Africa. If the operations were more generally directed by men conversant with the modes and requirements of the manufacturers at home, the coagulation of the milk would no doubt be carried out in a better way than is usual. If the coagulated rubber also were sorted out into lots of equal elasticities it could be bought in Liverpool or London in a more satisfactory manner. Manufacturers know from experience that separate lots of rubber bought under the same name frequently turn out of anything but the same quality as regards strength after being washed and sheeted. How often do we see part of a washed sheet hanging in the drying-stove and part lying on the floor, showing that the sheet is made up of a substance of varying degrees of strength, or what comes to the same thing, of varying melting point. An object of special inquiry with respect to African rubbers is, how to coagulate the milk so as not to include the resins with the rubber. In a previous paper I have detailed the different percentages of resin found in various rubbers of commerce, and I showed that the quality of the rubber varied inversely as the percentage of resin. This statement must not, however, be taken as showing that African rubber if separated from its 20 per cent. of resins is equal to Para rubber. There are differences in the two products which cannot be explained away as being caused only by an excess of resin in the one case.

The question of the day then is, how can we so improve the inferior qualities of African rubber as to increase their market value? At the same time we must not lose sight of the fact that there is a considerable demand for rubber in cases where its elastic properties are but slightly brought into play, and therefore any treatment which increased the cost as well as improved the quality of low-class rubbers, would only meet with partial favour at the hands of manufacturers.

It cannot be said that the initial stages of the rubber manufacture owe much to chemistry, as it is the mechanical engineer who has had most to do. As an example of the perfecting of mechanism the wide fine sheet-cutting machine may be mentioned, whereby sheets of rubber are now cut 160 to an inch. The rôle of the chemist, it must be said, has been more in connection with trade disputes, and a good deal of the chemical work that has been done on rubber has been first brought to light in the Law Courts. The court has to decide whether the premature decay of a waterproof coat is to be put down to bad work on the part of the cloth manufacturer or the rubber manufacturer. Elaborate analyses are produced in court tending to show for one side that the cloth contains grease, oxide of copper, or other injurious matter, while the other side retorts that the rubber-proofing is a bad one and the cause of its own decay. The fact is these analyses are very little good. Under certain conditions, no doubt, a little grease or a few hundredths per cent. of oxide of copper may be injurious, but not necessarily in every case, and decay may

be brought about in goods by some irregularity in the manufacture quite undiscoverable by analysis. The investigation of these cases requires special experience, as there is extreme difficulty, when goods have gone bad, in fixing on which of the ingredients the blame rests.

In a paper read at the British Association Meeting, 1890, Mr. W. Thomson, in dealing with the action of oil on rubber, startled some manufacturers by the statement that the oily matters which were dissolved from oxidised or sulphurised oil by ether were not only not injurious to rubber, but in many cases were actually beneficial. The conclusion was thereupon arrived at by some manufacturers that the oil bogey had no foundation in fact. A little consideration, however, will show that the results obtained by Mr. Thomson are only what might be expected. In the oxidation, chlorination, or sulphuration, if I may use the term, of fatty oils it is extremely rare that any oil is unacted upon. The portion soluble in ether is then not free oil, but only a modification of the matter insoluble in ether, which indeed is clearly shown by its containing sulphur, chlorine, &c. Its action then on rubber would resemble that of glycerin rather than that of a fatty oil. This of course only refers to the sound oxidised oil. If this has undergone decomposition back again to its original state, or, at any rate, has altered its physical condition, then the matters soluble in ether would not be so harmless in their action.

In a more recent paper,* with which the name of Mr. F. Lewis is also associated, Mr. Thomson has detailed at some length his observations of the action of metals, acids, salts, &c., on rubber. He finds that chromium salts are not injurious, a fact which might seem somewhat superfluous to those of us who have been accustomed to use chromium regularly were it not that Mr. Tatlock had recently published a letter showing that chromium had a destructive action. It was hardly necessary to republish the action of acids on rubber, and although the inimical effect of small quantities of acid in rubber goods has, I feel sure, been exaggerated, it is not safe to judge, by the action of a bath of dilute acid on a sheet of rubber, what the action would be if acid were produced *in situ* in the goods. Mr. Thomson finds with some surprise that the action of hydrogen peroxide on rubber is nil. I think, however, that if he had tried an ethereal instead of an aqueous solution of this reagent he would have obtained a different result. Mr. T. Bolas, amongst others, has used this solution for years in rubber analyses.

With respect to the action of nitric acid on rubber I have gone into the matter at some length, and my experiments are yet in progress, a preliminary report only having been published.† The most dilute acid acts injuriously, but the action if allowed to proceed slowly results in the formation of a more or less nitrated body, and not merely of a resin. A yellow brittle powder obtained by the action of dilute HNO_3 on sheet rubber for six weeks gave the following figures on analysis:—

	Per Cent.	Calculated for $\text{C}_{10}\text{H}_{15}\text{NO}_2$
Carbon	50.50	66.29
Hydrogen	6.13	8.28
Oxygen	37.94	17.70
Nitrogen	5.43	7.73
	100.00	100.00

This body has explosive properties and is evidently a mixture of an oxidised and a nitrated substance. The practical bearing of these experiments is to show that nitric acid, even if very dilute, cannot be used in connection with rubber articles with impunity, and this fact should be borne in mind by chemists.

With regard to Mr. Thomson's experiments on textures it should be mentioned that the method of testing their

* Proc. Man. Lit. and Phil. Soc. 1891.

† Ibid.

life so to speak by exposing them to temperatures higher than they are intended to stand, cannot be considered a satisfactory one. Rubber is very susceptible to heat, and I have found that there is absolutely no connection between say, the hours that rubber will remain sound at 150° F., and the months or years it will remain so at 60° F. I own that this seems to be the only available method of testing if one does not wish to wait a year or two for results, but nevertheless I feel sure that it leads to erroneous conclusions.

The paper published by Gladstone and Hibbert, although of scientific interest, may be passed over as devoid of technical bearing. A paper by Heinzerling and Pahl (*Chem. Zeit.* 16, 15) gives details as to the compounding of chemicals with rubber and gutta-percha, but does not advance anything of great originality. Heinzerling also (*Chem. Zeit.* 16, 84) has summarised recent improvements in the manufacture, but this paper is mostly a compilation of patents.

A paper of some interest dealing with the analysis of complex rubber mixtures has just been published by R. Henriquez (*Chem. Zeit.* 16, 86, 87, 88), and may prove of interest to the analysts. He deals chiefly with the estimation of the different forms of "gummi ersatz" or "gomme factice" as it is variously called on the Continent. It is not my purpose on this occasion to discuss the matter of rubber analysis, but it should be borne in mind that by following out the plan of extracting rubber compounds with solvents as advised by the author, discrepancies are likely to arise if care is not taken to distinguish between organic matters such as resin, which are naturally a part of the rubber, and bodies of a similar nature which may have been added. The work is characterised by great attention to detail, more so, I think, than is required or which the ordinary analyst could find time for. Authors of papers on these and kindred technical analyses should not take it for granted that because no methods have been published they have not been worked out. I have no doubt that I am not alone in saying that there is little that is novel in Henriquez' paper. Analyses of manufactured articles should, in my opinion, always be performed by experts who, by the selling price, would know pretty well what to look for and whether a foreign body was to be classed as an adulterant or not. Chemists who have to read up should not attempt these analyses. A treatise, I may say the first of its kind, has just been published in Paris on rubber and gutta-percha.* The book, as a compendium of general information respecting the trade, is of great interest, especially in its botanical portion, which is very fully treated. The space in the book devoted to the manufacture of toys and small articles is an indication of the department where our neighbours do more than hold their own against ourselves. The figures for the export of sheet rubber to the Continent and our imports of German balls to be found in Board of Trade returns will emphasize this allusion. We have the engineering skill; they have the art of producing a nice-looking article out of poor materials. Perhaps technical education will put us right.

The promised work of Dr. Arlidge on Diseases of Occupations has appeared and gives an immense number of statistics relating to the hygiene of our trades. It is not to be expected that such a work written by one man could be free from errors—and, indeed, the author asks the reader's indulgence in the preface on this account—but if the descriptions of the industries generally are so vague as that of the vulcanisation of rubber, I am afraid the credit of the book will suffer. I am glad to see that beyond bisulphide of carbon he has little complaint against the rubber works. There are indeed some vague invectives against steam and sulphur vapour, but these seem to me to be put in as padding. I do not wish to deny anything said about bisulphide of carbon, but it should be said that the really serious cases where the brain has been affected have occurred, not in the ordinary vulcanising process as carried out in the larger works, but rather in small ill-ventilated workshops and in processes where dipping the goods into the liquid takes place. Hospital authorities in Paris, New

York, and Manchester, have had their say on the serious symptoms produced by this mephitic liquid and it is therefore with pleasure that I am able to announce that its use is being much restricted, inasmuch as it has found a rival in its chief application. Is it too much to hope that chemistry will find some harmless substitute for it in its remaining applications?

With respect to chloride of sulphur, though this is a very disagreeable substance to work with, I have never found it to undermine the health of the operatives. This is probably due to the fact that it is impossible to breathe much of it without following out a desire to remove from its neighbourhood. With naphtha vapour, the smarting of the eyes warns us when the fumes are getting too strong. I have never seen any one really overcome by naphtha because in the ordinary manufacture the vapour could not be inhaled strong enough. Sensational stories reach us sometimes from abroad of whole factories of workpeople getting light-headed, and though these statements may or may not be highly coloured, I suppose there is no doubt that strong naphtha vapour if inhaled does produce a species of intoxication something akin to that of opium.

It is not until the process of vulcanisation is reached that chemistry begins to play a part in the rubber manufacture. Here various reactions take place, all however, where steam or heat is employed being effected by the agency of sulphur. The action of sulphur on rubber is the principal one, while subsidiary actions leading to the formation of sulphuretted hydrogen, lead sulphide, &c., also take place. I am not aware that any paper has appeared settling the vexed question as to the nature of the vulcanisation process, and I do not propose to say anything myself on the matter on this occasion beyond a brief reference to the point of how much sulphur is really taken up and fixed. It is customary in books to state that 3 per cent. of sulphur is chemically combined and the rest mechanically held. It is supposed that the latter is soluble in caustic alkalis and the former not so. However, by repeated boiling I have brought the sulphur down to 0.6 per cent. without destroying its properties. Thus the figure usually given is too high.

A piece of sheet rubber immersed in a bath of melted sulphur for four hours at 135° C. was found not to be vulcanised. It then contained 3 per cent. of sulphur. After five hours' immersion it was quite vulcanised, being found then to contain 5.5 per cent. of sulphur. It may be shown in many ways that although only a very small amount of sulphur is really fixed by the rubber, yet it is impossible to get this amount fixed unless a considerable excess is present. Rubber will absorb free sulphur from its solution in alkaline polysulphides, but it is found impossible to get articles properly vulcanised in this way. Notwithstanding this, this process, known as Girard's, may be found religiously described in all text-books, ancient and modern. With respect to the action of sulphides on rubber it has been found in all cases that where these have been used as vulcanising agents their action has been due solely to the free sulphur they contain, generally in the amorphous condition. Owing to the formation heat of most of the metallic sulphides being above the melting point of sulphur, the sulphide of lead may be taken as the only one formed during ordinary vulcanising processes. This is rather to be regretted as the formation of sulphides is a means of fixing the excess of free sulphur which we have seen is essential.

Our Society had an interesting paper last session from Mr. Fawsitt respecting the dry heat vulcanisation of rubber by means of metallic iodides. The paper is in our Journal (this Journal, 1891, April 332-336), and I need not therefore abstract it for the purpose of reference. Without going into the important question as to its commercial success, a subject of interest to only a limited number of our members, I shall confine myself to the scientific importance of Mr. Fawsitt's paper. Unfortunately lack of time prevented him from working out the chemical action supposed to take place. Gladstone and Hibbert and I think some authority before them

* *Le Caoutchouc et la Gutta-percha* par E. Chapel, Paris, 1892.

† This has occurred in naphtha works.

have shown that iodine has no action on rubber in the sense of forming a definite compound with it, and people have therefore jumped to the conclusion that it is sulphur, which always accompanies Mr. Fawcitt's iodides, which after all brings about the reaction. As far as I have gone into the matter myself I think that some substitution of hydrogen by iodine certainly does take place, but not to anything like the same extent as in the cases of chlorine and bromine. Though the combinations of rubber with these latter, as shown by the specimens on the table, are solid stable bodies prepared directly, yet it is quite possible that some body may be formed by the action of heat on the iodide and rubber during the vulcanising process. The formation of hydriodic acid cannot be taken as proof that substitution of hydrogen in the rubber has taken place, because hydrogen would be liberated by the action of sulphur present. These are points, however, for Mr. Fawcitt to clear up.

The use of halogens in the vulcanisation of rubber is not a new idea, a patent having been granted in 1846 to A. Parkes for this purpose, though not for dry heat purposes. Chlorine and bromine, however, alone are too powerful in their action, and at the present time the only agent used on the large scale is chloride of sulphur. With regard to the action of this body, I think there can be no doubt that it is due to the chlorine, and that although some sulphur must necessarily be absorbed at the same time by the rubber, yet that this latter does not play any part in the reaction. Sulphur in the cold has no effect on rubber and chloride of sulphur must be looked upon as merely chlorine in a diluted form. The action of chlorine in whatever form applied may be measured by the amount of hydrochloric acid produced; in the case of chloride of sulphur, no doubt secondary reactions take place which do not occur in the case of chlorine alone.

The action of nitric acid on rubber has been already referred to. That of the gaseous oxides of nitrogen is somewhat similar. I have found that while the monoxide is without action and the dioxide has little action, the higher oxides act energetically. If a sheet of rubber be placed in a bottle containing air and higher oxides of nitrogen the yellow colour will soon disappear and the rubber be found to be surface-vulcanised to some extent. These vapours have been employed in practice for the vapour cure of rubber sheet but they cannot be said to show any advantage over chloride of sulphur, while a very little over-exposure destroys the rubber.

There seems to be some misconception as to the part which bisulphide of carbon plays in the cold cure process of vulcanising rubber goods, but there can be no doubt that it acts merely as a solvent and takes no part in the reaction. Substitutes for this liquid have been proposed 20 years ago, but none of these have been successful until quite recently, when the success which has attended the use of a product obtained from benzol refining, certainly warrants the assumption that the days of CS_2 are numbered for most of its former uses.

The problem of the devulcanisation of scrap and old rubber has been before the trade since vulcanisation was first practised, and cannot be said to have yet been solved. Of course rubber, especially of poor quality, has been "recovered" by the action of oil and heat, but it is not the original hydrocarbon reproduced. There being no doubt that during the process of vulcanisation with sulphur hydrogen is given off, it becomes necessary to return this hydrogen to the rubber. Mr. Lascelles Scott has proposed to do this by the zinc-copper couple, but I do not know whether he has any solid grounds for believing that this would be successful. The greater part of the sulphur in vulcanised rubber can be removed as H_2S by heating with petroleum oil of high density. In all cases of this sort, however, the rubber itself goes into semi-solution and it is doubtful if the very small amount of sulphur actually combined is removed. In one respect the recovery of rubber from vulcanised scrap resembles that of the recovery of tin from tinplate scrap and old plate. Where the waste is all pure rubber and when the iron is coated with pure tin the recovery process is of commercial importance. As, however, at the present time the greater part of the waste

which requires treatment is not pure rubber, and the majority of tin plates are not coated with pure tin, the aspect of the question is altered.

Although under the strict title of my paper I am precluded from extending my observations to gutta-percha, yet in the minds of most people, and I think of most chemists, the two substances are so closely associated that I shall close these notes with some references to a substance that can claim at any rate a chemical, if not a physical, kindred with rubber.

The future supply of gutta-percha is a subject of grave import at the present time, and it behoves our countrymen to be up and doing on the matter. The *Isanandra gutta* is not a tree to be found all round the equator. Its home is in the Malay Archipelago, though it seems likely that the historian of the future will have to use the past tense in this connection if rigorous measures are not enforced to prevent the wholesale destruction of the trees. Under the title of "Borneo caoutchouc," an interesting description of the gutta trees appeared in the abstracts of our Journal recently. This had reference to the work recently carried on by M. Serullas, descriptions of which have appeared in the Bulletin of the Société d'Encouragement. He is an advocate of the method of collection proposed by Jungfleisch. This briefly is to extract the gutta-percha from the leaves of the trees by boiling solvents instead of cutting down the tree and extracting the milk from the stem as is usually done. The tree is said to yield as much in this way as before, and, of course, it lives to afford a further yield. The process, however, strikes one as being more adapted to pharmaceutical preparations than to commercial products, and it should be remembered that a very similar process was proposed by L. Wray in 1886, which, on being tried by the Silvertown Company, was reported upon as unsatisfactory. As the composition of the chemicals used by M. Serullas have not yet been divulged, it is of course too soon to speak confidently as to the process.

Supposing that the supply of gutta did really fail, would its loss be severely felt by the principal users, the cable manufacturers? I think not; rubber, both pure and vulcanised, is replacing gutta more and more for electrical purposes. The triumphs of sythetic chemistry are not yet exhausted, and it should not be so difficult to obtain an artificial body with the required attributes. Again, though there seems no chance of the real gutta tree being found in the Brazilian forests or the African groves, yet there is evidence that trees of a somewhat similar nature exist, and small quantities of bodies closely resembling gutta and Balata have from time to time come into the hands of experts. The latter body, perhaps I should explain, resembles gutta-percha in that it contains a hydrocarbon of the same constitution associated with a large amount of a peculiar resin. It is the product of the *Mimucops Balata*, or bullet tree of South America, though it is probable that what comes into the English market is a mixture of the products of more than one species of tree.

Some discussion has recently occurred as to a scientific serial as to the amount of resins in sound gutta-percha. Now if the commercial product were all of one quality and from one species of tree, a definite percentage could be looked for. Generally speaking, any percentage from 30 to 55 may be found; the former from a soft, and the latter from a hard sample. Of course, unlike the case of rubber, the resins form a part of the gutta, and help to determine its peculiar properties; they must in no sense be looked upon as an impurity.

The following figures may be of interest as showing the fluctuations in the supply and price of gutta-percha as compared with rubber.

GUTTA-PERCHA.

	1887.	1891.
Imports..... Cwt.	24,115	69,611
Average price..... Per Lb.	s. d. 1 2	s. d. 2 2

CAOUTCHOUC.

	1887.	1891.
Imports..... Cwt.	235,337	278,837
Average price Per Lb.	s. d. 2 0	s. d. 2 1½

The increased figures for gutta-percha are, of course, due to the electric lighting movement, and had not the supply run short, the imports would have reached a much higher figure. The above prices derived from official statistics must not be taken as representing all the market changes; great fluctuations may occur in the price of South American rubber, which may not show themselves prominently in the annual statistics as calculated for the whole imports over the year.

Before concluding I should like to say one word regarding nomenclature. Caoutchouc is not a gum in any accepted chemical sense of the term, though I am afraid the terms "gum," "gomme," and "gummi" are too strongly established in American and continental usage to give way easily to more correct ones. It is difficult, however, to see on what system of classification they depend. To my mind caoutchouc is distinctly *sui generis*. This could be sharply subdivided into the two species of caoutchouc and gutta-percha, the distinguishing property of the latter being that it is softened by hot water. Any other means of distinction such as those founded on the behaviour of solvents, will be found to be due to accident rather than any specific property of these two bodies.

DISCUSSION.

Mr. BRUNNER said that Mr. Terry had given them an interesting paper, and he had no doubt there were many points upon which they would be glad to get further information. What Mr. Terry had told them had been new to him. Chemistry had not hitherto played any very large part in rubber and gutta-percha manufacture; but it seemed to him that the question of the recovery of old rubber was more or less a chemical problem. Then again there was a possibility of some of the supplies of gutta-percha running short, and of the price going up very much in the market, and that ought to stimulate chemists to try, if possible, to invent some substitute that might take the place of either one or other of these materials.

Professor CAMPBELL BROWN said that why chemistry had little to do with the manufacture was because the chemist did not know anything about india-rubber. He should first find out what india-rubber and gutta-percha were, and what position they held in the system of classification of carbon compounds; this knowledge would aid him to understand better their real properties and their behaviour with other chemical substances. He would like also to know what was the nature of the process called coagulation. Was it an oxidation process, or merely a molecular change?

Dr. KOHN said that several questions occurred to him during the reading of the paper, the answers to which might be of interest to others. In the early part of the paper Mr. Terry had told them that the quality of the rubber was in proportion to the amount of resin present, and he would like to know what information was to be had in regard to the nature of those resins. Another point was the action of chromium salts on the rubber. They were told that they had no injurious action, and it would be interesting to know whether the action was beneficial or neutral. Chromium salts in the presence of organic matter were known to undergo change themselves on exposure to light, and in addition to affect the organic matter with which they were in contact. In regard to the nitro-compound which Mr. Terry had passed round and which he told them was a mixture of an oxidation product and a nitro-compound he would like to point out that the explosibility of the compound might be due to its being an ester of nitric acid rather than a nitro-body. He did not quite follow why the formula

$C_{10}H_{15}NO_2$ was assigned to that nitro-compound, was it the result of analysis? Another point was the inefficiency of a two days' test for rubber, and the efficiency of a four years' test, in order to make out the quality of rubber. It brought out the necessity for much more inquiry into the chemical nature of rubber, and especially into the conditions under which certain reagents affected rubber. By finding out the active substances in the destruction of rubber, it would surely be possible to make this test both more rapid and more effective. He would also like to ask what gutta-percha was used for beyond making cables for electric light, and whether it could be employed instead of india-rubber for any of the purposes for which the latter was used?

Dr. RAWSON asked whether Mr. Terry would kindly again mention the name of the liquid used instead of carbon disulphide as a solvent for sulphur. He was rather surprised to learn that chromium salts were not injurious to rubber, for in their action on gelatin was very marked, as evidenced by the rapid strides which the chromium process of tanning was making. It would also be of interest to learn what was the difference between india-rubber and gutta-percha, other than that they were the expressed juices of different trees, say in their chemical composition, behaviour with reagents or from a physical standpoint.

Mr. TERRY, in replying to Prof. Campbell Brown, said that there was no chemical action involved in the coagulation of the rubber milk. The action was similar to that of separating the casein from milk by an acid. In Africa solutions of vegetable acids were much used for that purpose. In reply to the various points raised by Dr. Kohn and Dr. Rawson, he said that there was very little information to be got about the resins occurring in the various rubbers of commerce, but he would refer Dr. Kohn to a paper by himself (the speaker) in the Journal for 1889. Surprise had been expressed that the action of chromium salts on rubber was not injurious. Whatever the ease was with leather he could only repeat that nothing had been proved against chromium in the case of rubber, even the red chromic acid having no action. Chromium salts were not used in the manufacture and it was in the case of mordanting cloth for textures that a question as to their action had arisen. The uses and manufacture of rubber and gutta-percha were quite distinct, and although for certain purposes mixtures of the two might be used to a small extent yet the great bulk of the latter was used in the insulation of cables.

In regard to the substitute for carbon bisulphide in the cold cure vulcanizing process he was precluded from saying anything very definite as to its composition, but it was a hydrocarbon of the aromatic series. It was not so volatile as carbon bisulphide and this precluded its general use, but at the same time its use had put an end to the fires which so often occurred with carbon bisulphide.

Dr. Kohn had referred to the question of testing by heat. What he had meant to express in the paper was that there was no royal road to the rapid testing of rubber goods for the uninitiated to follow. In some cases, notably in the heat tests as adopted by the Admiralty, information could be gained in a few hours as to whether mechanical goods were up to a certain standard. But this did not apply to cases where the goods had been manufactured in the cold and were intended to be used at ordinary temperatures. Light was the chief factor that determined the life of rubber; a piece of elastic thread which would keep sound for many years in a dark cellar would go rotten in as many months if exposed to sunlight.

Manchester Section.

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Hon. Local Secretary:

J. Carter Bell,

Bank House, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892.

Meeting held Friday, 2nd December 1892.

DR. E. SCHUNCK, F.R.S., IN THE CHAIR.

ON COP-DYEING.

BY CARL OTTO WEBER, PH.D., F.R.S.

FOR a number of years experiments on a more or less extensive scale have been carried on, with a view to accomplish the dyeing of textile fibre, especially cotton, at the most advantageous stage of their manufacture into yarns. The efforts, more or less successful, to dye cotton and wool in the raw or loose state, to dye the sliver, rovings, carded or combed wool, and cotton and wool in the cop, are all exertions in the same direction. At first sight it might appear that the simplest and most rational solution of this task would be the dyeing of the fibres at the earliest stage of their manufacture, *i.e.*, in the form of loose cotton or wool, but this is not so for various reasons. In the first instance all the colours requiring long-continued boiling cause the loose fibres to become in the process of dyeing entangled to such a degree as to cause very considerable loss in spinning, far in excess of the losses incurred when the undyed fibre is spun, reeled into hanks, dyed and wound back again into pirns, ready for the shuttle. Fibres dyed in the loose state are moreover generally very much harsher and stiffer than the natural fibres and therefore give infinitely more trouble in spinning than the latter, and to these drawbacks must be added the fact that the spinning, particularly of dark grey, brown, blue and black shades is an operation which proves exceedingly trying to the eyes of the operatives and very naturally decreases the production in proportion. There are even cases on record where the operatives refused to work on that account. But even supposing that all these difficulties could be overcome the fact would still remain that of the hundreds of different shades required for weaving only a very few are used in such quantities as would allow a spinner to keep his plant regularly employed, who could not afford to execute orders of a few hundredweights of fancy shades, owing to the loss of time incurred through frequent cleaning of a number of machines for each new colour. Difficulties of a similar nature arise whenever we attempt to dye the fibre at one of its manufacturing stages previous to that when it is obtained in the shape of cops, so that we come to the conclusion that generally speaking the dyeing of the textile fibres cannot advantageously be proceeded with before the actual conclusion of the spinning operations. This shows clearly the importance and advantage of cop-dyeing as against the dyeing of the raw or partly-manufactured fibre on the one side and hank dyeing on the other side. The fact that

large quantities of cotton are dyed in the raw or partly-manufactured state does not in the least affect these conclusions, as this is done for the purpose of spinning mixed yarns or colours as in the manufacture of vigogne.

In this case the dyeing of raw or partly-manufactured cotton being the only way to produce the desired effect, we are compelled to put up with whatever drawbacks the process may possess. From this it is further evident that cop-dyeing by no manner of means enters into competition with the rightful dyeing of unspun or half-spun cotton, although yarn and warp dyeing is bound to be considerably affected by it; and it is further likely that the production and dyeing of half-woollen goods will also more or less be influenced, although it may be difficult to judge the probable extent of this influence at the present time considering the splendid results obtained by Messrs. Cassella & Co., with their diamine colours in the dyeing of half-woollen goods.

The great importance of cop-dyeing is generally admitted at the present time, so that I need not say any more in this respect. But quite as well known is the great difficulty of this kind of dyeing, especially if it be desired to apply all the colouring matters and dyeing methods which are at present used in hank dyeing. There is a number of different cop-dyeing machines now being experimented upon, and the results achieved by the various inventors are watched with the keenest interest. The time has not arrived to award the prize in this competition to any one of these machines; but there is at the same time no doubt that the principles which have to be observed in the construction of a cop-dyeing machine of general applicability are already fairly established. Similarly the characteristic methods and operations by which cops can be dyed in these machines are developed to such an extent already that a fairly complete record of both of them may be said to be of general interest, and I believe that an exhaustive description of the present state of this new and most important dyeing industry will be welcomed by many who take an interest in this new departure in dyeing. I may say that I am in no shape or form interested in the eventual triumph of either of the various machines over the others, but what information I am able to convey to you on the subject is derived from actual experience and practical working. I can, however, not refrain from giving you my well-considered opinion that as matters stand at present British enterprise seems likely to carry off the prize in this fierce struggle for supremacy in a new and important industry; the results of the severest tests, and of continuous practical working on the machine of two English inventors being far ahead of anything achieved either at home or abroad.

I.—THE MECHANICAL PRINCIPLES OF COP-DYEING MACHINES.

In examining the mechanical or engineering side of the question of dyeing cops, we find ourselves at once confronted by three points of fundamental importance:—

1. Perfect evenness of the dye throughout each cop.
2. Perfect evenness of shade in and between the different lots dyed.

To these must be added a point of specifically economical bearing:—

3. Time required for each dyeing operation, *i.e.*, working capacity.

We can safely say that the machine answering the above requirements by means of the simplest mechanical appliances, will be the best. Of the above points, 1 and 3 depend entirely upon the construction of the machine, while point 2 is as much a question of mechanism as of dyeing methods.

If we immerse a cop in cold water, the latter slowly penetrates into the former, but the complete impregnation of the cop by the water is a matter of many hours, and even days with the very fine counts. The rate at which the water penetrates into the cop can easily be observed by adding to the water some dye, which on cutting an immersed cop parallel or in a right angle to the core, at once shows how far the water penetrated in a given time. In the first

instance this difficulty of impregnating is caused by the particular build of the cop which renders it very difficult for the occluded air to escape and make room for the water to get inside, but a great obstacle is also to be found in the vegetable, oily and resinous impurities contained in the grey cops. If we immerse the cops in hot water we observe in the first instance, that the air escapes much more rapidly owing to its expansion by the heat of the water, at the same time a considerable quantity of the impurities of the cops becomes dissolved or emulsified, and consequently the water penetrates much more rapidly. But even under these favourable conditions, in using a hot solution of some suitable dye the cop could not be dyed in a satisfactory manner, as it would become much darker on the outside than inside, chiefly owing to the fact, that although the hot dye-liquor has expelled the air from between the threads of the cops, there remains still the air which fills the central channel of each cotton fibre, and the complete expulsion of which requires either long-continued boiling or treatment in vacuo, also preferably at higher temperatures. This leads to the formulation of the first important principle required in a cop-dyeing machine:—

I. Perfect displacement of the air from the inside and outside of the cotton fibre is an essential requirement of the thorough penetration and saturation of the cops by the dye-liquor, and is best obtained by treating the cops with the dye-liquor in vacuo.

We shall see later on, that in many cases the non-observance or misunderstanding of this important principle led the inventors to substitute pressure for the vacuum. All machines of this description are wrong from the start, and if they did not turn out a downright failure, they are of very limited applicability only, and are generally conspicuous by the great amount of waste they produce in working. It is evident, however, that in complying with principle I., we obtain practically only the complete impregnation of the cops with the dye-bath, and under these circumstances the cotton would simply take up the dye contained in the absorbed quantity of bath, after which the cops would merely contain more or less colourless water. Taking into consideration the usual concentration of dye-baths, which very rarely exceeds 0.5 per cent. of colouring matter, it is evident that mere impregnation of the cops with such baths could not produce dark shades; and moreover, the outside of the cops being much longer in contact with the dye-liquor, would be much darker dyed than the inside. To overcome this difficulty we have to adopt another means which therefore forms the next important principle of cop-dyeing machines, namely:—

II. In order to obtain perfect evenness of dyeing throughout the cops, it is necessary for the dye-bath to circulate freely through the cops, so that at any time the concentration of the dye-bath is the same at every depth of its penetration into the cops.

This point is of very great importance in a cop-dyeing machine, as a slow circulation at a low hydrostatic pressure will allow the concentration of the dye-bath to vary in different parts of the cops. Likewise the quantities of dye-liquor passing through various parts of the cops will differ very widely, especially if the cops contain hard and soft places. In both these cases the result will be that the cops are unevenly dyed.

The principles I. and II. contain everything required to fulfil the first of our conditions, namely, to dye the cops perfectly even, and any machine carefully designed on these two principles will be satisfactory in that respect. Our second condition demands perfect evenness of shade in and between the different lots dyed, or in other words the maintenance of the standard shade for any number of cops dyed in successive operations. The observation of our two first principles does not ensure this, although they contribute very largely to the possibility of achieving this feat. I have stated above that our condition No. II., is as much a point of the mechanical principles upon which a cop-dyeing machine has been constructed, as of the methods of dyeing employed with the machine, and we shall now have to examine how far this second condition is dependent upon the construction of the machine. The part the dyeing methods

play in this respect will be discussed in the third part of this paper.

In dyeing yarns in the hank in the ordinary dyeing beck, the uniformity of the dyed shades in different lots is regulated by the concentration of the dye-bath, the temperature, and the time of the immersion. As far as cotton-dyeing is concerned the volume of dye-bath used is of comparatively little influence, as with mordant-dyeing colours the maximum quantity of dye is stoichiometrically fixed by the quantity of mordant previously fastened upon the fibre, while with the substantive dyes the obtainable depth of shade is entirely a question of concentration, temperature, and time. These three factors are, of course, of the same importance in cop-dyeing as in every other branch of dyeing. The maintenance of the original concentration of the dye-bath requires to be considered in the construction of cop-dyeing machines only in so far as every precaution ought to be taken to prevent any alteration of the concentration of the dye-bath from other causes than that of the actual dyeing itself. For this reason it must be considered a great mistake to heat the dye-bath with direct steam, as the dilution of the bath in this manner is exceedingly difficult and troublesome to compensate for and consequently makes it almost impossible to maintain the standard of shade. This difficulty can generally be avoided by heating with indirect steam through coils. Of course the concentration of the dye-bath can also be altered in an opposite manner, *i.e.*, through evaporation, but provided the temperature of the dyeing-bath always to be kept at the same point, the evaporated quantities of water for equal intervals of time will remain constant, and it is certainly much easier to dilute the baths than to restore again the higher concentration of diluted bath, especially if the degree of dilution attained from time to time is such a very variable quantity as in the case we have been considering. As regards the immersion of the cops in the machine, this can be either performed by a continuous or intermittent process. In the first case the dye-bath circulates through the cops during the whole time of the dyeing operation, and the machine ought to be so constructed that the operation can be interrupted at any moment. In the second case, working with intermittent immersion, it is essential that every immersion should require the same time. In both cases, whether the immersion be continuous or intermittent, is it desirable that during each immersion of the same duration equal volumes of the dye-bath should circulate through equal weights of the cops. This requirement may not be of such eminent importance in the dyeing of cotton cops, although it undoubtedly very materially assists in the important task of obtaining all consecutive lots of standard shade. But so soon as woollen cops have to be dyed this requirement is of paramount importance. From the above we deduce the two further principles:—

III. The dye-bath must not be subject to dilution through direct steam.

IV. The immersion of the cops can be either continuous or intermittent. The immersions must be of equal duration, and the volume of liquor circulating through equal weights of cops must be the same for each immersion.

The time required for each immersion is a point of very great interest as it is a very important factor in determining the working capacity of a cop-dyeing machine. All the more so as the large majority of these machines operate with comparatively very small quantities of cops at a time. There is, up to the present, only one cop-dyeing machine in which large quantities of cops are treated in each operation, but it appears that the results obtained are far from satisfactory with regard to quality. The difficulty of obtaining perfect circulation of the dye bath through the cops increases very considerably with the quantity of cops dyed in each operation, and in proportion, of course, increases the difficulty of dyeing the cops even. This observation seems to have been made by every individual designer or inventor of cop-dyeing apparatus, as, with one exception, all operate with very small weights of cops at a time. With regard to the possible output of a cop-dyeing machine everything depends therefore upon the time required for each dyeing operation, and this, of course,

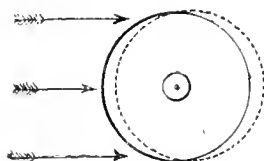
varies with the different classes of dyes employed. Generally speaking we know that the process of dyeing with the substantive dyes is finished as soon as the intercellular cavities of the cotton fibre appear to be filled with the colouring matter, and it is evident that the first principle we established with regard to cop-dyeing machines, demanding the expulsion of the air from the cotton fibre, will reduce to a minimum the time required for this dyeing process, which, in dyeing in the open beck, requires about 30 minutes. In dyeing mordant colours the question of time required is chiefly a question of how long it takes to produce upon the fibre the chemical compound of dye and mordant, *i.e.*, the colour-lake. But these points belong already to the matter of cop-dyeing proper, and will be discussed later on. In certain publications attempts have been made to compare the merits of the different systems by giving the quantities of cops which can be dyed in a working day in the various machines. At the present stage of cop-dyeing machines and cop-dyeing anything more misleading can scarcely be imagined. Cop-dyeing at the present day is eminently a question of quality and not of quantity. It is to-day a matter of absolute indifference whether a machine will dye 500 or 5,000 pounds of cops; the only question of actual importance is whether the machine will dye any quantity of cops dyed in succession perfectly even and without injuring the build of the cop. The machine that will do this, and, at the same time, can be applied to all the various dyeing processes is a perfect machine.

There remains only one more point to be mentioned with regard to the construction of cop-dyeing machines, but one the importance of which cannot be exaggerated. The cops possess a certain build or structure, which is the result of the particular mechanical winding action of the mule, and upon this build or structure, its mathematical regularity, depends to a great extent the behaviour of the cops in the loom. Every alteration in this normal build of the cops is at once noticeable in the weaving, by the frequent breaking of the thread, and the unwinding of the yarn in coils. This makes it evident that all cop-dyeing machines ought to be so constructed as to prevent any deleterious mechanical interference with the normal build of the cops. Thus we obtain as last principle:

V. *The unavoidable mechanical influence upon the cops by the circulation of the dye-baths through them ought to be of such a nature as to preclude any alterations in the shape or structure of the cops.*

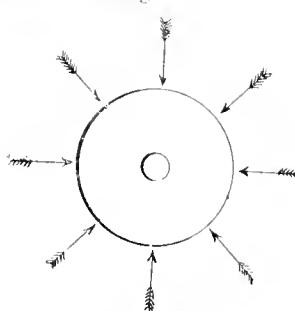
The mechanical action to which the cops are subject while being dyed is that of the forced circulation of the various baths employed through them, so that with regard to principle V it is important to decide which mechanical influences, incidental to forced circulation, are liable to injure the cop. In Fig. 1 I give the section of a cop.

Fig. 1.



In causing the liquor in a cop-dyeing machine to circulate through the cops in the manner indicated by the arrows, it is obvious that the resistance offered by them to the passage of the liquors will cause the cops to bend or bulge in the manner indicated by the dotted lines. Such one-sided pressure will have a most deleterious action upon the build of the cops. The only rational way to avoid this one-sided pressure is to arrange the circulation in such a manner that the circulation radiates in a right angle to the core of the cops either to or from the centre of the cops (Fig. 2). The cop then suffers a slight compression, or expansion respectively, but no disturbance in the build is caused thereby, owing to a compression or expansion in one direction being exactly counterbalanced through an exactly similar action in the opposite direction.

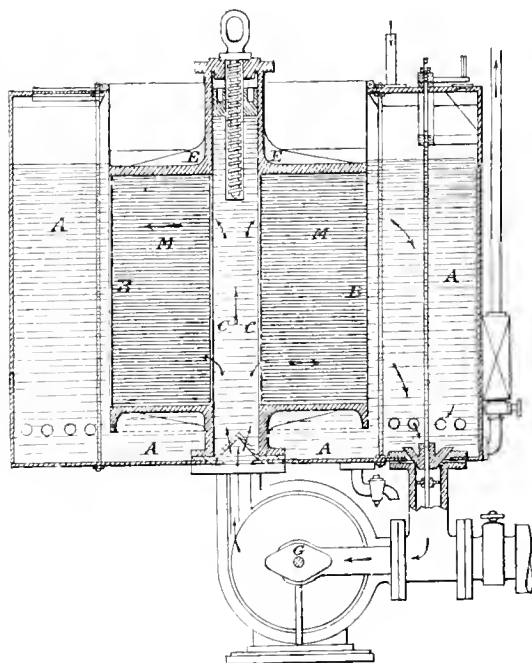
Fig. 2.



II.—THE COP-DYEING MACHINES OF THE PRESENT.

It might be interesting to critically examine some of the most important cop-dyeing machines from the point of view of the principles we have just laid down. In doing this we shall, perhaps, not arrive at a certain conclusion as to which of the cop-dyeing machines of the present is the best, but there will not be much difficulty in finding out which of those machines answer all the requirements contained in our four principles. I am fully aware, that in attempting in this manner a sort of criticism of the existing cop-dyeing machines, I am undertaking a not altogether pleasant task, as on the face of it there is no doubt whatever that only a small minority of these machines will survive the experimental stage; the rest are doomed to oblivion. Considering

Fig. 3.



that cop-dyeing is as yet surrounded by a halo of deep mystery, chiefly for reasons best known to the cop-dyers themselves, an impartial discussion of the features, merits, and failings of the various cop-dyeing machines can in the end only serve to promote the cause of cop-dyeing.

I propose to discuss the various machines in the order in which application for letters patent has been made for them. Obermaier's machine heads the list. The construction of this machine (Eng. Pat. 2181, April 30, 1883) is shown in Fig. 3. The space M between the two perforated cylindrical vessels B and C is uniformly and densely packed with the material to be dyed, any hollow spaces caused by the irregular shape of the cops or bobbins are filled with loose textile material.

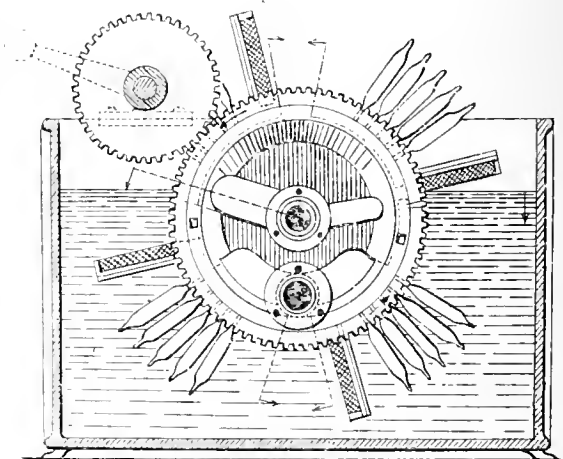
In order to keep these materials in their position, the piston cover E is screwed down upon them. By means of the rotary pump G the dye-bath is then forced into the cylinder C from where it penetrates through the textile material contained in space M, and subsequently flows through the perforations of the vessel B in the collecting vessel A, from where it again enters into circulation.

From this short description of the working of Obermaier's machine, we learn in the first instance, that the impregnation of the textile material is not performed in *vacuo*, but simply by means of a force pump. The perfect displacement of the air, especially of that part of it contained in the cotton fibre itself, will therefore occupy considerably more time, than if working in *vacuo* had been preferred. This disadvantage is of course much more noticeable in working with cold baths than it is with hot baths. It is probable therefore that the mordanting of textile materials in this machine, with cold baths (alumina, chrome, and iron mordants) will offer very considerable difficulties as regards thoroughness and evenness of impregnation. The possibility of the perfect impregnation of the textile material will also depend very essentially upon the care with which the machine has been charged, otherwise principle II. cannot be complied with, and the circulation will differ in intensity in various parts and sections, rendering thus the observation of principle IV. impossible. The observation of our principle III. offers no difficulty in this machine. The fact however that in this machine the cops to be dyed are subjected to not inconsiderable lateral mechanical pressure through the piston cover E is a very serious drawback. The great sensitiveness of cops against lateral or axial pressure, makes it almost impossible to guard the cops in this machine against detrimental or structural alterations, this all the more so, as after the dyeing operation, the vessel B C containing the cops is hydro-extracted on a centrifugal machine, in order to get rid of the superfluous dye-liquor retained by the textile material, which in this process will be pressed towards the outer wall of the vessel. I have no doubt that, in the dyeing of loose and partly manufactured fibres

and yarns in the hank, Obermaier's machine gives very good results, but for cop-dyeing it is, to say the least, of minor importance only.

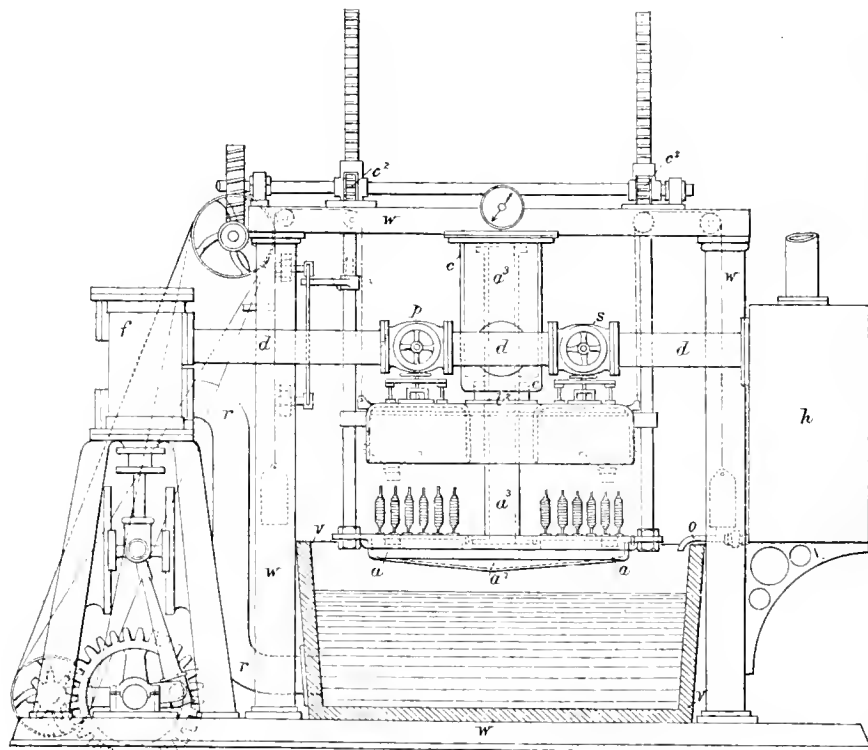
Graemiger's machine (Eng. Pat. 11,497, August 23, 1887) has been constructed as a cop-dyeing machine essentially. The cops are put upon hollow perforated skewers which are then fixed upon the perforations of a conical or cylindrical drum (Fig. 4) which revolves air-tight round a similarly

Fig. 4.



shaped receptacle. The latter is divided into chambers which are connected respectively with a pump and an exhaustor, the former in the first phase of the revolution drawing the dye-bath through the cops, the latter in the second phase of the revolution drawing air through the cops, in order to remove the excess of dye-liquor. The impregnation of the cop

Fig. 5.

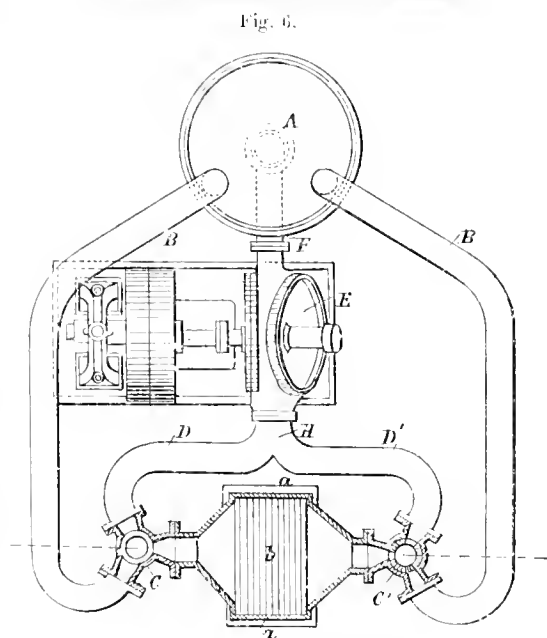


with the dye-liquor and the circulation of the latter through the cops, is performed in this machine by means of the above-mentioned pump, which here has upon the cops the same effect as a slight vacuum, and as far as this is concerned, the machine ought to work very well.

Unfortunately it possesses a very weak point, which consists in those two concentrically arranged drums of which the outer one is supposed to turn air-tight upon the inner one. As long as the gliding surfaces of these two drums have not suffered from corrosion, their air- and liquor-tight fit can easily be ensured and the machine will work satisfactorily; but as soon as through the unavoidable friction these drums and chambers lose their air-tight fit the working of the machine necessarily becomes deficient. This corrosion very quickly becomes noticeable, especially if mordant baths be employed. Hot baths of tannic acid, baths of acetate and sulphate of alumina and alkaline solutions of alumina and chromium peroxide, and in a lesser degree, all dye-baths are sure to cause this corrosion, and the progress of this corrosion is greatly assisted by the friction between the working parts. The circulation of the dye-liquor under these circumstances is bound to become deficient and irregular, and the contamination of the baths by the products of the corrosion must also have a very deleterious influence upon many of the shades dyed. In a later patent (Graemiger, Whitehead, Mason and Leigh) this drawback has been somewhat minimised by a reduction of the total area of the gliding surfaces, but it still forms a very weak part of this machine, upon the construction of which a very great amount of ingenuity and skill has been brought to bear. If the inventors should not succeed in remedying the above fault radically, there is very little prospect of this machine ever becoming of any importance.

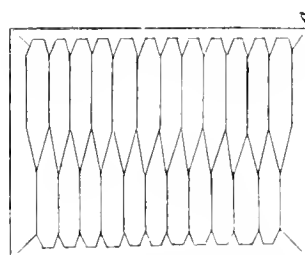
Mason and Whitehead's cop-dyeing machine (Eng. Pat. 14,019, Sept. 29, 1888) consists of the dye bath *c* (Fig. 5) placed under the rectangular frame *w*, which carries the cylinder *c*, which is connected with the pump *f*, and the vacuum cylinder *h*. On the lower end of this cylinder a stuffing box *b*₂ is arranged in which the tube *a*₁ moves vertically. The lower end of this tube carries the cop plate *a*, which consists of the chamber *a'* and the plate *a*. The latter is perforated and in the holes are placed the cops which have been put on hollow perforated skewers. By means of the cops *a*₂ the cop plate may be immersed into the dye-bath *c*, or be withdrawn from it. If the cop plate has been immersed in the bath, the former is connected with the pump *a*₃ by opening the valve *p*. The dye-liquor then circulates through the cops, passes into the chamber *a*₁, rises into the tube *a*₃, and travels through *c* and *d* to the pump *f*, from where it returns to the dye-bath through the pipe *e*. If the cops are dyed the cop plate is raised above the surface of the dye-bath, valve *p* is closed, and valve *s* opened, thus connecting the cop plate with the vacuum cylinder *h*, whereby the superfluous dye-liquor is removed from the cops. In order to expel the air from the cops previous to their impregnation with the dye-bath, a hood with valves, through which afterwards the dye-liquor is admitted, can be placed over the cop plate. From this description we see that the apparatus is fairly well in accordance with all our principles, but, at the same time, it must be said that the construction of the machine is exceedingly clumsy and a very cumbersome appliance for practical working.

One of the most interesting cop-dyeing machines of the present as regards its manner of working, is Mommer's machine (Eng. Pat. 2763, Feb. 20, 1890). This machine is not constructed upon principles which would be applicable to the treatment of individual cops, as is the case with all those machines working with the cops fixed in hollow perforated skewers. In this machine, which is in this respect identical with Obermaier's, an attempt has been made to form as it were a solid block of cops offering in all its parts the same resistance to the dye-liquor penetrating into and circulating through it. The machine (Fig. 6) consists of the dye-vat *A*, the box *a* in which the "cop block" *b* is inserted and the pump *E*. These three parts are connected with each other by means of the pipes *B*, *B'*, *D*, *D'*, and *F*. The circulation of the dye-liquor through these pipes and subsequently through the cops can be reversed by means of the valves *C*, *C'*. The



cops are put on solid skewers and then inserted into rectangular wooden frames in the manner shown in Fig. 7, each

Fig. 7.

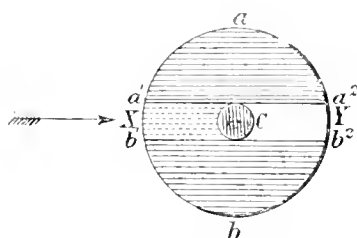


frame thus forming a screen or diaphragm of cops. A number of these frames are inserted face to face into the box *a*. It will be noticed that the circulation of the dye-liquor through such a cop block proceeds in the horizontal line, penetrating all cops from one side and passing through them in a right angle to their cores, while in all other systems, except Obermaier's, the circulation radiates to or from the core of the cops. Mommer's machine is therefore the only one working with solid skewers, all other machines, as long as they employ any skewers at all, use them hollow and perforated.

This machine does not work with a vacuum as our principle I. demands, but this in itself will not prevent the perfect impregnation of the cops, although it will make the process rather a slow one. There is no doubt, however, that the circulation of the dye-bath (principle II.) through the cops in Mommer's machine is very unsatisfactory. It is unquestionable that the dye-bath will penetrate the cop block in the machine, but it is utterly impossible for the amount of circulation to be the same in every part of the block. This being admitted, it necessarily follows that many of the cops will be unevenly dyed. Such an irregular circulation will be caused in Mommer's machine by the solid skewers upon which the cops are fixed, and the effect of which upon the circulation will be readily understood by anyone acquainted with the laws regulating the forced circulation of liquids through cops. In Fig. 7 is shown a diagram illustrating the circulation of the dye-bath through the cops in Mommer's machine. In the diagram *a x b y* is the section of a cop, *c* the corresponding section of the solid skewer.

The circulation of the dyebath through the cop is supposed to proceed in the direction indicated by the arrow, *i.e.* from the left to the right. The zones $a a^1 a^2$ and $b b^1 b^2$ then

Fig. 8.



indicate those parts of the cop in which the circulation proceeds under normal conditions. In the zone $x c$ the circulation proceeds much slower owing to the diversion of the liquid on the skewer and for the same reason no circulation whatever is possible in the zone $y c$ and the impregnation of this part of the cop is merely due to capillary action. Prompted, perhaps, by a knowledge of this fact the inventor of this machine provided for the reversion of the circulation. But, as will be easily seen, this reversion will only have the effect of eliminating the difference between zones $x c$ and $y c$, but will only increase the difference between zone $x c y$ on the one hand and zones $a a^1 a^2$ and $b b^1 b^2$ on the other hand. It is probable that as long as only light shades are dyed these differences are rather insignificant, but in the dyeing of medium and dark shades unevenness is sure to result. Also the fact that in this machine the dye-liquors are forced through a number of cop diaphragms of very considerable depth or thickness does not very well agree with our principle II., as to the high importance of which scarcely any doubt can exist. I mentioned before that of all the mechanical actions deleterious to the build of the cops, none is more dangerous than lateral unbalanced pressure, and considering that in Mommer's machine the cops are during the whole of the time exposed to very considerable pressure from one side only at a time, this looks

anything but hopeful with regard to principle V. The above mentioned difficulties and doubts are probably least noticeable when dyeing with the substantive dyes, but they will certainly almost entirely prevent the dyeing of mordant colours in this machine.

Surprising simplicity is the most striking feature of Crippin and Young's machine (Eng. Pat. 1157, Jan. 22, 1890), which consists mainly of the dye-vat a , the cop chamber b and the receivers b and f (Fig. 8). The cops are put on hollow perforated skewers, which are then inserted into corresponding holes in the cop plate. The cop plate is then transferred into the cop chamber. The latter by means of pipes is connected with the vacuum cylinders or receivers b and f , and by simply pushing a lever acting upon a steam jet exhauster, a vacuum is created in b , drawing the dye liquor from vat a into the cop chamber, through the cops and into receiver b . Pulling the lever back into its normal position at once interrupts the circulation, and the dye-liquor returns from the receiver b automatically into the vat. Another movement of the lever produces the vacuum in f which now extracts from the cops all the superfluous dye liquor, which is subsequently also again discharged into the bath. The waste steam from the exhauster passes through a coil in the vat a , heating the dye liquor. By an improvement in this arrangement (Eng. Pat. 4928, March 19, 1891) it is possible to let the dye bath circulate from the outside to the inside of the cops or *vice versa*.

With regard to the construction of this machine it will be noticed that it contains no moving parts whatever and especially none that would move in contact with the dye-liquor. The importance of this advantage, as compared with the arrangements in Graemiger's, Mason's, and Whitehead's and Mommer's machine cannot be overrated. By this total absence of moving parts the wear and tear of the machine, and consequently repairs of it are reduced to insignificance. The machine further allows a continuous control of the actual amount of circulation of dye-liquor through the cops, which in a high degree assists in obtaining identical shades in consecutive operations. The machine works with a vacuum of from 12 to 15 pounds, and it will be easily understood, that this will induce a most energetic circulation, which as a matter of fact amounts to nearly a gallon of dye-liquor per cop, and per

Fig. 9.

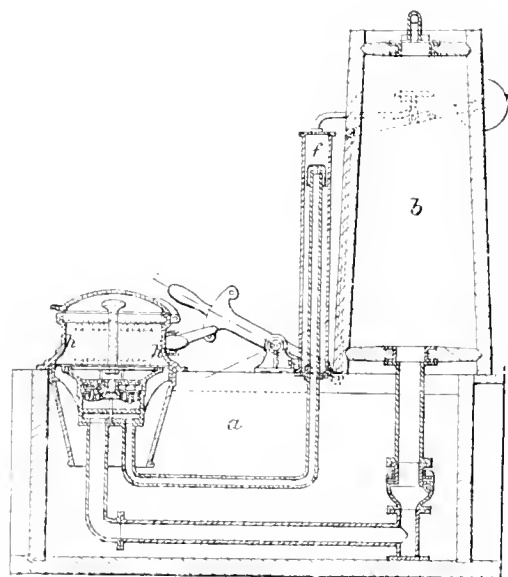
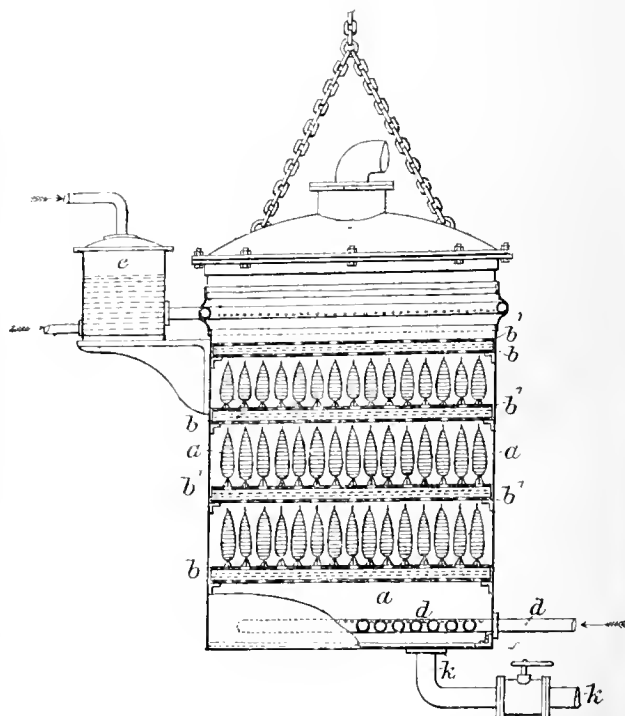


Fig. 10.

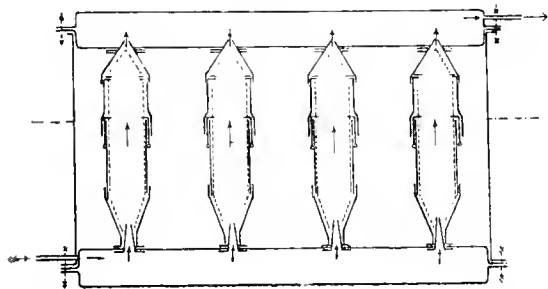


minute. In the presence of such an energetic circulation the existence of hard and soft places in the cops is no longer able to exert any influence upon the evenness of dyeing, so that this difficulty has no practical existence in this machine. The capacity of this machine with regard to the output of dyed cops is considerably less than in Obermaier's and Mommer's machines, and about the same as in Graeniger's machine, but in its rational construction, universal applicability to all dyeing processes, safety and simplicity of working, Crippin and Young's machine stands far ahead of all others.

In A. and M. Koblenzer's machine (Ger. Pat. 55,787, March 26, 1890) the cops are fixed upon a sort of filter-plates *bb* which are then placed in the chamber or cylinder *a* (Fig. 10). The cops are then first treated with steam, by means of the perforated steam coil *d* and subsequently the dye-bath contained in the reservoir *e* is forced into the cylinder *a* by means of steam pressure. The cops are thus simultaneously treated with a current of steam from below and the spray of dye-liquor from above, the dye-liquor gradually running to all the filter-plates carrying the cops. Any excess of dye-liquor eventually leaves the cylinder through the pipe *K*. It is certainly not easy to understand this peculiar dyeing process, and the manner in which anything like an efficient circulation of the dye-liquor through the cops is obtained. Neither of our principles bearing on this point is applicable to the machine, and if it is at all possible to dye cops satisfactorily in this machine, it is certain that this can only be achieved with the substantive dyes. To dye basic or acid mordant dyes, indigo or aniline black in this machine is an utter impossibility. I have seen a number of cops dyed in this machine with substantive dyes, but the surprising softness of these cops, although perhaps accounting for the evenness of the dye throughout the cops, is not very promising with regard to the result of the subsequent use of these cops in the loom.

P. Kornfeld's machine (Ger. Pat. 56,369, July 17, 1890) avoids the use of skewers altogether. Each cop is inserted in a tubular case *H* (Fig. 10), in which little projecting plates are provided in order to compel the dye-liquors to penetrate

Fig. 11.



into the cops. The apparatus may be useful for experiments on a laboratory scale, but is quite useless for practical cop-dyeing, owing not only to its output being infinitesimally small, but also to its management being troublesome in the extreme. A great deal of injury must be done to the cops by the projecting resistance plates. Herzfeld and Stommel's machine (D. P. A. 11,325) is very much like Kornfeld's machine, but those dangerous resistance plates are avoided. But the use of this machine on a large scale is quite as hopeless as that of Kornfeld's machine.

Although there is quite a number of other patents for cop-dyeing machines in existence, it would be needless to occupy space with their description, as they offer no essentially novel points for our consideration.

From the above we necessarily come to the conclusion that only very few of the numerous cop-dyeing machines have before them any prospect of success as soon as they are used to dye other than the substantive dyes. And it must not be forgotten that the substantive dyes answer the

actual purpose of cop-dyeing very badly, the great majority of them "bleeding" so excessively that in many cases cops dyed with these colours can not be used together with cotton, wool, or silk in the grey or bleached state, or dyed in light shades. Cop-dyeing will never become of any importance unless it is able to work with all the mordant dyeing colours, including the alizarin dyes, and also indigo and aniline black. But all these dyes are a very much severer test on the efficiency of a cop-dyeing machine than the substantive dyes.

I have remarked before that the question of the capability of production or the output of the various cop-dyeing machines is rather premature. It has been stated that in 10 hours Crippin and Young's machine will dye 25,000, Graeniger's 80,000, and Mommer's machine 360,000 pin-cops, but at the present stage of cop-dyeing this statement is useless for the purpose of weighing the intrinsic merits of one machine against those of the other, and can only serve to grossly deceive the uninitiated. Those figures are rendered still more valueless, owing to the cost of working of the different machines not being known; and in view of the almost absurd secrecy observed by the cop-dyers, there is little prospect of these data being obtainable in the near future.

III.—THE PRACTICE OF COP-DYEING.

The methods employed in the dyeing of cotton depend upon the chemical nature of the colours employed, and can accordingly be divided into three classes:—

- A. Direct dyeing (substantive) colouring matters;
- B. Mordant dyeing (adjective) colouring matters;
 - (a.) Acid dyes;
 - (b.) Basic dyes;
- C. Pigment colours.

A.—Direct Dyeing (Substantive) Colouring Matters.

The application of the direct dyeing benzidine and diamine dyes in cotton-dyeing is so very simple that these products appear particularly well suited to cop-dyeing. As all these dyes are dyed in one bath there is also one machine only required to dye them on cops, while all other dyes require two or more baths, and, consequently, as many cop-dyeing machines, thus considerably reducing the output of ready dyed cops per machine. Unfortunately, the fastness of the substantive dyes against washing and milling is almost without exception so unsatisfactory that their application on cops is comparatively very limited.

The chemical reasons, if there are any at all, for the affinity of these dyes to the cotton fibre are unknown at present. It is well known that the cotton takes up these dyes from the dye-bath at or near boiling temperature, but this absorption arrives at a standstill long before the dye-bath is exhausted. It may even be found with certain dyes that prolonged boiling causes the cotton to again lose part of the dye which it previously absorbed. For the production of a certain shade with these dyes a knowledge of the percentage of colouring matter is utterly insufficient, the final result depending quite as much upon the concentration of the dye-bath, its temperature, and the time allowed for dyeing. We find, therefore, that a bath made up from 3 lb. of dye and 50 gallons of water produces a much stronger shade than a bath made up from 3 lb. of dye and 100 gallons of water. This important fact is not of the same consequence in yarn and piece-dyeing, where it is comparatively easy to dye up to sample either by adding more of the dye to the baths, or interrupting the process as soon as the desired shade is obtained. In cop-dyeing this is not practicable, even in the machines of Graeniger and Mommer, which operate with comparatively large quantities of cops at a time. The reason of this is that during the dyeing operation the cops are practically beyond the control of the dyer, and, further, that dyeing is done in these machines in only a minute fraction of the time which it requires in the open bath, so that before any alteration of the bath could be made the cops are already finished. If, on the other hand, such weak

dye-baths were employed that the production of the attainable shade would require as much time as has to be allowed in the open beck, namely, from 20 to 60 minutes, the output of all cop-dyeing machines would be so small as to render the process commercially impossible. It is, therefore, necessary to employ dye-baths of such concentration and temperature that the desired shade is obtained in the minimum of time. The latter is, as I showed in the second part of this paper, determined by the construction of the machine, and is identical with the duration of each immersion, which is six minutes in Mommer's machine, two minutes in Graemiger's machine, and half a minute in Crippin and Young's machine. Owing to the extraordinary shortness of each immersion in the last-named machine, generally four immersions are given to complete the dyeing process, which therefore requires two minutes altogether. The fact that in Crippin and Young's machine dyeing is done, so to speak, in a number of very small instalments is of very great importance. The dyeing process can be interrupted, if required, in one-twelfth of the time from Mommer's, and one-fourth of the time from Graemiger's machine, thus depriving cop-dyeing almost entirely of its awkward mechanical rigidity, which in many cases places the dyer in a rather helpless position. It is further worth mentioning that the depth of shade obtained with the same bath in different machines varies not inconsiderably, and will be found lightest in Mommer's machine, darker in Graemiger's, and still fuller in Crippin and Young's machine. An advantage of one machine against the other cannot be inferred from this fact, as proportionally stronger dye-baths will remove any differences of this description, although I might perhaps mention that the cops, when they are removed from the machines after dyeing, contain about 70 per cent. of their dry weight of dye-liquor, and the proportion of free or uncombined dye contained in this liquor of course increases in proportion with the strength of the dye-bath, and, if not washed out, causes the yarns to bleed excessively; if washed out it represents a not inconsiderable loss of dyestuff. It is, therefore, desirable to dye each shade in as weak a dye-bath as possible, whereby also very much clearer and brighter shades are obtained.

In each operation we abstract from the bath a certain quantity of dye which has become fixed upon the cotton, and a further quantity of dye contained in the 70 per cent. of dye-bath which is mechanically retained by the cops. In other words, in the process of dyeing we reduce the concentration of the dye-bath as far as the percentage of dye it contains is concerned, and at the same time we reduce the volume of the dye-bath, containing all its constituents, in proportion to the quantity of it mechanically retained by the cops. A further alteration of the concentration of the dye-bath is caused either by evaporation or condensation of steam. The former is always the case in Graemiger's and Crippin's machines; the latter is a particularly disagreeable feature of Koblenzer's machine. It is evident that in order to obtain all the lots dyed in succession, of the same shade, we must always, before starting the treatment of a new lot, bring the dye-bath to its original volume and concentration. The restoration of the volume is very simple in all those machines in which the volume decreases during the dyeing operation. If however, as in Koblenzer's machine, the volume of the dye-bath is increased, we can only bring it to its old concentration by adding to it fresh quantities of the dye and other constituents. The quantities to be added are, however, very difficult to calculate, and, moreover, the dye-bath is constantly increasing in bulk. For this I consider dilution of the dye-bath in working one of the greatest drawbacks a cop-dyeing machine can possess, as it introduces in its working an element of great variability and difficulty.

For the restoration of the concentration and of the dye-bath the following data are employed:—

1. The strength of the shade dyed, or percentage of dyeing; this factor is best experimentally established for every shade.
2. The quantity of dye-bath mechanically retained by the cops.
3. The evaporation taking place at a fixed temperature in dyeing given weight of cops.

The use of these data is best shown by giving an example which might be directly applied to Graemiger's, Crippin and Young's or Mommer's machines:

Original dye-bath: 1 lb. Benzopurpurine.	
4 „ Soap.	
4 „ Soda crystals.	
100 gallons of water.	
Dyed: 100 lb. of cops, 2 p.d. shade.	
Loss of dye-bath 2 lb. Benzopurpurine.	
Dye-bath me- chanically re- tained by the cops	70 lb. Water.
	— „ 1.5 oz. Benzopurpurine
	— „ 1.5 oz. Soap.
	— „ 4.5 oz. Soda crystals.
Loss of water through evaporation: 330 lb. of water.	
Total loss per 100 lb. of cops: 400 lb. of water.	
2 „ 1.5 oz. Benzopurpurine,	
4.5 oz. Soap.	
4.5 oz. Soda crystals.	

From this it follows that for every pound of cops dyed per operation, we have to add to the dye-bath a mother-bath consisting of—

1 lb. of water.
0.045 oz. Benzopurpurine.
0.045 oz. Soap.
0.045 oz. Soda crystals.

There is a slight error in this calculation, owing to the neglect of the specific gravity of the dye-bath. This error is so small that it is not worth considering, although there is no difficulty in eliminating it.

This question of replenishing the baths becomes much more complicated if the dye bath contains more than one of the substantive dyes, because they are not taken up by the cotton in the same proportions in which they are present in the bath. At first sight this difficulty appears so great that the dyeing of mixed shades on cops has been pronounced altogether impossible. If not altogether impossible, it certainly will offer enormous difficulties in machines of the type of Mommer's, where large quantities of cops are treated simultaneously, and where the cops are not at any time at the same stage of impregnation. This difficulty does not exist in Graemiger's or Crippin and Young's machines. The best way to arrive at the respective proportions of the mixed dyes taken up by the cotton is to compare the baths before and after dyeing colorimetrically. The results of this test, together with the total percentage of dye put on the cotton, enable us to calculate the necessary composition of the replenishing or mother bath.

I have recommended above the use of the colorimeter for baths containing more than one colour, and I may say that such an instrument will often be found of great assistance in the cop-dye house. There is, however, also a direct dyeing test for estimating the various proportions in which several dyes participate in a compound shade. In carrying out this direct test standard solutions of the various colours are prepared, and very gradually added to a weighed hank of cotton, which is kept in a boiling 30 per cent. strong solution of common salt. By this means only traces of the dyes remain in the bath, and the quantities of the different dye solutions which have been used to produce a given shade at once supply us with the figures showing the total percentage of dyes taken up by the cotton, as well as the proportions in which the various dyes are present. The method requires some practice, but the results are very reliable. In many cases it may be desirable to ascertain the correct management of a dye or mordanting bath by a short test. For this purpose a simple hydrometer often answers very well. It will be hardly necessary for me to observe that for the testing of hot or boiling baths in this manner hydrometers registering below 1.000 sp. gr. must be used.

Altogether it may be said that the difficulties of dyeing cops with benzidine or diamine colours are very small indeed as long as only single dyes are employed, and as long as not exceptionally heavy shades have to be produced. The difficulties in the way of dyeing compound shades with these colours are also of such a nature as to be readily overcome

by careful and judicious manipulation. These direct dyes, moreover, all dyeing in one single bath, and thus requiring one machine only to carry out the dyeing process, it will be easily understood why the cop-dyers paid them such particular, almost exclusive, attention. On the other hand, however, it was found, that very heavy, brown, blue and black shades cannot satisfactorily be obtained with these dyes, so long as the circulation of the dye-bath through the cops takes place in one direction only. Under this condition many of the cops will be found to be very unevenly dyed. This can be remedied by constructing the machines in such a manner that the circulation can be reversed between alternate immersions. Mommer's machine is the first which provided for this emergency in a practicable manner, although I am afraid that the advantage to be gained by this mechanical arrangement cannot be realised in Mommer's machine owing to the inevitable bulging of the cops in his machine in the direction of the circulation. On reversing the circulation this bulging would of course be bound to be thrown on the other side of the cop, and if such a rough treatment of the cops does not destroy their build altogether, it will certainly cause an outrageous amount of waste in the loom. Also Graeniger speaks in his patents of the reversion of the circulation, but there is little doubt that it is quite impracticable in his machine, and if applied would prove utterly unmanageable in regular working. Crippin and Young also provided their machines with a reversing arrangement, and their machine is at present the only one which works equally well in either direction. In dyeing very heavy shades in this machine irregularities in the circulation, say, from the outside to the inside of the cops, and caused through irregularities in the build of the cops, are most efficiently compensated by a reversion of the circulation during each alternate immersion, and the heaviest shades dyed in this manner are obtained perfectly even throughout each cop. This is a very important point in favour of Crippin and Young's machine.

Unfortunately all the substantive colours known at present, with the only exception of the Oxypheanine of the Clayton Aniline Company, possess the great drawback of bleeding most excessively in washing and milling. This goes so far that cotton dyed with these colours cannot even be said to be fast against hot water. The reason of this is no doubt that there is no chemical bond or affinity between these colours and the cotton fibre, the nature of their union being what Knecht called "rigid solution." The bleeding of these dyes could be prevented by converting them upon the fibre into fast lakes; but the only lake forming group in these dyes being the sulpho group, which is not capable of forming lakes fast against alkalis, the solution of this problem offers considerable difficulties, although I have reason to believe that they can be conquered. The above seems not to be in accordance with the well-known fact that Bayer and Co., of Elberfeld, by treating certain of their colours after dyeing with the solutions of certain metallic salts, preferably copper salts, obtained dyeings the fastness of which to washing is very satisfactory. But I am not of opinion that this treatment results simply in the production of a copper lake with the dye fixed upon the cotton. The shade of the colour is so much altered in this treatment as to suggest a much more complicated reaction. This treatment has only proved successful with the benzo-azurines manufactured by that firm. The bright blue shade they produce on cotton is thereby altered to a dull indigo blue, which is quite fast to soap as far as bleeding is concerned, but the soaping, and in fact any other alkali changes this dull indigo shade into a still duller puce. This renders the process a rather questionable success. Of more importance is the fact that some of these dyes can be converted into other shades by diazotising them upon the fibre and combining them afterwards with various phenols, naphthols or amines. The shades produced in this manner are all fast to washing and milling, many of them also exceedingly fast to light. This process, also an invention of Bayer and Co., cannot be considered as a solution of the above mentioned problem, as it results in shades more or less different from the original ones, and is only available for browns, dull blues, greys, and blacks. By a similar process Green obtained on cotton, dyed with his primuline, shades ranging from yellow to scarlet, maroon,

and purple. These are also absolutely fast to washing and milling; unfortunately they are wretchedly fugitive. The only drawback of these developed colours in cop-dyeing is the circumstance that they require three machines, corresponding to the three different baths used; but, on the other hand, it must not be forgotten that if the cop-dyers have to fight shy of the fast colours on account of the greater number of machines required for their production this new branch of dyeing would certainly be very narrowly confined in its field of working. Happily this is not so. It is evident that the number of machines which a dyer can afford to employ for the production of a certain shade is eminently a question of capital, that is of the price of a machine. If the cheapest machine should turn out to be at the same time the most efficient, the dyer will not be obliged to restrict himself to the dyeing of one bath colours. Of those machines that are at all efficient and generally applicable, Crippin and Young's machine is by a long way the cheapest and I am satisfied that it is also the simplest and safest in working.

IV.—MORDANT DYEING (ADJECTIVE) COLOURS.

A.—*Acid Dyes.*

The mordant-dyeing acid colouring matters are far superior in fastness to the substantive dyes, but their application in cop-dyeing offers difficulties of the most intricate description. Everything of course depends in the dyeing of these colours upon the level fixing of the mordant upon the fibre. In the first instance, to accomplish this, it is absolutely indispensable that the mordanting baths must always remain perfectly clear. Any disassociation of the mordanting salts taking place either by working the bath at too high a temperature, or by working the baths too basic, causes a more or less thick film to be deposited on the outside of the cops, which renders them altogether impermeable, and under any circumstances leads to such unevenness in the subsequent dyeing process as to make the cops absolutely useless. Another very serious difficulty is the great insolubility of most of the alizarine and other mordant dyeing colours in water. It is true all these colours will dissolve in alkalis or certain alkaline salts, but it seems that the affinity of these dyes in such solutions to the mordant fixed upon the cotton is at best considerably weakened and often practically altogether destroyed. Further, if the mordant has not been perfectly fixed upon the fibre, numerous small particles of it are washed into the dye-bath, remaining suspended there in the form of a colour-lake which eventually again is deposited on the outside of the cops, thus greatly impeding the circulation of the dye-bath and producing, moreover, unevenness of the worst kind. Taking all these points into consideration, it is quite evident that the dyeing of alizarine colours on cops is a matter bristling with difficulties, the ordinary methods of dyeing these colours failing us altogether.

The mordants we have to deal with in working with these dyes are the oxides of alumina, chrome and iron, the alumina mordant being undoubtedly the most obstreperous of the three. If we treat cops in a cold bath of acetate of alumina of the usual strength (from 6° to 8° Tw.) no precipitation of alumina either in the cops or in the bath takes place; the cops simply absorb about 75 per cent. of their own weight of the bath. Working at higher temperatures is prohibited by the disassociation of the acetate in the bath. If those impregnated cops are now dried, disassociation of the acetate of alumina takes place, alumina being fixed upon the fibre; but at the same time, owing to the evaporation of the water from the surface only of the cop, an osmotic action takes place by which undecomposed acetate of alumina is slowly but constantly conveyed from the central to the peripheral parts of the cops. When perfectly dry the cops are found to be mordanted all through, but the mordant is very unevenly distributed, being much stronger on the outside, than in the inside. As regards evenness better results are obtained by passing the cops impregnated in the alumina bath without delay through a soda-bath, but the mordanting is very weak, as it will be easily understood, that on circulating a soda-

bath through the cops already filled with the alumina bath, the latter is simply pushed out of the cop in front of the soda-bath, without mixing with the latter within the cop. By treating, however, these weakly mordanted cops with a solution of aluminate of soda, the mordant becomes much heavier owing to the property of the aluminate of soda to disassociate into alumina hydrate and caustic soda in the presence of free alumina hydrate. The alumina mordant so obtained is very well fixed on the fibre and very even, and although rather tedious on account of the many operations required, this is the only method so far to produce a strong and even alumina mordant on cops.

The baths being all used cold and no combination of any of the chemicals with the cotton, as in the case of dyeing, taking place, the loss of the bath consists simply in the quantity of bath absorbed by the cops, and this loss is made up in adding to the working bath from time to time from a mother-bath of exactly the same composition as much as is required to maintain the former at its original level.

The application of chromic mordants to cops is much simpler on account of the very decided affinity of chromium oxide to cotton, and especially the solutions of chromium hydroxide in caustic alkalis, known as chromites, readily give up their chromium hydroxide to the cotton fibre. It is sufficient to treat cops in an alkaline solution of chromium hydroxide at a temperature not exceeding 50° C. in order to obtain the cops very satisfactorily mordanted. The mordanting takes place much quicker at higher temperatures than with cold baths, and the strength of the mordanting is directly proportional to the concentration of the baths and about inversely proportional to the excess of caustic alkali employed for dissolving the chromic hydrate. These chrome baths have a very great tendency to spontaneous decomposition, this tendency increasing with the concentration of the bath and with the decrease of free alkali. It is also possible, however, to produce chrome mordants on cotton by means of neutral and basic chromic salts, the behaviour of which against the cotton fibre has been thoroughly investigated by Liechti and Snida, and was found to be greatly different from that of the similarly constituted alumina salts. Least suitable for the purpose are the neutral (violet)* chromic salts. By treating cops with the solutions of such salts, followed by a passage through some alkali or alkaline salts, chromic hydrate is precipitated upon the fibre, but it is only very imperfectly fixed. Better results are obtained by drying the cops after the impregnation with chromic sulphate, when 12.8 per cent. of the quantity of this salt absorbed by the cops firmly combine with the cotton fibre in the form of chromic hydrate. Owing, however, to the necessity of drying the impregnated cops, the mordanting has a tendency to become uneven, for reasons mentioned above. Basic chromic sulphates are much more satisfactory and, differing from solutions of basic sulphate of alumina, they can be heated without disassociation taking place. Treating the cops with solutions of such salts at a temperature of about 70° C., the cotton is very evenly mordanted and chrome mordants of about medium strength can easily be obtained in this manner. But it ought not to be forgotten that the dissociation of basic chromic sulphates is very considerably retarded, or even entirely prevented by the presence of sulphate of soda or potash. This makes it advisable to prepare such mordanting baths, not by partial alkaline decomposition of solutions of chromic sulphate or chrome alum, but by dissolving freshly precipitated chromic hydroxide in solutions of chromic sulphate. The strength of the mordant obtained with such baths depends upon the concentration of the bath, its basicity and temperature. The latter of course can easily be kept constant, but the maintenance of the basicity is a matter of considerable difficulty and requires one to start with a knowledge of the quantity of chromic hydrate fixed upon a definite weight of cotton, in using a bath of known concentration and basicity.

In the same manner as the chromic sulphate, the chromic acetates and chlorides may be employed. The latter give excellent results, especially if the commercial "Chlorchrome" of the formula $(Cr_2Cl_2(OH)_4)$ is used. Of course there also exists the difficulty with regard to the management of the baths, and although this difficulty is by no means insurmountable it is a matter requiring great care and foresight.

The iron mordants are in their chemical behaviour closer related to the alumina mordants than to the chrome mordants and accordingly disassociate more easily than the latter. For mordanting cotton the so-called nitrate of iron, *i.e.*, ferric sulphate, is almost exclusively employed. The neutral salt produces only very weak mordants, but by adding to it acetate of soda or carbonate of soda basic salts are obtained producing, according to their concentration and basicity, very strong mordants. The cops are treated in the cold baths, then left to lie for from 6 to 12 hours, when they are thoroughly washed. The mordants so obtained are perfectly even. Very frequently the iron mordant is used in the production of a "black bottom," by treating cops after first mordanting them with tannic acid or somac in the above mentioned ferric baths. This important mordant is very easily applied and it is only necessary to prevent the iron bath from acquiring a neutral or acid reaction. It is best kept alkaline by adding to it from time to time small quantities of acetate of soda.

Other metallic mordants are very seldom applied to cotton and are of no interest in cop-dyeing. But there remains a point of very great importance in connection with the mordanting of cops, namely, the washing of the cops after the operation of mordanting. I have repeatedly pointed out above that in cop-dyeing, in order to maintain the standard of shade through any number of consecutive operations, it is absolutely necessary to maintain the initial concentration of the working bath by means of a suitably composed mother-bath. Accordingly, under whatever conditions we dye or mordant, after withdrawing the cops from the machines they retain, as I have shown, a quantity of bath equal to about 70 per cent. of the dry weight of the cops. This quantity of bath, containing of course all the components of the working bath, must be washed out of the cops. This is important enough in withdrawing the cops from a dye-bath, as the mechanically-absorbed dye-bath, if dried in the cops would cause them to bleed and rub very badly. But still more important a matter is the removal of these mechanically-absorbed liquors after mordanting operations. If not removed, larger quantities of the mordanting bath will get into the following dye-bath, thus almost at once rendering it unfit for further use. The cop-dyeing machines are as a rule not very well adapted for the purpose of washing the cops, as they are mostly so constructed as to return the water circulated through the cops in the bath, which thus very soon becomes inefficient for further washing operations. There is, however, no difficulty to so construct the washing machines that the water after circulation through the cops is discharged from the machines.

Many of the mordant-dyeing colours are either totally insoluble or only imperfectly soluble in water. In order to employ them for cop-dyeing where always absolutely clear dye-baths are required, these dyes must be brought in solution by means of caustic alkalis, alkaline carbonates, soaps or salts possessing an alkaline reaction, such as acetate, phosphate or borate of soda. Soaps and neutral Turkey-red oil give very good results in many cases. The caustic alkalis certainly give the clearest solutions, but deprive the colours of almost all their affinity to the mordants, and the alkaline carbonates are scarcely any better. Ammonia can be used in a few exceptional cases only, as the primary lakes of many of the mordant-dyeing acid colours are soluble in it, so that by using ammoniacal solutions of such dyes not only no dyeing takes place, but very frequently the cops are altogether stripped of their mordants. This can be prevented by changing the primary mordant, previous to dyeing, into a compound mordant by means of acetate of lime or zincate of soda, compound lakes being insoluble in ammonia.

* The so-called "green modification" of chromic sulphates need not be considered here, as, according to recent investigations these compounds possess a constitution entirely different from that attributed to chromic salts.

For the dyeing of the mordant-dyeing acid colours on cops Erban and Specht's process (Ger. Pat. 5,057, 1890), might appear to be particularly well adapted. In this process the cotton is first treated with an ammoniacal solution of alizarine and then dried. This drying, which is absolutely necessary in order to fix the alizarine insoluble upon the fibre, makes the process unavailable for cop-dyeing, as on drying the greater part of the dissolved alizarine is deposited on the outside of the cops. The cause of this phenomenon has already been mentioned. If on the other hand the cops without drying are treated with alumina salts all the alizarine is washed out of the cop, owing to the great solubility of alizarate of alumina $Al_2O_3(C_{14}H_6O_3)_3$ in diluted ammonia.

B.—Basic Dyes.

Some of the basic dyes, such as Bismarck brown and chrysoidine, dye the cotton fibre without any mordant and can be used on cops in this manner for the dyeing of light brown and orange shades. Such dyes, however, possess very little fastness, the basic dyes only dyeing fast shades upon the tannin-antimony or tannin-iron compound mordants. For the production particularly of brilliant light shades alumina or tin mordants fixed with soap or Turkey-red oil are frequently used, but, as regards fastness to light and washing, colours dyed upon these mordants are very much inferior to the same shades on tannin mordants.

The mordanting of cops with tannic acid is carried out under the same conditions under which this operation is performed upon yarns, *i.e.*, at a temperature of from 80° to 90° C. As is well known the yarns remain in this bath for from 6 to 12 hours, or until it has become cold. In this manner the process is of course impracticable in cop-dyeing machines, but neither is there any necessity for it, as in all cop-dyeing machines working with a vacuum, the tannin is taken up by the fibre with astonishing rapidity, only equalled by the rapidity with which dyeing with the substantive dyes proceeds *in vacuo*. An immersion of one minute in *vacuo* in a five per cent. strong tannin solution at 90° C. produces the same effect as an immersion of four hours' duration with hanks in an open bath. The strength of the mordant entirely depends upon the concentration of the tannin baths, to which it is directly proportional. After the impregnation of the cops, air is drawn through them, as is usual after each bath employed for cop-dyeing, in order to remove as far as possible the excess of bath absorbed by the cops. These contain, then, first the quantity of tannic acid directly fixed by the cotton, and, further, the quantity of tannin contained in that portion of the bath which could not be removed from the cops by drawing air through them after the immersion. I have mentioned several times already that after impregnation in the cop-dyeing machine, hot or cold, the cops retain 70 per cent. of their dry weight of the bath, and this quantity cannot be removed by drawing air through them. According to this, 100 lb. of cops treated with a 5 per cent. strong tannin bath will retain 70 lb. of this bath, equal to about 3.5 per cent. of tannin. On extracting the tannin from such cops, 3.898 per cent. were recovered, so that about 0.5 per cent. of tannin were fixed direct by the cops. But there is no doubt that the whole of the tannic acid originally contained in the cops, in the form of mechanically-absorbed bath, is eventually assimilated by the cotton as the cops become cold. This assumption is supported by the fact that of the 4 per cent. of tannin contained in those cops only about 0.3 per cent. can be readily extracted, while for the complete extraction of the remaining 3.7 per cent. 21 hours are required. In precisely the same manner as tannic acid, all the other tannins used in dyeing may be applied. An important feature in the mordanting of cops with tannic acid is the extreme economy of the process as compared with the same operation on yarns. To produce a 1.5 per cent. strong tannin mordant on cops 1.5 per cent. of tannic acid is required, but to produce the same mordant on hanks 10 per cent. of tannic acid is used, or rather wasted.

The cops impregnated in a tannin bath ought to lie and cool for from five to 10 hours, but they must not be dried.

After lying for some time they are passed through a bath of tartar emetic and subsequently well washed. The various antimony fluorides and their double salts cannot be used in place of the tartar emetic owing to the enormous corrosion they cause if in contact with metals. If the cops have not been standing long enough before being treated with the tartar emetic, larger quantities of tannate of antimony are washed into the baths, rendering them unfit for further use or necessitating their filtration. It is, however, impossible to keep the tartar emetic baths absolutely clear, and it is therefore inevitable to prevent some of this free tannate of antimony from being filtered by the circulation of the bath upon the outside of the cops, which then in the subsequent dyeing results proportionately darker than the inside of the cops. This defect will not occur in Koblenzer's machine, on account of the filter-plates separating each layer of cops, while in Mommer's machine it will render the application of the basic colours an exceedingly awkward operation if not prohibit it altogether. In Crippin and Young's machine, this difficulty has been met with in a very simple and efficient manner by placing over each plate of cops in the machine a hood made from perforated metal and covered with some filter cloth, through which the tartar emetic bath has to pass before reaching the cops. If for the fixing of the tannin in the fibre a bath of ferrie sulphate is employed instead of a tartar emetic bath, the most important point is to prevent it from ever acquiring an acid reaction, by adding to it from time to time some acetate or carbonate of soda. After the fixing of the tannin, the cops are thoroughly washed and are then ready for the dyeing.

The dyeing of the basic colours on cops mordanted with tannin is exceedingly simple, especially if the dyes used do not possess any affinity for the unmordanted fibre. The concentration of the dye-baths requires almost no control, as the quantity of dye which can be fixed by the cops is unalterably determined by the percentage of tannin mordant which they contain. In the interest of greater purity of shade it is advisable to work with rather weak baths at a temperature of from 50° to 60° C. Rather more care is required if such colours like Bismarck brown, chrysoidine, rhodamine or indulin blue are used which possess a distinct affinity to the unmordanted fibre. It is necessary in this case to maintain the original concentration of the dye-baths in the manner already described. I have shown above that the exact quantity of tannin present in mordanted cops is always known and the equivalent quantity of any basic dye can be estimated with mathematical accuracy according to a method previously (this Journal, 1891, 794) described by me. From the data so obtained it is then very easy to calculate the composition of a suitable mother-bath. We will suppose the cops to contain 1.25 per cent. of tannic acid, and to be dyed with rhodamine B for which (*loc. cit.*) a tannin equivalent of 41 per cent. was found. If then we dye in a bath containing 5g of rhodamine per litre of water, the quantity of dye used for each kilogramme of cops is found as follows:—

1 kilo. of cops containing 12.5g of tannin	
	combine with : 29g rhodamine B.
1 kilo. of cops retain 0.7 litre of dye-bath	
	containing : 3.5g „

Dye used for 1 kilo. of cops : 32.5g „ B.

From this we find that after each operation, and for each kilogramme of cops dyed we have to add to the dye-bath 32.5g of rhodamine dissolved in the quantity of water lost in each operation through evaporation and absorption by the cops, the latter item amounting to 0.7 litre of water for each kilogramme of cops. The loss through evaporation shows its amount in the falling level of the dye-bath, and is very considerable in all those machines working under reduced pressure. In Crippin and Young's machine, for instance, the loss through evaporation amounts in boiling dye-baths to 3 litres of water for each kilogramme of cops. This loss of course decreases with the temperature of the baths, and in cold baths it is practically nil.

Such careful management of the dye-baths, as I have said before, is only required in the dyeing of the few basic colours which are capable of dyeing unmordanted cotton. Loss of colour from that source appears not to have been

accounted for in the above calculation, but it is represented by part of the colour retained by the cops in the form of mechanically retained dye-bath. The fact is that no dye is directly assimilated by the cops as long as there is any uncombined mordant, so that the direct dyeing capability of these dyes can only be exercised by that quantity of dye-bath remaining in the cops after each operation, which has been admitted already in the above calculation. As the effect of this direct dyeing action is proportionate to the concentration of the dye-bath, it is necessary to keep the concentration of the latter constant.

After dyeing it is absolutely necessary to wash all uncombined dye out of the cops, and in many cases it will be advisable to follow this washing by a second washing in a warm soap bath. Also a neutral solution of Turkey red oil may be used for this purpose.

C.—PIGMENT COLOURS.

By the term of pigment colours I understand all those dyes, which can be fixed on the fibre neither direct, nor by means of mordants, but only *in statu nascendi*. Dyes of this description are :—

- (a.) Developed colours ;
- (b.) Mineral pigments ;
- (c.) Vat dyes ;
- (d.) Aniline black.

Most of the dyes of these four classes are eminently important in the dyeing of cotton on account of their great fastness to light, washing, and milling.

a.—Developed Colours.

The term of developed colours is applied to azo colours produced upon the fibre from their components, but there is little doubt that also colours of other composition and the formation of which is based upon simple quantitatively proceeding reactions will be available before long. The formation of the azo colours depends upon the well-known reaction of some diazotised base with phenols, naphthols, amines, and their derivatives. In cotton-dyeing only such combinations command general interest which are absolutely insoluble in water, dilute alkalis, soap, and acids. The components used are either the so-called half-products of the coal-tar colour industry, or colouring matters themselves if they are either diazotisable or capable of combining with diazo compounds with formation of azo colours. We shall see later on that those especially of the substantive colours which can be diazotised are in their great importance in cotton dyeing only equalled by the alizarine dyes.

The formation of azo colours upon the fibre can be effected in two ways. We can first treat the cops with the solution of a diazo salt, and subsequently immerse them in the alkaline solution of some phenol or naphthol, or in the solution of some amine in hydrochloric, or preferably acetic acid, or we may first immerse the cops in the solution of the developer, and then treat them with the solution of the diazo salt. Both methods, particularly the last one, give very bad results upon cops ; in fact, they cannot at all be applied to them, although some Continental dyers employ them with very good results on piece-goods and yarns in the hank. The reason of the process giving bad results on cops lies in the fact that neither of the above-named compounds has any affinity to the cotton fibre, and are simply washed out of the cops in the process of developing the colour. To this must further be added, that solutions of diazo compounds are very unstable, and decompose so quickly as to make their use in cop-dyeing practically an impossibility. It is obvious that the process of forming azo colours upon the fibre can only be applied to cops if it should be possible to fix either the base to be diazotised or the developer upon the fibre after the manner of a mordant and fast against cold water. Developers of this kind are scarcely known,* nor could they be of much use in cop-dyeing, as the prospect of having to treat them in the baths of the exceedingly unstable diazo salts is not very

encouraging. Diazo compounds, which could be fixed upon the cotton fibre in the manner of a mordant, are, strictly speaking, not known, but there are some substantive dyes which can be dyed upon cotton in the well-known manners, and being amido-azo compounds of a certain order or constitution, they can be diazotised upon the fibre, forming diazo compounds insoluble in water, which by combination with amines, phenols or naphthols, form upon and in the fibre azo colours which are almost without exception fast to light, and all uncommonly fast to acids, alkalis, washing, and milling. Substantive dyes of this kind are primuline, diamine black B O, R O, and B H, diamine blue black E, diamine brown V and R, cotton brown A and N.

These dyes are dyed upon the cops in the manner before described, and the dyed cops are then well washed. This is of great importance, as otherwise the dyes finally obtained would rub off in an excessive degree. It is advisable to use warm water for washing if the cops have been dyed with colours difficultly soluble in water, such as diamine black R O for instance, otherwise cold water may be used. The perfectly cold cops are then treated in the diazotising bath, containing about 0.5 lb. of nitrite of soda and 0.9 lbs. of hydrochloric acid (1.50 sp. gr.) in every 10 gallons of water. It is desirable that these baths should always contain about the same quantity of free nitrous acid. The quantities of nitrite and hydrochloric acid to be added to the bath after each operation are calculated in the identical manner as the mother-baths used in dyeing. The diazotised cops are carefully washed, and treated in the developing baths without delay. The latter may with advantage be kept more concentrated than is usual in hank- or piece-dyeing; solutions containing from 3 to 5 per cent. of the developers answer very well. Of course after developing the cops are washed again.

Yarns dyed with primuline produce in this treatment, with various developers, fine shades of yellow, orange, scarlet, maroon, brown, and purple, which are all exceedingly fast to washing. Unfortunately their fastness to light is worse than bad, and I have no doubt that the discovery of a substitute for primuline would amply repay anyone for the trouble of searching for it. The developed colours obtained with the above-named or Cassella's diamine colours are also absolutely fast to washing and milling, and at the same time they rank, almost without exception, amongst the colours which are fastest to light.

(b.)—Mineral Pigments.

Before the introduction of the substantive dyes and of the coal-tar colours generally, the colours of this group were of very considerable importance in cotton dyeing. At present they have only their cheapness and, in some cases, their great fastness to light to recommend them. It is very doubtful, however, whether in cop-dyeing they will assume even the moderate importance which they still possess in hank dyeing.

Of all the mineral pigments used in cotton dyeing the "iron buff" is probably the most ancient. It is produced upon cops in the same manner and with the same materials as the iron mordants, namely, by treating the cops with cold solutions of basic ferric sulphate, and a subsequent passage through soda carbonate. In dyeing in this manner light "Naunking" shades, they become frequently uneven in the following soda bath. To avoid this the soda carbonate bath may be omitted altogether, instead of which a small quantity of gaseous ammonia is drawn through the cops. This operation offers no difficulty in most machines, and directly after the ammonia treatment the cops can be washed.

More important than the "iron buff" are the chrome yellows, which, even to this day, are largely used in hank dyeing, although there is no scarcity in yellow cotton dyeing colours. The chrome yellows are dyed by first handling the cotton in a solution of some lead salt, preferably sugar of lead, and subsequent treatment in a bath containing bichromate of soda or potash and sulphuric acid or some sulphate, either sulphate of soda or alumina. The dyeing of this yellow on cops is exceedingly difficult. Of course the impregnation of the cops with the solution of

* Chrysoidine could be used in this manner, as it is capable of combination with diazo compounds.

the lead salt is simple enough, but in the subsequent operation with the chrome bath large quantities of lead chromate are unavoidably washed out of the cops into the bath, rendering it at once unfit for further use. This difficulty might be avoided by fixing the lead salt upon the fibre in an insoluble form; for instance, by impregnating with the lead salt cops previously mordanted with tannic acid. But this would be found too expensive. Attempts to fix the lead salt by treating the impregnated cops with gaseous ammonia, or alkaline sulphates, or carbonates, gave very unsatisfactory results.

Prussian blue is easily obtained upon cops by treating cops mordanted with ferric sulphate, after washing them in an acidulated bath of ferrocyanide of potash. The blue shades so obtained, although very beautiful, are not very fast to light and still less fast to washing.

Cadmium yellow, arsenic orange, and antimony orange, which are fixed upon the fibre in the form of their sulphides, also the brown manganese pigments or bistres, are very little used at present, partly owing to the poisonous nature of some of them, and there is no prospect that these colours will ever become of any importance in cop-dyeing. Suggestions as to applying these colours to cops would therefore be useless.

From the above it will be seen that mineral pigments are of very little, if of any, importance for cop-dyeing. In most cases the baths are rendered useless after the first operation, owing to the great quantities of loose pigment forming in them.

(c).—*Vat Dyes.*

There exists a number of natural and artificial colouring matters which are capable of forming a "vat" suitable for the dyeing of cotton goods, but only the indigo vat and the indigo-indophenol vat are of such importance as to be worthy of consideration with regard to their application to cop dyeing. The dyeing of indigo on cops is, of course, in the first instance a question of the reducing agent to be employed, only perfectly clear and limpid vats being applicable at all. For this reason all those vats working with insoluble reducing agents, such as the ferrous hydroxide (ferrous sulphate) vat, the zinc-dust vat, or the fermented vats, cannot be used. Of course it would be possible to filter from the insoluble sediments in these vats the clear solutions of indigo white, but as these solutions would then no longer be in contact with reducing agents, oxidation of the indigo white would result in a considerable degree during the circulation of the vat in the machine and through the cops, which would be badly dyed, and contain a large amount of loose dye. To avoid this we shall have to use a vat which is working with a soluble reducing agent, and which accordingly accompanies the indigo white everywhere. This condition hydrosulphite of soda fulfils in the most excellent manner, and, indeed, all attempts that have been made up to now to dye indigo upon cops have been made with the hydrosulphite vat. The preparation of this vat is so well known that we need not concern ourselves with it, and, moreover, there are now concentrated solutions of hydrosulphite in the market which reduce the preparation of the vat itself to a very simple operation.

The dyeing of the cops by means of this vat is performed by drawing the absolutely clear vat one or more times through the cops, the cops between each immersion being submitted to oxidation by drawing air through them. The formation of some indigo blue outside the fibre is unavoidable in this process, nor can this indigo be prevented from getting subsequently into the baths. Most of it is there reduced again, but it is certainly advisable to provide some filtering arrangement, so as to prevent any of this suspended indigo blue from being deposited upon the outside of the cops. The oxidation of the indigo white fixed in the cops appears to offer no difficulties whatever, and from a purely chemical point of view this is indeed so, the mere drawing of air through the cops being quite sufficient to produce complete oxidation. It is somewhat surprising, however, that the blue obtained under these conditions is greatly lacking in beauty and "bloom."

Another process of performing the oxidation in indigo dyeing has lately been recommended by Flick and

Michaelis, who propose to immerse the yarns in hot ammoniacal water. Also in this method absorbed atmospheric oxygen is the oxidiser. The process, which is said to give excellent results, can also be adapted for cops.

Somewhat remarkable is the great tendency of the indigo vat to dye the cops very unevenly, and also frequently numerous lighter or even white spots are noticeable. These latter invariably appear if the cops are dyed in the grey state. This, of course, is scarcely surprising and can be stopped at once by submitting the cops previous to dyeing to an efficient scouring in alkaline liquors. Much more difficult is it to secure evenness of dyeing, especially in the high-priced dark coppery shades, and I do not believe that the production of these shades can be carried out in a satisfactory manner on any one of those machines circulating the dye-liquor in one direction only through the cops. The unevenness disappears at once if we reverse the circulation alternatively, and the great ease with which this can be done in Crippin and Young's machine I consider one of its most noteworthy features.

For the dyeing of cheap indigo shades the yarns are given, before the vat treatment, a "bottom" of logwood or some suitable coal-tar colour. This principle, of course, is also applicable to cop-dyeing. But it must not be forgotten that it is almost impossible to wash cops as thoroughly as yarns or piece-goods. For this reason only such dyes ought to be employed for these bottoms which are absolutely fast to washing and do not bleed in contact with alkaline liquors, otherwise the vats soon get badly contaminated by dye bleeding off the cops, and I need hardly remark that indigo shades dyed in vats contaminated in this manner lack more or less in brightness. But, altogether, I believe that in the majority of cases it is very much to be preferred in cop-dyeing to produce the cheap shades by topping light indigo shades, instead of dyeing them on a bottom. Better results are obtained in this manner and any possible contamination of the vat is avoided, which is a matter of no small concern.

The indophenol vat if used by itself is scarcely capable of dyeing cotton in a satisfactory manner, the shades being altogether wanting in body and brightness. If, however, a vat be employed containing indigo and indophenol in certain proportions excellent results are obtained, the shades dyed being brighter than with indigo alone and much faster to rubbing and soaping. At the same time the fastness to light is quite as great as that of pure indigo. The management of this vat, as well as its preparation, is identical with that of the indigo vat, but there is, of course, a very substantial economical advantage in the use of the mixed vat, indophenol being so much cheaper than indigo; and as, on the other hand, these mixed shades are in every respect at least equal in fastness to the pure indigo shades, this indigo-indophenol vat deserves much more attention than it has hitherto obtained.

(d).—*Aniline Black.*

The production of aniline black on cops has not passed yet beyond the experimental stage, but we shall not have to wait long for the solution of this important task.

The method of aniline-black dyeing, known as the one-bath process, which is so extensively used in yarn and piece-dyeing, cannot be applied to cop dyeing owing to the unavoidable formation of free aniline black in these baths. Considering the small quantity of cops dyed in one operation in a comparatively very great volume of dye-bath, which applies to all cop-dyeing machines, the one-bath process, through the spontaneous decomposition of the baths, would be exceedingly expensive, and complicated filtering arrangements would be required in order to prevent large quantities of loose aniline black from being deposited on the outside of the cops.

Oxidation aniline black offers no difficulties of the above-mentioned description, but it has not been produced yet on cops in a satisfactory manner. The impregnation of the cops with the bath is, of course, an easy matter, but the difficulties begin with the drying and ageing of the cops, which in the manner previously referred to, causes the constituents of the bath to migrate from the inner to the outer

parts of the cops. If then, subsequently, the aged cops are oxidised in the bichromate bath, a very uneven black is obtained. Apart from this difficulty, the ageing of the impregnated cops proceeds very satisfactorily provided the temperature and moisture of the air be judiciously regulated. Too high a temperature or too low a moisture of the air in the ageing chamber will tender the fibre more or less; and I may say that cops want in this respect more care and precaution than hanks or piece-goods, owing no doubt to the heat accumulating through the oxidation in so non-conducting a material as cotton cops. A temperature of 15 C. on the dry and from 38 to 10 C. on the wet bulb ought never to be exceeded. An excellent black is obtained by the use of aniline fluoride, but the starch which is contained in the aniline-black bath as recommended by Messrs Bayer & Co. must be omitted, it being impossible to force such a bath through the cops. Of the beneficial action of the starch there is, however, no doubt, and I recommend therefore to use in its place for cops dextrine, glucose or glycerin. Unfortunately aniline fluoride possesses properties which render its application in the present cop-dyeing machines absolutely impossible. Wherever this salt comes in contact with iron, copper, brass, phosphorbronze, lead, silicates, (glass, enamels, earthenware) it exerts a most vehement corrosive action.

Steam aniline black applied to cops shows the same difficulties as oxidation black. Also the steaming of the dried cops is much more difficult as might be expected. Considering however, that this black is by far less injurious to the cotton fibre than the oxidation black, I have no doubt that the difficulties preventing its application to cops will be conquered before long.

Some recent aniline black patents of Jagenburg (Fr. Pat. 220,031, 1892), and Mommer are not likely to become of importance in cop-dyeing owing to the unavoidable turbidity of the baths used in these processes, while the casein used in Mommer's process will produce such viscous baths, that it will be almost impossible to force them through the cops.

DISCUSSION.

The CHAIRMAN said Dr. Weber had explained the subject of his paper in such a clear manner that it could not fail to be intelligible to everyone. Still it was a subject so entirely out of the range of ordinary experience that they could hardly expect him (the Chairman) to make any remarks upon it. Looking at the subject from a general point of view it seemed to him that the process depended much more upon mechanical than upon chemical principles. The great difficulty seemed to be to get uniform shades of colour through the dense masses of raw material, and he presumed this was the great difficulty which presented itself to those gentlemen who had occupied themselves in the construction of these machines. He was very much interested in Dr. Weber's remarks about substantive colours as applied to cotton. He had always been of opinion that cotton had no chemical affinity whatever to any dye, and he was very much interested with the cursory remarks with regard to substantive dyes, in the course of which the author stated that the dye was contained in the cell which exists in the centre of the cotton fibre. He would like Dr. Weber to explain how any colouring matters could enter the cotton fibre without affecting the surrounding substance.

Dr. WEBER, in reply to the Chairman's question with regard to the penetration of the dye into the cavities of the cotton, said he had absolute proof of this in some microscopical slides he had prepared showing a section of the thread with the interior entirely filled with dye, but how the dye got into the cell he could not say. It might be that the penetration was due to an osmotic process, but this might hardly be considered a satisfactory explanation. In order to dye cotton perfectly with the substantive dyes, they had to get the dyes into the cavities of the cotton, but before this could be done the air or water in the cavities of the cells must be removed either by producing a vacuum or expelling the air or water by pressure.

In reply to Mr. Thomson, he could only say that dyeing cotton in the grey was certainly more difficult than

dyeing bleached cotton, for reasons he could not fully explain. With regard to Mr. Thomson's further remarks as to the boiling off of the substantive dyes, he could give as an absolute fact within his experience that in a case where the ordinary wood dyes were used they were given up in favour of the substantive dyes. In dyeing drab shades in this manner, dyeing was started at a very low temperature in order to prevent unevenness of the dye. The black fell on splendidly, but when they proceeded to fix it by raising the temperature all the colour came out again. His explanation of this was that dyeing with substantive dyes was not dyeing at all—it was simply staining. They got the colour inside the cotton fibre and there it stuck, but as soon as they treated the hank with water some of the dye came out. They were never able to abstract the whole of the colour. There always seemed to be two antagonistic attractions with regard to these dyes, preventing the complete exhaustion of the dye-baths; and he believed Witt's well-known theory of dyeing was based upon observations made in the dyeing of substantive colours. They could always prove a substantive dye to be present in the cotton in an absolutely free state. If they treated benzidine colours with acid they would change colour. For instance, Congo red turned blue; because while the free acid of Congo red was blue, other benzidine colours had colour acids of the same colour as the dye itself; and that was the reason why some of them are said to be fast to acids, which they are not in a strictly chemical sense. With regard to Mr. Thomson's remark as to dyeing the cotton before it goes on the cops, this was rather a large demand. He would remind Mr. Thomson of the tremendous speed at which the thread travelled in the mule, and which would give no reasonable time for the dyeing. In winding the cops into hanks waste was incurred by breakages and otherwise, and in winding the hanks back into pirns there also was loss. If they dyed in the cop there was no shrinkage possible, and, further, there was no appreciable risk of breakage. In reply to Mr. Hurst he believed he had noticed the effects of some peculiar substances in cotton (the nature of which he did not know) which prevented the dye from entering the fibre.

Newcastle Section.

Chairman: A. Allhusen.

Vice-Chairman: John Pattinson.

Committee:

P. P. Bedson.
G. T. France.
G. Gatheral.
T. W. Hogg.
John Morrison.
B. S. Proctor.

W. W. Proctor.
W. L. Remoldson.
W. A. Rowell.
T. W. Stuart.
John Watson.

Hon. Local Secretary and Treasurer:
Dr. J. T. Dunn, The School, Gateshead.

SESSION 1892-93.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Thursday, December 8th, 1892.

PROFESSOR P. P. BEDSON IN THE CHAIR.

THE VALUATION OF SULPHURIC ACID, CHIEFLY FROM A COMMERCIAL ASPECT.

BY JOHN MORRISON.

THOUGH the production of pyrites vitriol is a process not less than fourscore years old, I question whether there is a manufacturer to-day who can prove that he knows, by any positive method of estimation, and within, say, 10 per cent. of its present commercial value, what his acid costs him per ton; and it is something to be regretted that in detailing Leblanc process results, the only recognised practical course is to ignore the vitriol chambers altogether, and to tabulate merely the quantity of salt-cake or alkali which a given amount of sulphur consumed will produce. This—even if in other respects unobjectionable—is somewhat unfair, inasmuch as it debits to sulphuric acid instead of to sulphate of soda—or in other words to *vitriol made* instead of to *vitriol consumed*—the acid volatilised in the salt-cake process.

There are of course considerable difficulties in the way of estimating large process bulks, and chamber areas of liquid of such variable density and temperature; for even supposing—which is very far from the case—that the acid in a single chamber is of uniform specific gravity, a “dipping” error of a single tenth of an inch may involve a discrepancy of 10 or 15 cwt. of “O.V.”

Yet bearing in mind, that in many processes cheap vitriol is the real hinge upon which financial success turns; that, as regards the chemical manure trade, the sale of superphosphates is little more than a dry way of selling sulphuric acid; and that the vitriol traffic in this country is of considerable importance; it must surely be regretted that some standard and universally acceptable method has not ere this been devised for estimating, otherwise than negatively, and within reasonable limits of accuracy, the cost of a ton of vitriol in terms of itself. For until the manufacturing cost of vitriol becomes correctly determinable, the sale price can never be perfectly equitable.

One of the first difficulties perhaps, is an agreement as to the calculative *standard of strength*. If absolute H_2SO_4 be fixed on, then there is the objection that it is practically non-existent, and that its specific gravity is uncertain; and in fact any strength over $150^\circ Tw.$ has the disadvantage of

representing what I might term a *rectified* rather than a *chamber* or a *Glover tower* standard. This objection possibly is not serious, yet it would certainly have some weight where the manufacture and sale of both these acids was simultaneously carried on. But whatever universal standard be selected, it should at all events not only meet both buyers' and sellers' views, but be one to which all acid process results could be systematically reduced. I question, therefore, whether any other than an “O.V.” or absolute H_2SO_4 standard is ever likely to be generally enforced.

Then there is the *hydrometer* difficulty. The hydrometer in common use is, I am afraid, distinguishable rather by its cheapness than by its reliability; for when compared with standard instruments, errors of 2° or 3° are by no means uncommon. And besides this, its paper scale—as is well known—occasionally glides from its allotted position, and under the most favourable circumstances its register is, I am afraid, decidedly against the vitriol consumer.

Next come the *calculating table* difficulties, and it is something of a disgrace that no standard tables are in universal adoption. Probably the best published tables are those of Lunge and Isler, given in the Journal of May 1890. These have been, I believe, introduced into some of the U. A. Co.'s works, but the tables in more general use are for the most part extremely antiquated. Indeed all the tables with which I am familiar yield excessive results for commercial acid, because of their ostensible reference to chemically pure vitriol only. If there were but one existing table, the position would not be so bad, but there are to the front not only the tables of various original investigators, but sundry illegitimate offspring of which the parentage is exceedingly difficult to trace. And surely the time has arrived for the elaboration or selection of a set of tables fairly applicable to the denitrated Spanish pyrites of commerce, the purity of which at ordinary merchantable strengths cannot be very variable.

The tables in use are not only discordant, but exhibit also unequal ratios of variation between successive specific gravities. That any substantial irregularities really exist, seems hardly likely, and if they do not, surely their elimination from accepted tables is highly desirable.

As illustrating these discrepancies, I may take five of these tables: A = one used in a Tyneside works; B = Kolb's table as given by Lunge; C = Otto's table in Bayley's Chemist's Pocket Book; D = an unidentified table from the Chemical Trade Journal of September 24, 1892; and E = the Lunge and Isler table already mentioned. From these several tables, therefore, we obtain the following particulars:—

° Tw.	Specific Gravity.	Lb. of H_2SO_4 in One Cubic Foot.					° Tw.	Increase in Lb. H_2SO_4 per cubic Foot.				
		A.	B.	C.	D.	E.		A.	B.	C.	D.	E.
100	1.500	57.45	55.94	56.22	55.99	55.97	100/110	6.40	6.45	5.97	6.31	6.28
110	1.550	63.85	62.39	62.19	62.30	62.25	110/120	6.30	6.33	7.16	6.16	6.26
120	1.600	70.15	68.72	69.35	68.46	68.51	120/130	6.84	6.67	5.88	6.58	6.58
130	1.650	76.99	75.39	75.23	75.04	75.09	130/140	6.84	6.21	6.68	7.31	6.90
140	1.700	83.83	81.60	81.91	82.35	81.90	140/150	7.10	7.60	6.93	6.53	7.21
150	1.750	90.93	89.20	88.84	88.88	89.20	100/150	33.48	33.26	32.62	32.89	33.23

Tables B, C, and E deal with a temperature standard of $15^\circ C.$ (= $59^\circ Fahr.$), but the standards for A and D are not stated. Also tables A, C, and D assume a cubic foot of water to weigh 62.36 lb. or thereabouts, while tables B and E put it at $62\frac{1}{2}$ lb.*

For commercial purposes the *temperature standard* of this country is $60^\circ Fahr.$ And this will be perfectly convenient so long as the Fahrenheit scale remains in favour.

The *water standard* also for that temperature is $62\frac{1}{2}$ lb. per cubic foot, which is equally convenient, if only it be reasonably accurate. That it is so I am unable to say. But inasmuch as the steam entering the sulphuric acid chambers, either direct or from the Glover towers, cannot vary very much in purity, I think the water standard might with advantage be reinvestigated and verified, as it is in all probability somewhat high.

The handling and transit of sulphuric acid are now accomplished by far different methods from those prevalent 25 to 30 years ago. At that time delivery in fragile earby tubs, weighing nearly half as much as the liquid they

* Some manufacturers I may remark, use as a sort of calculative starting point 1 cub. ft. $120^\circ Tw.$ acid = 100 lb., and contains 70 lb. “O. V.”

contained, was customary. But now carboys have to a large extent given place to wrought-iron tanks lined with lead, or, more recently, to unlined tanks of steel, from which the acid can quickly and tidily be discharged by gravity or compressed air.

This change has necessitated the estimation of weight by gauging and calculation, and it is here that a correct water standard, as well as an accurate hydrometer observation, is of importance.

Having first carefully taken the strength of the acid, and ascertained the quantity in cubic feet discharged into the tank, it is only necessary to multiply the latter by the lb. of water in 1 cubic foot at 60° F., and the result by the specific gravity calculated from the hydrometer strength. This gives the dead weight in lb., so that the only question left is the determination of the selling strength. Here a temperature correction is usually needful, because the acid is presumably sold on the definite temperature basis of the water, in relation to which the acid weight has been computed. If this were not so, it would be to the seller's interest to refrigerate the acid, and to the buyer's to have it delivered hot. Hence commercially the acid is assumed to rise 1° Tw. in strength per 10° F. fall (or vice versa) in temperature. And in accordance with this, all necessary strength adjustments must be made. But of course the corrections must be made *after* the ascertainment of the weight, because the weight of acid obtained (as just mentioned) from the specific gravity *at the actual temperature at the time of observation*, gives the weight as compared with the 60° F. water standard adopted, and variations in the acid temperature being inversely proportionate to variations in the specific gravity, the two neutralise each other, and so have no ultimate effect upon the acid weight.

So far, therefore, the vitriol selling business is pretty fair sailing. But the chief difficulties are yet to be described.

If sulphuric acid be sold (as it almost invariably is) at so much per Twaddell-degree-ton, I think it may fairly be assumed that Chamber and Glover tower acids possess commercially a purely H_2SO_4 strength pro rata value, and that the loss of nitrogen to the manufacturer selling chamber acid (from at all events the strong chamber)

something like counterbalances the extra expenses involved by the sale of denitrated vitriol.

I am of course aware that this does not fully represent matters in the case of a salt-eake and bleaching powder maker disposing only of his surplus vitriol, inasmuch as for decomposing purposes the stronger acid of the Glover tower is naturally the acid he prefers retaining for his own use. But with this trifling exception, which is technical rather than commercial, I think the assumption may pass. In fact, that acid from say 120° to 150° Tw. possesses commercially an even *pro rata* H_2SO_4 strength value, is proven to a pretty conclusive degree (though in a negative way) by the adoption of high standards in those selling centres where acid is cheapest. For vitriol has to my certain knowledge been sold this year in quantity at 2s. 6d. per ton less for 140° Tw. in one district, and only 3d. per ton more for 148° Tw. in another district, than the lowest price at which I believe it has been sold in a third district for 120° Tw.; all of these districts being of substantially equal importance, and the last-named—as regards the economy of production—being, I am satisfied, the most favoured of the three.

Sulphuric acid then is sold upon a Twaddell basis which varies in different localities. In some, 120° Tw. prevails, and in others, strengths varying from 140° to 150° Tw. are customary.

Occasionally inequalities in delivered strengths are reduced to the fixed basis before invoicing. But far more usually variations of strength are charged at the *pro rata* price per Twaddell degree (or unit) ton.

Thus, if the agreed price be, say, 22s. 6d. per ton of 120° acid (= 2½d. per unit), the cost of the acid = 24s. 4½d. on 130°; 26s. 3d. on 140°; 28s. 1½d. on 150° Tw.; and proportionally as regards the strengths between.

The reduction-to-a-fixed-standard method is, however, by far the best, as a variety of invoicing strengths greatly confuses and prejudices the manufacturing accounts of both buyer and seller.

But to show the effect of the already quoted tables upon the usual method of acid selling, I will give the figures from 100° to 150° Tw. at 10° intervals on the price basis just mentioned.

Tw.	Cubic Feet in one Ton of Acid.					Lb. of Absolute H_2SO_4 in one Ton Acid.				
	A. C. and D.	B. and E.	A.	B.	C.	D.	E.			
100	23'94	23'89	1375'35	1336'49	1345'90	1340'40	1339'92			
110	23'17	23'12	1470'40	1442'45	1440'94	1443'49	1442'33			
120	22'45	22'40	1574'87	1539'32	1556'91	1536'93	1538'65			
130	21'77	21'72	1676'07	1637'47	1637'75	1633'62	1634'71			
140	21'13	21'08	1771'33	1720'13	1730'76	1740'05	1732'45			
150	20'52	20'48	1865'88	1826'81	1822'99	1823'82	1830'38			

Tw.	Price per Ton on per Unit Basis.	Price per Ton at 22s. 6d. on 120° Tw. Acid on Basis of actual H_2SO_4 according to Tables.					Average per Ton in favour of Seller on Unit Basis of Sale.	Price per Ton at 28s. 1½d. on 150° Tw. Acid on Basis of actual H_2SO_4 according to Tables.					Average per Ton in favour of Buyer on Unit Basis of Sale.
		A.	B.	C.	D.	E.		A.	B.	C.	D.	E.	
100	s. d. 18 9	s. d. 19 7½	s. d. 19 6½	s. d. 19 5½	s. d. 19 7½	s. d. 19 7¼	s. d. *0 9½	s. d. 20 8½	s. d. 20 7	s. d. 20 9	s. d. 20 8	s. d. 20 7	s. d. 1 11
110	20 7½	21 1½	21 1	20 9½	21 1½	21 1	*0 5	22 3½	22 2½	22 2½	22 3	22 2	1 7½
120	22 6	22 6	22 6	22 6	22 6	22 6	Basis	24 1½	24 1½	24 5½	24 1½	23 4	1 6½
130	24 1½	23 11½	23 11	23 8	23 11	23 10½	0 6	25 9½	25 2½	25 3	25 2½	25 1½	0 11
140	26 3	25 3½	25 1½	25 0	25 5½	25 4	1 0	26 8½	26 5½	26 9½	26 10	23 7½	0 5½
150	28 1½	26 7½	26 8½	26 4	26 8½	26 9½	1 6	28 1½	28 1½	28 1½	28 1½	28 1½	Basis.

* Of course in the two *below basis* strengths given in the first section of this table, the variation is in the same direction (*i.e.*, against the seller) as that in the second section of the table.

These figures shew an average of $\text{£}1\ 6\ 7\frac{1}{2} = 1\text{s. } 6\frac{1}{2}\text{d.}$ per ton against the buyer, where the standard is 120°Tw. , and the delivered acid is 150°Tw. ; or $\text{£}1\ 0\ 8 = 1\text{s. } 11\text{d.}$ per ton against the seller where the standard is 150°Tw. , and the delivered acid is 120°Tw. And as will be also observed, the error is slightly erratic in one or two of the intervening strengths.

The discrepancy is of course due to the degrees Tw. varying one-third more rapidly than the percentage of O.V. in the successive specific gravities which they indicate. And the remedy appears to me to lie in the direction of the entire abolition of the Tw. degree pro-rata method of sale; the selling universally on H_2SO_4 ; and the correction of all acid deliveries before invoicing to their H_2SO_4 or "O.V." equivalent.

It may be said that the discrepancy is not serious, but it *will* be serious when the price of pyrites is advanced, and that of vitriol follows suit. Indeed it is already serious in the chemical manure trade at a time like the present, when every penny saved in the production of a ton of superphosphate is of importance. And in any case, the mere pecuniary assessment of the value of chemical discrepancies is too often a depraved and unjust judgment. Besides, it must be recollected that the maximum possible error is not the *difference*, but the *sum* of the several possible erroneous elements contributed by the use of inaccurate hydrometers, incorrect water-standards, and doubtful tables never intended for commercial oil of vitriol.

It may be also urged that the selling basis is usually fixed at somewhere near the average delivered strength of the particular contract or district. But vitriol is frequently sold on a simple minimum Twaddell guarantee, with no over-strength restrictions, so that the deliveries oscillate between the acids of the chambers or Glover Towers, just as suits the variable convenience of the manufacturer. To most large buyers, the higher sp. grs. are solely of consequence from the saving in transit which they secure. And what chiefly rules the minimum strength is the action of acid under 126° to 130°Tw. upon the steel tanks in which deliveries are made. Indeed to the manure maker, strengths approaching 140° to 150°Tw. are positively objectionable, inasmuch as strong acid is not quickly miscible with water, and so results in irregularities in the superphosphates for the production of which it is supplied.

There can then I think be no question that vitriol should universally be sold and invoiced at per ton of "O.V."; the margins of delivery strengths being arranged to suit both buyer and seller; and of course an extra charge being made for rectified and non-arsenical acids; and carriage being charged in all cases on dead weight. It may be pleaded that this would introduce extra calculations, but they would be avoidable with suitably prepared reduction tables. And even for some slight additional tax on clerical forbearance, there would be the abundant reward of greater accuracy and consistency in the process and costs books of both makers and consumers.

But in the event of such a wholesome reform being agreed on, all the more need would arise for standard calculating tables, showing as far as may be evenly progressive variations of H_2SO_4 between the several Twaddell degrees. And towards the furtherance of such a reform, I for one would like to see the appointment of a strong representative committee of acid manufacturers, sellers, and purchasers, to legislate not only upon the tables, but upon the hydrometers, and the temperature and water standards of the future.

Dorsetshire Section.

Chairman: Sir James Kitson, Bart., M.P.

Vice-Chairman: Dr. F. H. Bowman.

Committee:

A. H. Allen.	J. Lewkowitsch.
J. B. Cohen.	F. W. Richardson.
T. Fairley.	Jas. Sharp.
A. Hess.	G. W. Slatter.
R. Holliday.	G. Ward.
J. J. Hummel.	F. B. Wilkinson.

Hon. Local Secretary:

H. R. Procter, Yorkshire College, Leeds.

Notices of Papers and Communications should be addressed to the Hon. Local Secretary.

Meeting held at the Yorkshire College, Monday,
December 5th, 1892.

MR. JAS. SHARP IN THE CHAIR.

PRIMITIVE MODES OF DYEING.

BY PROFESSOR J. J. HUMMEL.

(Abstract.)

PROFESSOR HUMMEL gave a communication with regard to primitive modes of dyeing, which he illustrated by specimens. He first described the methods of dyeing practised by the Timanees and Mendis races of Africans living about 200 miles inland from Free Town on the Sierra Leone coast. For vat-blue on cotton yarn they employ the leaves of a large forest shrub, *Lonchocarpus cyaneus*, which are rubbed in the hand till they become blue, and then dried. In use, the dried leaves are mixed with water and the ashes of some plant which no doubt yields the necessary alkali, so that in principle the process is similar to that employed in Europe. Yellow and brown cotton are dyed by simply steeping in infusions of certain barks, the origin of which is unknown. The natives have no knowledge of the use of mordants, and do not apply camwood, which abounds in the district, although they have no red dye.

A brief description of the methods practised by the Maoris (this Journal, 1, 1882, 170) was next given, and samples of dyed mats, of the barks used, and of the black mud of certain swamps were shown. The barks yield small percentages of tannic acid, and the mud contains iron, partly in solution. The colours produced on the *Phormium tenax* fibre are various shades of grey and black, and the methods are interesting as showing in all probability the origin of the application of mordants, the principle involved being that still in use in Europe for the dyeing of tannin and iron blacks.

The "Batick" dyeing of the Javanese, and the "knot dyeing" of the Hindoos were also described and illustrated by specimens. In the first of these the dyeing of certain portions of the fabric is prevented by a wax resist painted on by hand; in the second by tying up with thread; and in both cases effects are produced which prove impossible to imitate satisfactorily by the processes in ordinary use in Europe.

DISCUSSION.

The CHAIRMAN commented upon the specimens of primitive dyeing exhibited, and made mention of methods adopted in England to achieve the same results. The method of "knot-dyeing" finds a limited application here, being used to mark the ends of the pieces with symbols indicating the quality of the material, or with the trade-mark of the manufacturing firm. The goods for the Java market are mostly in loose colours, "steam-work" being largely used.

Mr. RAWSON inquired how the fermentation of the dye-stuff was started on the West Coast of Africa.

Mr. SLATFER thought that the "alum-water" obtained by the West Africans from the ashes of the leaves of a certain tree could hardly contain alum, clubmoss being the only plant at present known to absorb aluminium.

Mr. F. W. RICHARDSON enquired if there were two separate fermentations in the process of indigo-dyeing employed by the natives of West Africa. Had the microbe of the indigo ferment been isolated?

A Member asked how the black in the Japanese specimens were obtained. It had rather the appearance of a brown possibly owing to fading of the colour.

Mr. PROCTER remarked that the tanekeha bark used for dyeing yellow in New Zealand was identical with the "golden-tan" bark used in this country for dyeing leather, especially kid.

Professor HUMMEL, in reply, stated that he had no information as to how the fermentation of the dye was induced on the West Coast of Africa. As to the "alum-water," mordants were unknown in this district, and it was probably the alkali in the ashes of the leaves that acted as a developer of the dye. In the indigo-dyeing there were two distinct fermentations: one when the leaves were rubbed in the hand and stored, the indican being broken up and indigo-blue formed; and a second when the leaves were steeped in water along with the fabric to be dyed: in this latter process the indigo-blue was reduced and rendered soluble. As to how the black in the Japanese specimens was obtained he could not say; Chinese black was not dyed, but painted on.

Mr. RAWSON then described a new form of dyeing-vat designed by Messrs. Smith and Whittaker (see Journal of the Society of Dyers and Colourists, January, 1893). At one end the dyewood is contained in a perforated box, and at the other steam is blown in, and the water is thus heated to boiling, and a current created which is directed so as to flow over and through the fabric to be dyed, and then through the dye-wood in the box and back again. If the water is already boiling when fresh wood is put in, 60-66 per cent. of the colouring matter is removed in four minutes.

Obituary.

WILLIAM NATHANIEL EVANS.

A MEMBER OF THE SOCIETY OF CHEMICAL INDUSTRY.

WILLIAM NATHANIEL EVANS, of Bristol, was born in 1826, at Ottery St. Mary, and came of an old Devonshire family. The greater part of his life was devoted to the manufacture of leather, but his strongly developed scientific tendencies led him early to study chemistry, and to apply it to the trade in which he was interested and in the technology of which he became a considerable authority. He started, and for some time edited the journal *Leather*, and was the writer of the article on "Leather" in Mackenzie's "Chemistry applied to the Arts and Manufactures," and also of a very useful text-book on "Burr Tanning" and made and published many analyses of new tanning products, and especially of those collected at the Indian and Colonial Exhibition. He was an earnest advocate of scientific and technical education, and his kindness and readiness to impart information to others will make his death felt as a personal loss by many outside the circle of his immediate friends. He died at Bristol on Sunday, October 23rd.

—H. R. P.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Improvements in and relating to Apparatus for Expressing Liquids from Vegetable, Animal, or Mineral Substances. H. H. Lake, London. From La Société Anonyme du Compresseur Jourdan, Paris. Eng. Pat. 17,886, October 19, 1891.

See under XII., page 1017.

Improvements in Apparatus for Evaporating, Condensing, and the like. G. Y. Blair, Stockton-on-Tees. Eng. Pat. 20,125, November 19, 1891.

THIS patent refers to means for cleaning or changing the coils in evaporators or similar apparatus in which special coils are used enclosed within an upright vessel. The coils are placed around a common centre upon a revolving trunnion with arms through which the steam has free access to them, and they may be successively brought opposite a door or opening in the vessel when required for examination, cleansing, or removal.—B.

Improvements in Apparatus for Producing Cold in or Freezing Liquids. J. W. Bowley, London. Eng. Pat. 20,563, November 26, 1891.

IN this apparatus the vessel holding the freezing mixture is traversed by horizontal tubes through which the liquid or material for cooling is passed. Each tube is provided with a screw conveyor, which in revolving effects a rapid equalisation of temperature and acceleration of the process.—B.

* Any of these specifications may be obtained by post by remitting 5s.—the price now fixed for all specifications, postage included—to Sir Henry Reader Luck, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

Improvements in Thermometers. J. Dawson, Rochdale.
Eng. Pat. 21,157, December 4, 1891.

THE object of this invention is to provide a thermometer better adapted to withstand the rough usage and sudden changes of temperature to which they are liable to be exposed in dye-vats, &c. A collar is formed on the glass thermometer tube about one-third of the length from the top; the lower part of the tube is mounted in a metal casing by means of india-rubber washers; the upper part of the tube is fitted with a scale in an enlarged continuation of the metal casing, and an index finger is provided, which may be adjusted from the outside by means of a key fitting the end of a traversing screw.—J. C. C.

Improvements in Bottles or Holders for the Storage and Conveyance of Quicksilver, Gas, and other Fluids under High Pressure, and in the Method of Manufacture thereof. J. Brotherton, Wolverhampton, and W. Griffith, Sheffield. Eng. Pat. 21,507, December 9, 1891.

THIS invention relates to an improved method for securing the tops and bottoms to metallic holders or bottles used for

storing quicksilver or gases under high pressure. The ends of the cylindrical tubes forming the holder are drawn or forged into a conical shape so as to leave the ends into which the plugs are fastened of smaller diameter than that of the tubes. These holes are slightly bell-mouthed and sometimes beaded, and the end pieces made to fit, when they are welded together with the aid of tools of special shape.—B.

Improvements in Filtering Apparatus. P. A. Newton, London. From M. Weigel, Tetschen, Bohemia, Austria.
Eng. Pat. 21,714, December 11, 1891.

IN this apparatus the filtration is effected by means of fibrous material, or cellulose, which at the commencement is added to the water to be filtered, and is deposited on the side surfaces, so as to form filtering beds for the remainder of the liquid. The accompanying illustrations show the arrangement recommended.

IN the tank *a* are placed filtering frames *s* covered on both sides with wire gauze and fitted with perforated drainage tubes *t*, which communicate with the exit chamber *c*.

Fig. 1.

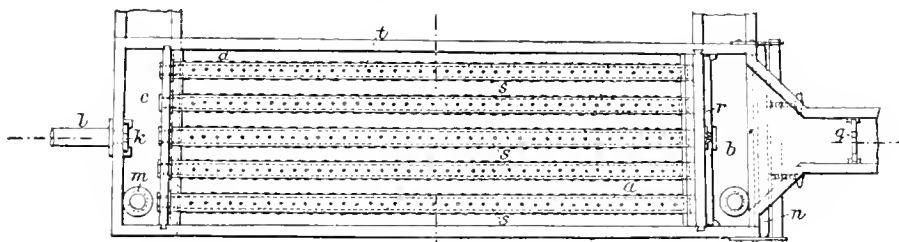


Fig. 3.

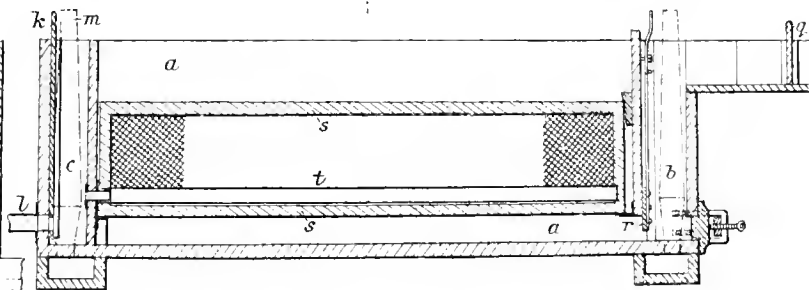
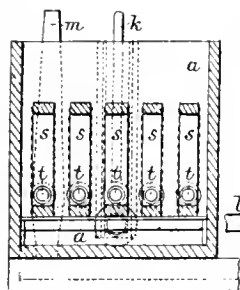


Fig. 2.

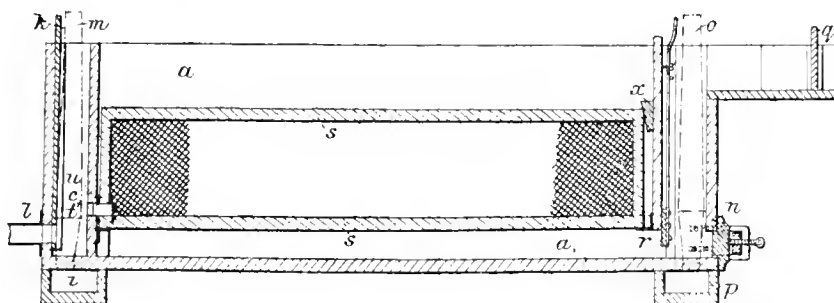


Fig. 4.

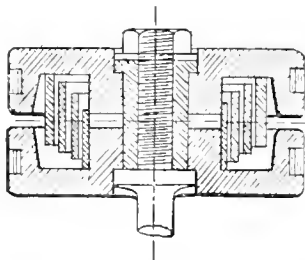
IMPROVEMENTS IN FILTERING APPARATUS.

Here there is an outlet tube *l*, fitted with sluice *k* and an outlet with plug *m*. The inlet chamber *b* is fitted with sluices *q* and *r* for regulation of the supply, and with openings for cleaning. At starting, the outlet *m* is left open in order to allow turbid liquid to be drawn off separately, until the actual filtering surfaces have been formed, when the liquid commences to run clear and is allowed to leave through the pipe *l*.—B.

Improvements in Air Compressors. S. H. Johnson and C. H. Hutchinson, Stratford. Eng. Pat. 3, January 1, 1892.

IN order to avoid the waste spaces between the reciprocating piston of an air compressor and the cylinder covers when it reaches the end of the stroke, the patentees allow the piston to come in contact with the end covers. In order to accomplish this without danger of breakage they construct

the body of the piston in such a manner as to allow the end to yield on striking the covers, as will be seen from the accompanying illustration. They also use large gridiron



IMPROVEMENTS IN AIR COMPRESSORS.

valves of light construction, having a low lift, in order to secure a high piston speed, with little wear on the valves.—B.

Improvements in Stores or Apparatus for Drying Skins, Malt, Phosphates, and Animal, Vegetable, and Mineral Products. A. Rübenkamp, Dortmund, Germany. Eng. Pat. 9992, May 26, 1892.

THE object of this invention is to avoid the great loss of heat from drying stoves when the products of combustion and the hot air are allowed to escape directly into the atmosphere, and to effect a gradual cooling of the goods under treatment.

The air for drying the goods passes through pipes or channels arranged in a closed furnace chamber. The air thus heated having been led through the drying chamber is brought back to the closed furnace, where it effects combustion of the fuel. The products of combustion are not conducted directly to the chimney, but are passed through the heating tubes of a second apparatus, to which it gives up portion of its heat. When the goods in the first chamber are dry they are allowed to cool slowly by diverting the heat to the second chamber, which is then brought into use. The drying chambers may be arranged in series and the air heated by a central furnace. One advantage of the apparatus is that the noxious gases, given off by the goods under treatment, are burnt in the furnace, and thus rendered innocuous.—D. A. S.

Improvements in Apparatus for Grinding, Crushing, Pulverising, or Disintegrating. J. U. Askham, Shetfield. Eng. Pat. 14,663, August 13, 1892.

THE described improvements are in grinding mills of the roller centrifugal class of machine. The specification describes detachable wearing surfaces for the drivers, cylindrical grinding paths formed in parts, and arrangements of feed-hoppers, to avoid their removal during repairs to the machine.—J. C. C.

Improvements in Steam Superheating Apparatus and Appliances in connection therewith. L. Uhler and H. Cadische, Bâle, Switzerland. Eng. Pat. 15,308, August 25, 1892.

THIS specification proposes certain improvements in the apparatus described in Eng. Pat. 12,372, 1890. The tubes are placed horizontally instead of vertically, and by a series of tubes or bars are protected against excessive heating; the fire may therefore be brought nearer, and a better utilisation of heat effected. Besides other improvements, an apparatus is described for drying and purifying the steam before entering the superheater.—J. C. C.

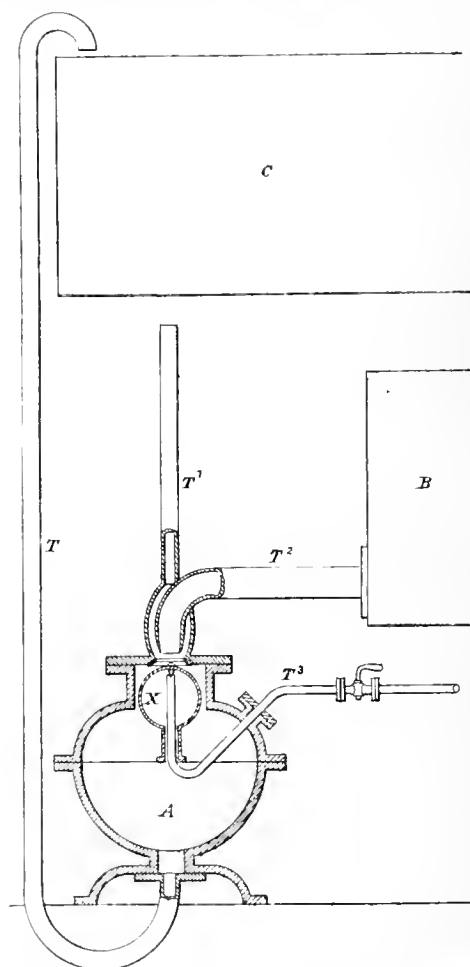
Improvements in Furnaces. J. Sargent, Rochester, U.S.A. Eng. Pat. 15,514, August 30, 1892.

THIS patent relates to furnaces in which, when the doors are opened to apply fresh fuel, a jet of steam is turned on over the fire and air is admitted over the fire to produce

combustion of the smoke. The improvement consists in the application of a time mechanism, whereby steam is turned on; a supplementary furnace door is opened, and the time mechanism wound up by opening the main door of the furnace. The time mechanism is provided with suitable connections for turning off the steam and for closing the supplementary door at the end of a given period.—F. S. K.

Self-Acting Apparatus for Raising Liquid by Compressed Air or other Elastic Fluid under Pressure. P. Kestner, Lille, France. Eng. Pat. 15,648, August 31, 1892.

B is a vessel supplying the liquid to be raised to the cistern C by means of compressed air supplied by the pipe T_3 . On the vertical limb of this pipe, within the vessel A, is a float X, which closes the pipe T_3 , unless it is buoyed up by liquid, and when raised by the liquid which enters the vessel A closes the inlet from the pipe T_2 . The action is as follows: When the vessel A is being filled by



SELF-ACTING APPARATUS FOR RAISING LIQUID BY COMPRESSED AIR.

liquid from the pipe T_2 , air escapes by T_1 until the float X closing T_1 and T_2 opens T_3 . Compressed air now enters A, and forces the liquid up the pipe T until A is emptied of liquid, and air escapes up T, relieving the pressure in A, whereupon the float X drops, closing T_3 and opening T_1 and T_2 ; and the action is repeated.—J. C. C.

An Improved Universal Thermometer. E. Edwards, London. From H. Hartl, Reichenberg, Bohemia. Eng. Pat. 12,553, July 7, 1892.

THE object of this invention is to provide means by which—

1. The temperature indicated by the thermometer may be read off directly.
2. This indication may be registered at a distant room or station.
3. The thermometer may be adjusted for any temperature so that a rise or fall of the mercury of 1° — 2° C. also may be indicated at a distant station.

The details of the invention cannot be described without reference to the drawings.—J. C. C.

II.—FUEL, GAS, AND LIGHT.

Calorific Power of Coal, and Formula by which it is Calculated. Scheurer-Kestner. Bull. Soc. Chim. 7—8, 1892, 475—480.

THE experiments of the author and Meunier-Dollfus have clearly demonstrated that it is impossible to determine accurately the calorific power of a combustible mineral, except by experiment, and that any value, calculated from the composition of the substance, is in every case uncertain. In the present paper the author controverts a statement made by Bunte in Schilling's Journal, that the calorific power of a coal can be calculated with a sufficient degree of accuracy by employing the old formula of Dulong; he gives specific instances, showing that the calculated value is sometimes as much as 6 per cent. higher or lower than the actual value determined experimentally. He also describes experiments which prove that Berthier's method of determining the calorific value of a coal is most inaccurate.—F. S. K.

On the Formation of Petroleum. Engler. Austrian Society of Chemical Industry, Meeting of June 4, 1892. Chem. Zeit. 16, 1892, 843—844.

THERE have been a number of theories put forward to account for the formation of petroleum; Mendelejeff considers it to be formed by the decomposition of a carbide of iron by steam, ferric oxide and a hydrocarbon being produced; Sokoloff, by a combination of carbon and hydrogen; Ross by the reaction of sulphuretted hydrogen and calcium carbonate; Daubrée by the decomposition of vegetable matter. The author is inclined to consider it produced by the decomposition of animal substances; it is possible to obtain petroleum by distilling animal matter under pressure. (This Journal, 1891, 753, 979, and 980).—A. L. S.

The Combustion of Gaseous Mixtures. P. Askenasy and V. Meyer. Annalen, 269, 49—72.

See under XXIII., page 1039.

The Behaviour of Ethylene on Explosion with less than its own Volume of Oxygen. B. Lean and W. A. Bone. Proc. Chem. Soc. 1892, 115, 144.

AFTER giving a brief account of previous observations, the authors describe a series of experiments in which mixtures of ethylene with its own or a less volume of oxygen were fired in a leaden coil. Their results are in agreement with those of Dalton, Kersten, and E. von Meyer, and show that, when fired with about its own volume of oxygen, ethylene yields mainly carbonic oxide and hydrogen as the final result; but they have also observed that methane, acetylene, and carbon are produced.

The following are the tabulated results of the analyses :—

Composition of Mixture.	C.	D.	E.	F.	G.
Ethylene	56.03	51.18	49.77	48.64	49.41
Oxygen	39.16	41.52	45.81	45.84	47.69
Nitrogen	4.51	4.30	4.42	5.52	2.90

Composition of Product.	C.	D.	E.	F.	G.
Unsaturated hydrocarbons ..	5.53	3.77	2.78	2.14	..
Methane	5.96	3.77	2.52	2.55	1.01
Carbon dioxide	1.63	2.80	1.24	0.94	0.33
„ monoxide	38.85	44.84	47.79	46.53	49.11
Hydrogen	43.30	41.72	43.32	45.35	48.78
Nitrogen	5.16	3.10	2.35	2.49	1.01

Incidentally it is shown that oxygen is appreciably absorbed by fuming sulphuric acid, but that neither strong potash nor alkaline pyrogallol solution appreciably affects ethylene.

PATENTS.

Improvements in or Relating to the Manufacture of Coke.

Sir G. Elliot, London, and J. MacGowan, jun., Stoke-on-Trent, Staffordshire. Eng. Pat. 19,758, November 14, 1891.

By employing the apparatus and method of coking described in this patent it is claimed that the percentage of sulphur in coke can be reduced and the commercial value of the fuel increased; if desired the sulphur may be recovered.

Any convenient form of coke oven may be employed. The fumes from the chimney at the top are first carried to the end of the furnace, and are then caused to pass through a series of flues underneath the floor of the oven so that their heat may be utilised; they then pass away into the main flue. The flues underneath the floor of one oven are connected by bye-pass flues to those of the other ovens, so that the waste heat can be utilised for maintaining the temperature when necessary.

“In the lower portion of the oven is a pipe connected with any suitable form of exhaust fan or suction apparatus, by which the sulphur and heavier gases, which would collect in the lower part of the oven and would not be removed by the upper flue, can be drawn off. This drawing off we prefer only to effect at the termination of the coking process, and, if desired, after the admission of steam and water to the contents of the oven.”

In the lower corner of the oven a number of tiles are arranged obliquely at slight intervals apart, “so that the heavy sulphurous fumes may readily have access to the pipe provided for their removal at or below the level of the floor.”—F. S. K.

Improvements in Feeding Fuel to Gas Producers, and in the Generation of Combustible Gas. J. Hargreaves, Widnes. Eng. Pat. 20,573, November 26, 1891.

THE fuel is fed into the producer from the bottom upwards, at a point preferably above and in front of the nozzle, through which the air and steam are supplied, in such a manner that the fuel piles itself up into the body of the producer. The inventor claims also the combination of this system with the supply of measured quantities of air and fuel, and with steam to gas producers, so as to obtain a desired quality of evolved gas.

Any suitable feed and measuring appliances for solid fuel and air may be used.—D. A. S.

Improvements in Coke Ovens to Facilitate the Cooling of the Coke before Drawing. C. E. Bell, Durham. Eng. Pat. 22,106, December 17, 1891.

THE usual method of cooling coke prior to its withdrawal from the oven is to spray water over it from the top by means of a long perforated pipe coupled to a flexible water supply main and worked by hand. In this patent the method of cooling is improved by making use of a water pipe which is fixed within the arched radial passage of the oven, or introduced into the opening at the top of the domed roof of the oven: this pipe is provided with a rose or perforated end so that after opening the oven and turning on the water the spray falls over the whole upper surface of the coke.—F. S. K.

Improvements in Supplying Heated Air to Steam Generating and other Furnaces. G. W. Hawksley, Sheffield. Eng. Pat. 22,208, December 19, 1891.

THE object of this invention is to supply a stream of heated air in such a manner as to cause the more perfect combustion of the unburnt gases, and so reduce the production of smoke and increase the draught.

An air tube or conduit is fixed near the crown of the flue and runs longitudinally with it over the fire-box, terminating in a nozzle or spreader at some little distance from the bridge. The front end of the tube is conveniently formed to receive a small jet of steam or compressed air. When the jet is turned on a current of steam and air, or of air alone, is forced along the hot pipe and expelled from the nozzle in a sheet across the heated gases.—D. A. S.

Improvements in Artificial Fuel. C. Winter, Tottenham. Eng. Pat. 16,322, September 12, 1892.

IN the manufacture of this artificial fuel any kind of refuse vegetable matter is used, in combination with lime or cement, and refuse cocoa-nut fibre or refuse tan, and coal or coke dust. The selected ingredients, when intimately mixed together, form a plastic compound, which is pressed into blocks and allowed to set hard. The inventor claims that one ton of these blocks will give off, during combustion, an amount of heat equal to that emitted by a ton of the best household coal.—D. A. S.

Improvements in Apparatus for Simultaneously Burning both the Light and Heavy Portions of Vaporisable Oils at one Burner. W. P. Thompson, Liverpool. From G. H. Harvey, G. F. Perrenoud, J. Getty, and G. D. Bayard, New York, U.S.A. Eng. Pat. 16,359, September 13, 1892.

IN the apparatus pipes lead from the top and bottom of the carburettor to the burner. Air, which may be heated before entering or when passing through the carburettor, is forced in at sufficient pressure to maintain a flow of heavy oil to the burner from the bottom pipe, while a supply of carburetted air passes from the top, both of which can be regulated by suitable valves.—D. A. S.

Improvements in the Manufacture of Gas. R. M. Bidelman, Adrian, Michigan, U.S.A. Eng. Pat. 17,262, September 27, 1892.

IN this process air is passed through a liquid hydrocarbon, which has already been deprived of all vapours which condense at the ordinary temperatures of a gas main, and the resulting gas is used for heating purposes, or with Welsbach burners for the production of light.

The inventor recommends the use of a distillate of petroleum oil of specific gravity approximately 0.698, from which all the more readily condensable hydrocarbons have been removed.

The liquid hydrocarbon employed is forced from a suitable reservoir into the generating receptacle. This receptacle consists of a cylindrical metallic shell capable

of resisting considerable internal pressure. A few inches above the bottom there is a perforated false bottom, upon which rests a packed body of absorptive solid porous material such as wood charcoal or its equivalent. These receptacles are connected in series by pipes leading from the top of one receptacle to below the perforated false bottom of the next. The above-mentioned distillate is forced into the receptacles until the space below the perforated diaphragms is filled, and the liquid rises well up into the body of the charcoal. Compressed air is then forced through the series to the point of storage or use. Analyses show that the gas produced contains about 3 per cent. of fixed hydrocarbon gases, of which marsh-gas is the principal constituent, the other constituents being olefiant gas and other heavy hydrocarbons intermixed with air.—D. A. S.

Improvements in the Combustion of Carbonaceous Fuel. E. A. Ebb, Appleton, U.S.A. Eng. Pat. 12,762, July 12, 1892.

IN the combustion of carbonaceous fuel the formation of carbon dioxide, which is a non-supporter of combustion, has a tendency to check the process of combustion while being drawn up through the fuel.

The object of this patent is to remove the carbon dioxide by taking advantage of the fact that this gas is specifically heavier than air. This is done by introducing a pipe into the centre of the ash-pit and connecting the pipe with an exhaust fan. As, when bituminous coal, or coal-dust is employed its caking obstructs the passage of the carbon dioxide cubical perforated blocks of iron or short tubes of iron are mixed with the fuel in any quantity desired; these afford a free passage to the gas so that it may be drawn off from below. Steam is injected into the fuel chamber whenever the iron blocks are red hot.

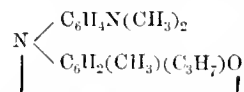
The patentee claims: "The improvement herein described in the combustion of carbonaceous fuel, the same consisting in running off the generated carbonic acid gas by its own gravity, assisted by an exhaust fan or other exhaust pump device, and further assisted by feeding the fuel mixed with perforated iron cubes, or other forms of perforated iron, and further assisted by injecting steam in the fuel chamber."

—F. S. K.

IV.—COLOURING MATTERS AND DYES.

Indothymol: Preparation of Thymoquinone. P. H. Bayrac. Bull. Soc. Chim. 7-8, 1892, 97-99.

Indothymol—

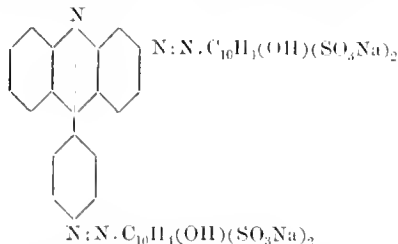


the indophenol of thymol, is formed on mixing a dilute solution of *p*-amidodimethylaniline with a dilute alkaline solution of thymol, adding potassium bichromate and faintly acidifying with acetic acid. It is purified by washing successively with water and a small quantity of cold alcohol, and crystallising from alcohol, being thus obtained in long violet-green dichroic needles, which melt at 69.5° C. and are slightly sublimable. It is insoluble in water and alkalis; soluble in alcohol with a fine blue colour, and in acetic acid with a green one; it is reduced by zinc and acetic acid to its easily oxidisable leuco-derivative; is unacted upon by aqueous solutions of alkalis, but is decomposed by mineral acids quantitatively into dimethylaniline, ammonia, and thymoquinone. This reaction furnishes a ready method of preparation of the last-named compound, which is obtained with difficulty by the methods in general use:—The indothymol is decomposed by gently heating for a few minutes with 10 times its weight of dilute (1:10) sulphuric acid, and the solution cooled. The

thymoquinone is then extracted with ether, the solution evaporated and the residue dissolved in a mixture of ether and alcohol, and filtered. On evaporation pure thymoquinone is obtained.—E. B.

Some Derivatives of Chrysaniline. A. Trillat and De Raekowski. Bull. Soc. Chim. 7—8, 1892, 257—259.

Tetrazophenylacridine—



is formed (the sodium salt of the naphthol disulphonic acid) by the action of nitrous acid on a cold dilute solution of diamidophenylacridine (chrysaniline) which is obtained, probably along with higher homologues, by precipitation with sodium carbonate from a dilute solution of phosphine. It combines readily (although perhaps in two stages like other tetrazo compounds) with phenols and amido compounds; thus, with the sodium salt of naphthol disulphonic acid R it yields a compound which in the dry state appears green, but when in solution has a splendid red colour. Salt G similarly yields a pink dye (see above formula). These two compounds dye silk very well, but give only poor colours on cotton and wool. Alkyl derivatives of chrysaniline are produced on heating it in alcoholic solution with alkyl iodides. The dibenzyl derivative is obtained by the action of benzyl chloride in the form of a sparingly soluble brown paste which appears to be microcrystallisable. It dyes silk, cotton, and wool dull red, the methyl and ethyl derivatives dyeing a similar shade. None of these derivatives possesses much technical value.—E. B.

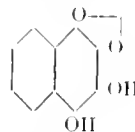
The Action of Hypochlorous Acid on β -Naphthaquinone.

E. Bamberger and M. Kitchelt. Ber. 1892, 25, 133—136 and 888—898.

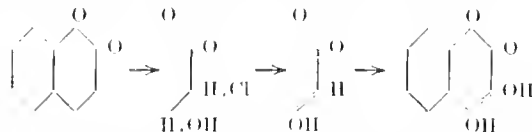
β -NAPHTHAQUINONE is converted by hypochlorous acid, according to the conditions obtaining, either into a colouring-matter isomeric with naphthazarin, or into a mixture of acids, amongst which phthalic acid and the δ -lactone of α -carboxyphenylglyceric acid have been recognised.

The colouring matter is formed by adding 2.5 to 5 grms. of the quinone, in the state of very fine powder, to a solution of hypochlorous acid, prepared by grinding 35 grms. of bleaching-powder with 135 of water, adding a solution of 26 grms. of potassium carbonate in 40 of water, filtering, adding 20 grms. of boric acid to the filtrate, and, after an hour's rest, filtering from the potassium borate which has crystallised out. Considerable heat is evolved when the quinone is added. The action is assisted by 8 or 10 minutes' agitation, after which the quinone will have dissolved with an olive-brown colour, which rapidly changes to orange. As soon as this change has taken place, concentrated hydrochloric acid is added and the solution is heated until its colour suddenly turns dark red, when the heating must be discontinued. The solution is now allowed to stand for several hours to enable the colouring matter to crystallise out. Some boric acid simultaneously separates, but is easily removed by washing the crystals with hot water. The mother-liquor still contains a not inconsiderable amount of the colouring matter, which is precipitated by copper acetate and liberated in an almost pure condition from the dark-blue copper compound thus formed, by pouring hydrochloric acid over it. Both quantities of the colouring matters so obtained contain traces of a second one, probably a monohydroxynaphthaquinone, which dissolves in alkalis with a red colour. It is removed by

crystallising from acetone or, less satisfactorily, by subliming. The yield of the chief colouring matter amounts to 45—50 per cent. of the β -naphthaquinone employed. This colouring matter, on account of its close resemblance, both chemically and physically, to naphthazarin has been named *Isonaphthazarin*. It crystallises in splendid orange-red plates with a green surface-lustre, and is obtained by sublimation in needles of a metallic lustre, which differ from those of naphthazarin by their paler appearance. It melts at 276° ; is sparingly soluble in hot water, and very sparingly in cold, but still appreciably more so than its isomeride. Acetone dissolves it readily, chloroform and alcohol with moderate ease, and ether and benzene very slightly; each with an orange colour. Concentrated sulphuric acid dissolves it with a dark red colour. Sodium and potassium hydrates dissolve it easily with a blue colour; carbonated alkalis and ammonia with a violet-red. Its acidity is greater than that of naphthazarin: for while a solution of the latter is unaffected by the addition of sodium acetate, one of isonaphthazarin is coloured red-violet (= the red-orange of the free dyestuff + the blue of its sodium compound), the acetic acid being partly displaced by it. Its aqueous solution, also, reddens litmus strongly. The alkaline solutions are decolorised by a month's exposure to light. The sodium compound is precipitated by common salt from its aqueous solution in voluminous indigo-blue flocks. Isonaphthazarin yields coloured precipitates with salts of the following metals: copper, lead, cadmium, and nickel, dark-blue; zinc and barium, pale-blue; mercury and cobalt, green-blue. It also dyes very well on metallic hydrate mordants, giving on chrome, for instance, a beautiful purple-grey colour. Its want of fastness to light, however, will stand in the way of its technical application. The above detailed properties of the substance correspond with a compound containing hydroxyl groups in close proximity to a quinone complex, thus—



Its analysis accords with this view. The formation of this compound probably takes place in the following phases:—



The lactone compound is produced by the action of sodium hypochlorite on β -naphthaquinone.—E. B.

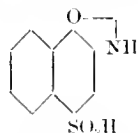
Oxidation Compounds of Amidonaphthol Sulphonic Acids.

F. Reverdin and C. de la Harpe. Ber. 1892, 25, 1400—1409.

I.—DERIVATIVES OF α -NAPHTHOL.

1:2:4 (=OH:NH $_2$:SO $_3$ H)—Amidonaphthol sulphonic acid yields a purple dye when heated in sodium carbonate solution in the presence of air. The alkaline solution has at first a green tint, but gradually turns brown and deposits a purple powder which is filtered off. A compound which dyes wool red-brown remains in the filtrate. The latter is produced in larger amount when the free sulphonic acid is oxidised, and is probably, therefore, a sulphonic acid of α -naphthaquinone (this Journal, 1892, 155). The purple compound is sparingly soluble in cold water, but more readily in hot, and easily in alkalis. It is precipitated by acids from its alkaline solutions in chocolate flocks, which after some time becomes green and crystalline. Sulphuric acid dissolves it with an olive colour. It dyes wool from an acid bath purple to black shades according to the proportion employed, and dyes cotton which is mordanted with

metallic oxides, the shades produced being in both cases very fast. A compound possessing the same properties is obtained by sulphonating imido-oxynaphthalene, the oxidation product of 1:2 amidonaphthol. From this it would appear that the purple dye is an imido-oxynaphthalene sulphonic acid of the constitution—



A body which closely resembles this dye as regards its behaviour in wool dyeing, but which does not dye so well on mordanted cotton, is produced by adding sodium acetate to a dilute solution of the above amidonaphthol sulphonic acid, and allowing to stand a considerable time in the cold, or more rapidly by treating with a current of air.

1:4:2-Amidonaphthol sulphonic acid, when heated in sodium carbonate solution, is coloured golden-brown by the air; in sodium acetate solution it is coloured red-purple. The body produced cannot be precipitated with either common salt or acids, and dyes wool in an acid bath a worthless yellow-brown.

Two amidonaphthol sulphonic acids are obtained on diazotising Witt's 1:5-naphthylamine sulphonic acid, boiling with dilute acid, combining with diazobenzene chloride and reducing. The azo-compounds were separated by taking advantage of the difference in their solubilities. The more soluble compound which was of a yellowish colour, gave on reduction a sparingly soluble product, whose solution in sodium carbonate was oxidised similarly to the 1:2:4-amidonaphthol sulphonic acid, while the little soluble reduction-product of the other compound oxidised into a brown dye of no value, thus resembling the 1:4:2-acid. The first reduction-product would, therefore, seem to be the 1:2:5-, and the second the 1:4:5-amidonaphthol sulphonic acid.

1:4:8-Amidonaphthol sulphonic acid in sodium carbonate or ammonia solution, becomes brown on exposure to air; in sodium acetate solution it becomes red-brown and eventually purple. The compound formed gives a brown colour on wool but is of no technical value.

1:4:2:7-Amidonaphthol disulphonic acid is converted by the atmospheric oxidation of its sodium carbonate solution into a red purple dye, which is precipitable by common salt, and gives a fairly-bright purple on wool in an acid bath, but dyes imperfectly on cotton mordanted with metallic oxides, yielding greenish-olive shades.

II.—DERIVATIVES OF β -NAPHTHOL.

2:1:6-Amidonaphthol sulphonic acid (*Eikonogen*) becomes coloured olive-green when exposed to the air in sodium carbonate solution. The addition of common salt produces a voluminous precipitate of a compound which dissolves in water with a green colour, but is changed to red by acidifying. This compound dyes red-purple on unmordanted wool, green on chrome-mordanted wool, and grey or grey-olive on mordanted cotton.

2:1:8-Amidonaphthol sulphonic acid yields a similar product which does not, however, dye mordanted cotton so well as the preceding compound.

2:1:5-Amidonaphthol sulphonic, and 2:1:3:6-amidonaphthol disulphonic acids give brown oxidation-products of no value as dyes. The 2:1:6:8-disulphonic acid (from orange G) gives a small quantity of a dye resembling that obtained from the 2:1:8-acid, its formation being probably due to the presence of this acid.—E. B.

at a low temperature β -naphthylamine nitrate is converted by sulphuric acid essentially into a mixture of two new nitronaphthylamines, namely, the 2:5- and 2:8-derivatives.

The nitration is effected by gradually adding finely-powdered β -naphthylamine, dried at about 100° C. (a higher temperature causes decomposition), to 10 parts of concentrated sulphuric acid, at a temperature not exceeding 5°. The low temperature is important, as considerable quantities of resinous matters are formed if it be allowed to rise. Thus, in an operation conducted between -22° and -12° only 10 per cent. (of the nitrate employed) of resinous matters was formed, while between -11° and +2°, 18 per cent., between -5° and +6°, 26 per cent., between -7° and +10°, 31 per cent., and between 0° and 11° C. 42 per cent. were produced. The resinous matters were removed by diluting the sulphuric acid solution with 6 to 8 volumes of water and filtering. On cooling, the greater part of the nitro-products crystallised out as a brown-yellow mass, a further small quantity being obtained on neutralising the mother-liquor. From these salts the nitro-bases were liberated by ammonia and dried on the water-bath, a mean yield of 60 per cent. of the theoretical being obtained. The dried mass was then separated by fractional crystallisation from benzene or alcohol into a sparingly-soluble compound, recognised as the 2:5-derivative, and a more soluble 2:8-compound, which is produced in smaller amount. The latter body is best isolated by acetylating the mixture of bases and repeatedly crystallising from a large volume of alcohol until the crystals obtained are uniform and melt at 195.5°; the free base being then obtained in the usual manner. The alcoholic mother-liquors contain the acetyl compounds of other bases (of lower melting point) than the above, which have not yet been identified.

2:5-nitro- β -naphthylamine forms beautiful red needles, melting at 143°, which dissolve readily in hot alcohol (with dark red colour) and in benzene (with pale yellow) and acetic acid, sparingly in hot water, and scarcely at all in cold water and light petroleum. The hydrochloride of the base dissolves easily in hot water and crystallises in nearly colourless needles. The sulphate is sparingly soluble, and, when slowly crystallised, forms pale yellow laminae. Both salts undergo partial dissociation when heated with a large quantity of water or alcohol. The acetyl-derivative crystallises in stellate aggregates of melting point 185.5°; the benzoyl-derivative in needles, melting at 181.5°. Nitrous acid converts the amido compound into 2:5-nitrodiazonaphthalene. This is readily soluble in water, and combines with naphtholsulphonic acids, forming brownish-red to purple dyes.

2:5-nitro- β -naphthol is prepared by boiling the aqueous solution of the last-mentioned compound with a small quantity of urea until the evolution of nitrogen has ceased. After filtering off the resinous matters which are simultaneously formed, and cooling, it crystallises out as a pale yellow acicular mass. It melts at 147°, and is sparingly soluble in cold water, but readily so in hot, and dissolves readily in dilute alkaline solutions and in the customary organic solvents. Its potassium salt is precipitated by an excess of potash in red laminae.

2:5-amido- β -naphthol is formed on carefully reducing the nitro-compound with excess of a mixture of stannous chloride, tin, and hydrochloric acid. The stannous double salt which separates is conveniently decomposed by dissolving in the minimum quantity of hot water and adding concentrated hydrochloric acid, the hydrochloride of the amido-compound being precipitated in an almost pure state. On decomposing this precipitate with sodium bicarbonate and extracting from the filtered aqueous solution, the free base is obtained as a white, crystalline mass, easily soluble in acids, alkalis, and organic solvents. When exposed to the air, it suffers oxidation and darkens.

2:5-naphthylenediamine is obtained by the reduction of the above nitronaphthylamine. It is easily soluble in hot water, alcohol, benzene, and acetic acid, sparingly so in cold water and ether, and crystallises in short, white needles, of melting point 77.5°, which darken on exposure to air. Its aqueous solution shows a blue fluorescence, and is coloured purple by ferric chloride or bleaching powder. When heated on the water-bath with fuming sulphuric acid it

The Nitration of β -Naphthylamine. P. Friedländer and St. Szymanski. Ber. 25, 1892, 2076—2083.

THE authors undertook this research in consequence of a statement by Hirsch (Ger. Pat. 57,491) that the nitration of β -nitronaphthylamine followed a different course from that supposed by Levinstein (Ger. Pat. 30,889). They find that

yields a sparingly-soluble sulphonic acid. This description of the properties of 2:5-naphthylenediamine does not agree with that given by Ewer and Pick (Ger. Pat. 45,788), who considered they obtained the body in question (which they stated to be uncrystallisable) by heating 1:6 (= 2:5)-dihydroxynaphthalene with ammonia under pressure. Also the assertion that the tetrazo-derivatives of this naphthylenediamine dye unmordanted cotton is found to be incorrect (this Journal, 1889, 278).

2:5-dichloronaphthalene. The constitution of the above compounds was proved by converting the diamido-compound into the corresponding dichlor-derivative by diazotising and treating with copper powder (this Journal, 1890, 923). The dichloro-compound, which was isolated by distillation with steam, melted at 48° and possessed the properties ascribed to the 2:5-compound by Erdmann and Kirchhoff (Ann. 247, 379).

2:8-nitro- β -naphthylamine, produced as above described, forms red needles melting at 103.5°, and soluble with difficulty in hot water (in which the compound melts), and very sparingly in light petroleum, but easily in other organic menstrua. Its sulphate and hydrochloride are rather less soluble than the corresponding salts of the 2:5 compound, and like these are partially dissociated by heating in dilute aqueous or alcoholic solution. Its acetyl compound crystallises in long yellow needles melting at 195.5°. It is converted by the diazo reaction into 2:8-nitro- β -naphthol, a considerably better yield of this substance than of its isomeride from the 2:5-nitronaphthylamine being obtained. This compound crystallises in dark red needles which melt at 142°, and is easily soluble in alcohol, but with difficulty in water. It dissolves in alkalis with a dark red colour, and its potassium salt is precipitated in red needles on the addition of a large excess of potash.

2:8-amido- β -naphthol was prepared and isolated in the same manner as its above-described isomeride. It crystallises in small white needles which darken on exposure to air and decompose, without melting, at 212°–218°, and is soluble in acids and alkalis, as well as in water, alcohol, and ether.

2:8-naphthylenediamine is formed on allowing an alcoholic solution of the corresponding nitronaphthylamine to flow gradually into an excess of a mixture of stannous chloride, hydrochloric acid, and tin. It is easily soluble in acetic acid, alcohol, and benzene, less so in water, and very slightly so in ether and light petroleum, and crystallises from benzene in white plates, but from water in feathery clusters of needles, of melting point 117.5°. The surfaces of the crystals rapidly darken when exposed to the air. The aqueous solution of this compound shows a faint fluorescence, and is coloured violet by ferric chloride. Its tetrazo-derivative combines with naphthol-sulphonic acids, forming purple-brown dyes, and is converted by copper powder and hydrochloric acid into 2:8-dichloronaphthalene (Erdmann and Marchand, *loc. cit.*), of melting point 61°.

—E. B.

Methoxyamido-1:3-Dimethylbenzene and some of its Derivatives. W. R. Hodgkinson and L. Limpach. Proc. Chem. Soc. 1892, 115, 166.

HAVING devised a method of separating 1:2:4-metaxylyline from paraxylyline, &c., with which it is mixed in commercial xylidine, the authors have had the opportunity of preparing 1:2:4-metaxylylenol in large quantity. An almost theoretical yield of this phenol was obtained by diazotising a solution containing only 5 per cent. of the xylidine sulphate and then steam distilling; the product did not solidify even at -20°; but a considerable quantity was caused to crystallise by adding some solid obtained by cooling a small portion by means of carbon dioxide and ether. The presence of a trace of water was found to prevent crystallisation. On nitration, metaxylylenol yields almost the theoretical amount of a nitroxylylenol in which the NO₂ group is contiguous to the hydroxyl. The authors have prepared the corresponding amido- and hydroxy-xyleneols and their methylated derivatives (dimethylanisoils); they also describe a quinaldine derivative, formed by condensation from the methoxy-amidoxylylene and ethylic aceto-acetate.—W. S.

PATENTS.

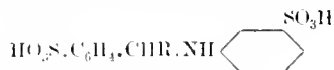
Improvements in the Manufacture of Alpha-Naphthol Sulpho Acids and Diary Naphthalene Sulpho Acids, and of Dyestuffs therefrom. B. Willeox, London. From "The Farben fabriken vormals F. Bayer & Co.," Elberfeld, Germany. Eng. Pat. 3397, March 4, 1890. (Second Edition.)

The specification describes the preparation of two new α -naphthol disulphonic acids, a new trisulphonic acid and new dihydroxy naphthalene sulphonic acids therefrom. The following methods are given for the formation of these new products. A certain weight of α -naphthol sulphonic acid (OH: SO₃H = 1: 5) is dissolved in three times its weight of sulphuric acid of 66° B., the temperature is slowly raised to 90° C., on the water-bath and kept at this temperature until a change in the fluorescence shows that the sulphonation is complete, when the melt is limed and converted into the sodium salt which crystallises in spikes from a concentrated solution. This α -naphthol disulphonic acid differs from those described in Ger. Pat. 40,571 and 45,776 as it does not give a nitroso compound. Other sulphonating agents may be employed such as sulphuric acid monohydrate or monochlorhydrin. When α -naphthol sulphonic acid (OH: SO₃H = 1: 4) is dissolved in three times its weight of fuming sulphuric acid and slowly raised to the temperature of a water-bath, the mass stiffens at about 75° C., forming naphthyl sulphuric acid, and at about 90° the melt is in the form of a thin clear liquid. It is converted in the usual way into the sodium salt which precipitates in the form of jelly. This α -naphthol disulphonic acid only combines with difficulty with diazo compounds. The new α -naphthol trisulphonic acid is obtained by sulphonating the naphthosultone or naphthol mono- or disulphonic acid S described in Ger. Pat. 40,571, or from the naphthosultone monosulphonic acid. Any one of these acids is mixed with 4-5 times its weight of fuming sulphuric acid containing 25 per cent. of anhydride and allowed to stand at the ordinary temperature until a sample ceases to form a colouring matter with diazo compounds, which is generally the case after about twelve hours. At higher temperatures the sulphonation is completed more rapidly, but not at temperatures above 100° C., or when acid containing more anhydride is used. The melt is converted into the sodium salt and precipitated by adding hydrochloric acid and salt to the hot concentrated liquor, when it forms a heavy sandy powder. A characteristic property of the new acid is that it does not combine with diazo compounds. The neutral sodium salt dissolves easily in water with a green fluorescence. Nitric acid forms a nitro-naphthol sulphonic acid. By fusion with caustic alkalis at high temperatures all the above-mentioned acids are converted into new dihydroxynaphthalene sulphonic acids. The new α -naphthol disulphonic acids are fused with three parts of caustic soda at about 250° C., until a sample shows no fluorescence and smells strongly of sulphurous acid when acidulated. The α -naphthol disulphonic acid obtained from the 1:5 α -naphthol monosulphonic acid gives a dihydroxynaphthalene monosulphonic acid, the sodium salt of which crystallises in thin shining plates containing water from solutions saturated with salt. Ferric chloride gives an unstable blue-green solution and chloride of lime produces a reddish brown colour which does not change on adding an excess. The α -naphthol disulphonic acid from the 1:4 α -naphthol monosulphonic acid yields a dihydroxynaphthalene monosulphonic acid of which the sodium salt crystallises from acid solutions saturated with salt in fine white needles. Ferric chloride gives a permanent blue green solution and chloride of lime a bluish-red solution which turns yellow and then colourless. By heating the α -naphthol trisulphonic acid with concentrated soda-lye to 200° C. in an open vessel it is converted almost instantly into a new dihydroxy naphthalene disulphonic acid. The reaction is complete when a sample no longer fluoresces or when it gives a colour with diazo compounds. The melt is then dissolved in water and saturated with salt when the new dihydroxynaphthalene disulphonic acid crystallises out in white needles. The α -naphthol disulphonic acid obtained from the 1:5 α -naphthol monosulphonic acid and the dihydroxynaphthalene mono- and disulphonic acids above mentioned can all be employed in the manufacture of

colouring matters by combining them with diazo and tetrazo compounds. A variety of shades can be produced according to the particular amine employed. Blue to blue-black colouring matters, for instance, are obtained from *p*-phenylene diamine by diazotising acetyl-*p*-phenylene diamine, combining it with α -naphthylamine or α -amido- α -naphthol ether, rediazotising, combining with one of the above-mentioned dihydroxynaphthalene sulphonic acids splitting off the acetyl group, again diazotising and combining with a pbenol, amine or one of their derivatives.—T. A. L.

Improvements in the Manufacture and Production of Sulpho Acids and of Colouring Matters. B. Willcox, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 19,062, November 4, 1891.

WHEN either methyl- or ethyl-benzylaniline is heated with monohydrated sulphuric acid or with fuming sulphuric acid of a moderate strength at a low temperature, it is converted into a mono-sulphonic acid, in which the sulphonic acid group is in the benzyl nucleus. By using fuming sulphuric acid of sufficient strength the bases are converted directly into disulphonic acids, one of the sulphonic acid groups having entered the phenyl nucleus in a meta position to the amido group so that the body has the following formula—



Where R stands for CH_3 or C_2H_5 .

Ten kilos. of ethylbenzylaniline are dissolved in 20 kilos. of cold fuming sulphuric acid containing 20 per cent. of SO_3 , and the solution mixed with 25 kilos. of fuming sulphuric acid containing 80 per cent. of SO_3 and heated to 60°C . The sulphonation is complete when a sample partially neutralised with sodium carbonate gives no precipitate on treating with an excess of sodium sulphate. The melt is then poured into water neutralised with lime, and the filtrate evaporated to a syrup which becomes solid on standing. The barium salt will crystallise from a concentrated aqueous solution. By decomposition with alkaline carbonates the corresponding alkaline salts are obtained, which can be precipitated by adding salt or potassium chloride. No precipitate is, however, produced by adding hydrochloric acid to the aqueous solution of the disulphonic acid, differing in this way from the monosulphonic acid. The position of the sulphonic acid group in the phenyl nucleus was determined by fusing the disulphonic acid with potash, when, after acidulating, an oil was obtained which gave a rhodamine on heating with phthalic anhydride and zinc chloride. These disulphonic acids condense with tetra-alkyldiamidobenzhydrols, forming leuco-compounds which on oxidation yield colouring matters. Two examples for the formation of blue to violet dyestuffs are given in the patent. 27 kilos. of tetramethyldiamidobenzhydrol are dissolved in 400 kilos. of dilute sulphuric acid (containing 5 per cent. of H_2SO_4), and after adding 40 kilos. of sodium methylbenzylaniline disulphonate the melt is heated on the water-bath until the condensation is complete, when, after neutralisation with sodium carbonate, the leuco-compound is salted out with sodium sulphate. This is then dissolved in 200 kilos. of 50 per cent. acetic acid and oxidised by adding 48 kilos. of a lead dioxide paste containing 50 per cent. of PbO_2 . The lead is precipitated with dilute sulphuric acid, and after filtering, the colouring matter is precipitated from the solution by adding sodium sulphate, when it separates in small brassy crystals very easily soluble in hot water, less so in cold, and dyes wool blue from an acid bath in a similar shade to that produced by "Cotton blue R." Another colouring matter is obtained by dissolving 27 kilos. of tetramethyldiamidobenzhydrol in 135 kilos. of dilute (10 per cent.) sulphuric acid and adding 20 kilos. of dimethylaniline-*m*-sulphonic acid dissolved in 80 litres of water. When the condensation is complete the solution is neutralised with sodium carbonate, and the sodium salt of the hexamethyl-*p*-leucaniline monosulphonic acid separates on cooling in characteristic lustrous scales. It is oxidised by the same quantities of acetic acid and PbO_2 given above, and the lead is

precipitated by adding 20 kilos. of sulphuric acid of 66°B . The filtrate from the lead sulphate is evaporated when the colouring matter separates. It possesses both basic and acid properties, and dyes cotton mordanted with tannic acid or wool from a neutral bath. All these dyestuffs are said to be valuable on account of their fastness to alkalis, and those which contain benzyl-groups dye wool from acid baths.—T. A. L.

Improvements in and relating to the Manufacture and Production of Azo-Dyes, and of Materials therefor. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 20,275, November 21, 1891. (Second Edition.)

IN Eng. Pat. 9676 of 1890 (this Journal, 1891, 538) 1·1' amidonaphthol monosulphonic acid is described, which combines with tetrazo compounds, giving however, dull colours. The benzoyl or acetyl derivatives of the acid give bright shades with tetrazo compounds; but in order to enable the dyestuff to be applied in a soap or soda bath the tetrazo compound must contain a sulphonic or carboxylic acid group, as otherwise the colouring matters will only dye from a bath containing a caustic alkali. In the present specification an isomeric 1·1' amido-naphthol sulphonic acid is described which yields colouring matters similar to the above, but does not require that the tetrazo compound shall contain an acid group, as the benzoyl or acetyl derivatives of the bodies produced from diazotised tolidine, for example, will dye cotton from an ordinary soap or soda bath. The starting point for the new acid is the naphthylamine disulphonic acid obtained by sulphonating that 1·1' naphthylamine sulphonic acid which forms a slightly soluble sodium salt. It is the so-called naphthylamine monosulphonic acid S of Eng. Pat. 15,775 of 1885 and of Ger Pat. 40,571. About 1 kilo. of the sodium naphthylamine disulphonate is mixed with 3 kilos. of caustic alkali and a little water, and heated from 200° — 230°C . until no increase in the quantity of the 1·1' hydroxynaphthylamine monosulphonic acid formed is observed. The melt is then allowed to cool, dissolved and acidified with dilute (3 per cent.) hydrochloric acid, boiled until all the SO_2 is given off, and filtered hot. On cooling, the new acid separates out in light grey crystals. The acid is slightly soluble in water or alcohol. The alkaline salts are readily soluble in water, and when alkaline have a bluish-green fluorescence. The substance combines with diazo and tetrazo compounds, which, however, are only dull colouring matters. By employing the benzoyl or acetyl derivatives of the new acid for combination with tetrazo compounds, bright and useful dyestuffs are obtained. About 10 kilos. of 1·1' hydroxynaphthylamine sulphonic acid and 7 kilos. of calcined soda are dissolved in 90 litres of water. After cooling to 5°C . 5·2 kilos. of benzoyl chloride are added and the mixture agitated below 10°C . for about one hour. The sodium salt of the benzoylated derivative is filtered, washed with brine, pressed and dried. A blue colouring matter is obtained from it by dissolving about 20 kilos. of the sodium salt and 15 kilos. of calcined soda in about 650 litres of water, and after adding 100 kilos. of ice, running in the tetrazodiphenyl chloride solution from 4·6 kilos. of benzidine, 16·5 kilos. of 30 per cent. hydrochloric acid, 250 litres of water, 50 kilos. of ice, and 3·5 kilos. of sodium nitrite. The mixture is then agitated for 24 hours at the ordinary temperature, after which it is boiled, precipitated with salt, filter-pressed and dried. The dyestuff forms a dark brown powder with a slight metallic sheen.—T. A. L.

The Manufacture and Production of New Derivatives of Alizarin and its Analogues. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 21,717, December 11, 1891.

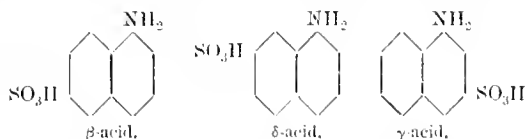
THIS patent describes a number of compounds derived from alizarin, and is an extension of several previous specifications. Some new reactions of the polyhydroxyanthraquinones are also described. A new alizarin derivative is formed by applying the process described in Eng. Pat. 8725 of 1890 (this Journal, 1891, 337) to the pentahy-

droxyanthraquinone obtained from symmetrical dihydroxybenzoic acid and gallic acid. A sulphuric ether of the dyestuff is obtained as an intermediate product capable of dyeing mordanted wool, and can be converted into the dyestuff in the well-known manner. About 10 kilos. of pentahydroxyanthraquinone are mixed with 200 kilos. of fuming sulphuric acid, containing 80 per cent. of SO_3 , and allowed to stand at 30°C . for 24 hours. The solution is poured on to ice, heated to boiling, and the precipitate filtered off. In order to convert it into the dyestuff it is dissolved in soda-lye, boiled, and hydrochloric or sulphuric acid added in excess, when the new dyestuff separates as a fine precipitate which is filtered off and washed. It dyes wool reddish-violet when mordanted with alumina, and violet when mordanted with chromium salts. According to Eng. Pat. 13,677 of 1891 (this Journal, 1892, 740) the hexahydroxyanthraquinone there described is produced from anthrachrysone by oxidation with sulphuric anhydride. It has now been discovered that the oxidation may be performed with manganese dioxide, the anthrachrysone being dissolved in ordinary (66°B .) sulphuric acid. The oxidation may be performed at high or low temperatures, but in the latter case more manganese dioxide is required, and an anthradiquinone, identical with the diquinone of hexahydroxyanthraquinone of Eng. Pat. 4871 of 1891 (this Journal, 1892, 513), is formed as an intermediate product. It is converted into the hexahydroxyanthraquinone by heating with water or reducing with sulphurous acid. By applying the reaction described in Eng. Pat. 12,715 of 1890 (this Journal 1891, 759) to the sulphuric ether of hexahydroxyanthraquinone, viz., by dissolving this body in concentrated liquid ammonia, a new dyestuff is obtained which dyes wool mordanted with chromium salts a pure blue. Certain of the polyhydroxyanthraquinones can be converted into dyestuffs soluble in water by the action of strong nitric acid. The following bodies have been treated in this way: the tetrahydroxyanthraquinone of Eng. Pat. 8725 of 1890 (this Journal, 1891, 537), the penta- and hexahydroxyanthraquinones of Eng. Pat. 4871 of 1891 and the hexahydroxyanthraquinone of Eng. Pat. 17,712 of 1890 (this Journal, 1891, 917), obtained from alizarin bordeaux according to Eng. Pat. 18,729 of 1890 (this Journal, 1891, 917) or from anthraquinone according to Eng. Pat. 13,677 of 1891, or from anthrachrysone by oxidising it with strong fuming sulphuric acid or by other processes. The following are the stages of the reaction. The compounds are first nitrated, and one hydrogen is replaced by hydroxyl, and finally the bodies are oxidised by the nitric acid into quinones, so that they belong to the class of the so-called anthradiquinones, and are known as "nitrohydroxyanthradiquinones." The process is carried out by adding concentrated nitric acid of sp. gr. 1.5 to the alizarin bordeaux suspended in an indifferent solvent such as glacial acetic acid, petroleum ether, or chloroform, or else by exposing the dry powder in shallow trays to the fumes of concentrated nitric acid. The colouring matters dissolve in water to a dark red-coloured liquid, which, on standing, boiling or reducing with sulphurous acid gives a precipitate of a nitrohydroxyanthraquinone which crystallises from acetone and alcohol in red needles with a metallic lustre. Hexahydroxyanthraquinone in this manner yields a dinitrohexahydroxyanthraquinone, whilst alizarin bordeaux and alizarin pentaeryanine yield the same mono-nitropentahydroxyanthraquinone. The dyestuff soluble in water obtained from the hexahydroxyanthraquinone of Eng. Pat. 17,712 of 1890, 18,729 of 1890, and 13,677 of 1891, crystallises readily. Ammonia dissolves it with a greenish-blue colour, whilst sodium carbonate and caustic soda dissolve it to a blue solution, and give a greenish precipitate on adding an excess of the reagents. It differs from the hexahydroxyanthraquinone in not showing an absorption spectrum when dissolved in sulphuric acid, the colour of the solution being blue. It dyes wool mordanted with chromium salts greenish-blue to bluish-black, whilst alumina produces a heliotrope colour. The other colouring matters of this class dye from bluish-red to greenish-black, and on account of their solubility in water can also be used for printing.

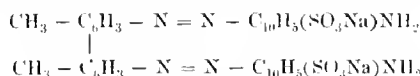
—T. A. L.

The Manufacture of New Colouring Matters. B. Willeox, London. From the "Farbenfabriken vormals F. Bayer and Co., Elberfeld," Germany. Eng. Pat. 22,641, December 28, 1891.

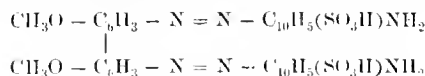
ACCORDING to Clève three α -naphthylamine- β -monosulphonic acids are obtained by nitrating naphthalene- β -monosulphonic acid or sulphonating α -nitro-naphthalene and reducing the mixture of nitro-derivatives thus produced. The following are the acids according to Clève's nomenclature:—



Of these the β - and δ -acids are of particular value in the formation of colouring matters, since, when combined with tetrazo-compounds they yield dyestuffs which can be diazotised on the fibre and combined with phenols or amines, &c., a property not possessed by other α -naphthylamine sulphonic acids. A variety of dyestuffs can be obtained from these compounds in a manner similar to the processes described in Eng. Pat. 16,484 of 1887 (this Journal 1888, 619). The following are some typical examples. 1. One molecular proportion of tetrazodilolyl is combined with two molecular proportions of Clève's β -acid, forming the dyestuff—

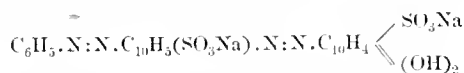


This is diazotised and combined with two molecular proportions of naphthionic acid in presence of acetic acid, and gives a colouring matter which dyes unmordanted cotton a deep bluish-black. 2. The tetrazo solution from o -diamidodiphenol dimethyl ether is combined as before with two molecular proportions of Clève's β -acid, forming—



This compound is then diazotised with two molecules of sodium nitrite and combined with one molecular proportion of 1.4 naphthylamine sulphonic acid in presence of sodium acetate. When the combination is complete an alkaline solution of one molecular proportion of 1.4 naphthol sulphonic acid is allowed to run in, the solution being kept alkaline by means of sodium carbonate. A bluish-black dyestuff for unmordanted cotton is thus obtained. In the above process other amines and phenols, &c., can be substituted for the naphthol and naphthylamine sulphonic acids in the second stage, and other tetrazo compounds can also be used. The colours obtained dye a greenish and blue-black. 3. Tetrazo-diphenyl chloride is combined with one molecular proportion of Clève's β -acid. The free amido group is diazotised and the tetrazo chloride so obtained is combined with two molecular proportions of 1.8 dihydroxynaphthalene- α -monosulphonic acid. 4. In the preceding example the intermediate tetrazo compound may be combined first with one molecular proportion of β -naphthol-mono-sulphonic acid F and afterwards with one molecular proportion of the 1.8 dihydroxynaphthalene- α -monosulphonic acid. Both these colouring matters dye unmordanted cotton bluish-black from an alkaline soap bath. 5. Valuable disazo colouring matters, which dye wool bluish-black from an acid bath, are obtained by combining a diazotised amine with Clève's β - or δ -acid, rediazotising the amido-azo compound formed, and combining this with a phenol or amine, &c. As an example, 9.3 kilos. of aniline are diazotised by means of hydrochloric acid and 7 kilos. of sodium nitrite and added to a solution of 24.5 kilos. of the sodium salt of Clève's β -acid and 50 kilos. of sodium acetate. The resulting amido-azo-compound is diazotised with 7 kilos. of sodium nitrite and hydrochloric acid, and combined with 26.2 kilos. of 1.8 dihydroxynaphthalene- α -monosulphonic

acid in an aqueous solution, together with about 50 kilos. of sodium acetate. When the combination is complete the solution is made alkaline and the dyestuff salted out, filtered, pressed, and dried. It has the following formula—



and dyes unmordanted wool bluish-black from an acid bath, whilst the shades on wool mordanted with chromium salts are greenish-black. When used for printing it gives a pure black.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

The Specific Gravity of Textile Fibres. L. Vignon. Bull. Soc. Chim. 7—8, 1892, 247—250.

THE author has determined the densities of the more important textile fibres with a hydrostatic balance sensible to $\frac{1}{100}$ of a milligramme. As the fibres occlude gases and are to some extent water-repellent, benzene was employed instead of water as the immersing fluid. The gases were eliminated by placing the balance in a suitable apparatus and reducing the pressure of the enclosed atmosphere to 50 mm. for 5 to 10 minutes. The following results were obtained:—

SPECIFIC GRAVITIES AT 18° OF TEXTILE FIBRES CONTAINING THEIR NORMAL AMOUNT OF MOISTURE.

Fibre.	Condition.	Specific Gravity.
Cotton	Wool	1.50
"	Spun	1.51
Wool	Combed	1.30
"	Spun	1.30
Mohair	Combed	1.30
Hemp.	Carded	1.48
Ramie	Carded	1.52
"	Spun	1.51
Linen	Spun	1.50
Jute	Spun	1.48
French silk	Raw	1.33
"	Un-gummed	1.34
[Glass wool	"	2.72]

—E. B.

The Specific Gravity of Silk. L. Vignon. Bull. Soc. Chim. 7—8, 1892, 249—250.

THE density of silk in various states, namely, raw, un-gummed, dyed, and weighed, was determined in the manner described above (preceeding abstract). The results are as follows.

The presence of tannic acid very slightly increases the density of the fibre. Metallic compounds cause a considerable increase. (See also this Journal, 1892, 600 and 640.)

Condition of Silk.	Increase or Decrease in Weight caused by Treatment Indicated.	Sp. Gr.
SILK DYED OTHER THAN BLACK.		
Per Cent.		
Sample:—		
"Pure"	— 1.43	1.33
Weighted with tannic acid.....	+ 47.28	1.37
Weighted with stannic oxide ...	+ 71.70	1.94
Weighted with stannic tannate .	+ 70.36	1.66
Boiled off:—		
"Pure".....	— 25.72	1.34
Weighted with tannic acid.....	— 7.04	1.37
Weighted with stannic oxide ...	+ 58.64	2.01
Weighted with stannic tannate.	+ 32.82	1.60
BLACK-DYED SILK.		
Raw.....	0.0	1.34
Sample:—		
Weighted with tannic acid.....	+ 31.6	1.39
Weighted with stannic oxide ...	+ 52.30	2.40
Weighted with tannic acid and metallic salts.	+ 63.70	1.43
Boiled off:—		
"Pure".....	— 21.10	1.34
Weighted with tannic acid.....	+ 79.90	1.39
Weighted with stannic oxide....	+ 44.50	2.60
Weighted with tannic acid and metallic salts.	+ 64.10	1.52

—E. B.

PATENTS.

An Improved Water and Grease-proof Packing Material. J. A. Turner, Lancaster. Eng. Pat. 15,899, September 19, 1891.

PAPER and canvas or other suitable woven fabric are united together by means of size or other similar grease-proof, adhesive material; the surface of the woven fabric is then coated with tar or other waterproofing material.—A. G. B.

Improvements in and relating to the Manufacture or Production of Paper Pulp and Textile Fibre. C. G. Hagemann, Ludwigsbafen, Germany. Eng. Pat. 18,470, October 27, 1891.

See under XIX., page 1026.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Cause of the Greening, during Milling, of Logwood-Black on Wool. O. Walther. Färb. Zeit. 1892, 305—308.

THE greening or lightening of logwood-black on wool, which takes place to a greater or less extent during the milling and finishing operations, has been attributed to the omission of tartar from the mordanting bath, and to inefficient oxidation of the logwood. But it cannot be due

to either of these circumstances, for logwood-blacks of satisfactory fastness are obtained without the use of tartar, and it is well known that a good black cannot be obtained with logwood which has been injuriously or insufficiently oxidised, so that the defect in shade exists, in the latter case, prior to milling. The author traces the cause to difference in the dyeing characters of the various kinds of wool, to imperfect removal of the wool-yolk in scouring, and to prolonged milling necessitated by the deterioration of the felting property of the wool by the chromic acid mordanting bath, such prolonged exposure of the colour lake to a heated alkaline solution being the chief factor in its destruction, which is aided by the friction of the rollers or other apparatus employed. The effect of the first of these causes is seen on mordanting and dyeing together a number of samples of various kinds of wool, the blacks produced being of various shades and exhibiting a slight difference in their ability to withstand milling. The effect of the presence of grease in the wool is to prevent the colour-lake depositing in an intimate state in or upon the fibre. To show this and also the injury to the felting property accruing from the employment of chromic acid in mordanting, samples of imperfectly-cleansed and of well-cleansed wool were severally mordanted with iron and chrome, dyed with logwood, and milled. The samples dyed iron-logwood black were sufficiently milled in 6½ hours, those dyed chrome-logwood black required 16 hours. The latter were found to have lost more colour than the former, and the imperfectly-scoured samples much more than the well-scoured. The difference in the two lots of wool dyed iron-logwood black was less apparent. This injurious action of chromic acid on wool has induced many dyers to replace it in part by copper sulphate, or to employ a smaller proportion than usual, and to supersaturate the mordanted material with colouring matter to obtain the desired intensity of shade; or, again, to sadden with ferrous sulphate the material thus supersaturated. The last of these methods yields a colour-lake which is to a large extent superficially deposited on the fibre, and hence readily detached on milling. The excess of colouring matter absorbed according to the second method is also readily removed. The first method alone gives a satisfactory result. Thus, an excellent black of a superior degree of fastness to both milling and light (see also this Journal, 1891, 460) is obtained by mordanting with 2 per cent. of potassium bichromate and 2 to 2½ per cent. of copper sulphate, of which one-third can be advantageously applied after dyeing.—E. B.

Peroxide of Sodium and its Application in Bleaching.
Prud'homme. Monit. Scient. July 1892, 495—496.

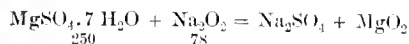
UNTIL a short time ago this substance was only known as a rare product of the laboratory. The peroxides of potassium and sodium were first described by Gay Lussac and Thénard in 1810. In 1876 Fairley obtained the sodium compound in a crystalline form of the following composition $\text{Na}_2\text{O}_2 \cdot \text{H}_2\text{O}$. H. Carrington Bolton prepared it in 1886 by dropping sodium into potassium nitrate.

The peroxide has lately been put on the continental market at a price of 5 francs per kilo. The German Patent deposited on 3rd February 1892, is not yet published and therefore the mode of preparation is at present unknown. The substance as sent out is of a yellowish-white colour, partially powdered, and dissolves in water with a notable rise in temperature and the disengagement of a certain amount of oxygen. It is very hygroscopic, gaining 20 per cent. in weight after 24 hours' exposure to the air. On heating it with aniline, azobenzene is formed. If water be added to the mixture, or to a mixture of peroxide and benzene, flames are produced, and in the latter case an explosion.

The peroxide contains about 20 per cent. of oxygen available for bleaching purposes, corresponding with the formula Na_2O_2 (20·15 per cent.). This percentage is very high, barium dioxide containing 8 per cent., and peroxide of hydrogen (12 vols.) only 1·5 per cent. It is decomposed by dilute acids, and a solution of peroxide of hydrogen may in this way be prepared.

Cellulose is strongly attacked and turned yellow by a 15 per cent. solution. If it be then washed and treated with dilute acid, it will take a darker shade when dyed with Methylene blue, in this way resembling "mereerised" cotton.

The sodium compound, on account of its strongly alkaline reaction, cannot be directly employed in the bleaching of fibres of animal origin, such as wool or silk. In this case de Haën recommends that peroxide of magnesium be employed. The author has previously studied its action in bleaching (this Journal, 1891, 834) and showed that it possessed greater stability than peroxide of hydrogen. In application, 3 parts of sulphate of magnesia, which must be free from chlorine, are added to 1 part of sodium peroxide proportions which allow a slight excess of the former salt, as shown in the following equation—



Method of Bleaching. (de Haën.) *Wool*.—Well scour the wool and enter into a bath containing 30 kilos. of sulphate of magnesia to every 100 kilos. of wool. Temperature of bath 30° C. Turn several times, lift, and add 10 kilos. of the peroxide, re-enter, and heat up to 60°—70° C., and keep at that for one hour; lift and pass through a weak sulphuric acid bath to get rid of magnesia, rinse, and dry as usual.

Tussah Silk.—Prepare silk in usual way, taking care to remove all soap by repeated washing. For every 100 kilos. of silk use 2,500 litres of water at 30°—35° C. Dissolve 90 kilos. of sulphate of magnesia in the bath, give silk 3—4 turns, and lift. Add in 2—3 lots, 30 kilos. of peroxide and note that the bath be well stirred after each addition. Heat up to 80°—95° C. and keep the silk in the bath for 1½—2 hours. Remove magnesia by passing through weak sulphuric acid, wash and dry, or pass on to dyer. This method is applicable to ivory, feathers, bone, or hog's bristles.

"Chappe" Silk.—Clean the silk in the ordinary manner and enter into a bath containing 2,500 litres of water to every 100 kilos. of silk to which have been added 36 kilos. of sulphate of magnesia; give several turns, lift, and add in small quantities 12 kilos. of the peroxide, stirring well. Work for ¾ hour at 95° C. and once or twice bring just up to a boil, and take out after 1 to 1½ hours. Acidulate with sulphuric acid as above, wash, and dry.

Half-Silk Goods.—(Wool and silk, or cotton and silk). Prepare the goods before bleaching and remove all soap by repeated washing. Enter into bath containing 30—36 kilos. of sulphate of magnesia, according to colour. Give several turns and add the peroxide, 10—12 kilos., and keep for ¾ hour at 95° C., finally arriving at a boil. Pass through sulphuric acid. For 100 metres of cloth, 60 centimetres wide, and weighing about 5 kilos, use 250 litres of water.

W. P. D.

On the Resistance of Oxycellulose to Colouration by Tetrazoic Dyes. M. G. Saget. Monit. Scient. September 1892, 640—641.

Wirtz in 1882 found that oxycellulose was dyed by basic colouring matters but not by acid colouring matters. In view of this, experiments were made to ascertain the effects of the tetrazoic dyes, which are of an acid nature.

The author has experimented with several dyes of this kind and find that they stain oxycellulose but slightly, if at all.—A. L. S.

A New Process for Photo-Dyeing. A. Villain.
L'Amateur Photographe, 1892.

See under XXI., page 1031.

PATENTS.

A New or Improved Machine for Dyeing one or more Warps. E. Brook, Slaithwaite. Eng. Pat. 22,060, December 17, 1891.

THE machine consists of a central shaft, carrying two discs or wheels, capable of being rotated partly in and partly out of the dye-vat. Between the two discs are cross bars or plates arranged in radial series, and these carry the warp which is wound round them in a continuous manner. These bars or plates are provided with curved or rounded edges and are capable of oscillation (whereby the plates of one radial series come into contact with those of its neighbouring series) for the purpose of gripping or holding the warp as it emerges from the dye-liquor.—W. E. K.

Improvements in Colour-Printing and in Apparatus to be Employed therein. J. L. Davies, London. Eng. Pat. 22,093, December 17, 1891.

THE object of this invention is to apply printing ink in a circular, elliptical, or curvilinear direction to blocks or surfaces for the production of rainbow or iridescent effects, in a circular or elliptical form. For this purpose a taper or conical inking roller suitably mounted on a circular inking slab is employed.—W. E. K.

Improvements relating to Rollers for Printing Fabrics and Wall Papers. H. H. Lake, London. From La Société Evesque and Cie., Lyons. Eng. Pat. 16,958, September 22, 1892.

THE design is drawn upon a lithographic stone or in fat-inks upon transfer paper, and then transferred to a plate of zinc or other metal, which is subsequently immersed in an acid vat, whereby the parts not covered with fat-ink are etched to the depth required. From this plate an impression is pulled off on either paper or lead, and this impression is then wound on a roller of wood and placed in a two-part cylindrical mould, which is heated by gas or steam. The roller of wood is next withdrawn, the axis of the roller put back in its place, and then into the mould thus prepared a mixture is poured of fused unattackable metal or plastic material, such as india-rubber. After hardening, the roller is removed from the mould, and is ready for use. The design may be prepared either in relief or intaglio, as desired. By a modification, the rollers, when made of zinc, copper, or other metal attackable by acid are engraved direct by gently rolling them with pressure against the fat-ink transfer of the design, and then submitting them to the etching process by means of acid.—W. E. K.

Improvements in Dyeing Silk or Half-Silk Goods. E. Zillesen, sen., Crefeld, Germany. Eng. Pat. 22,538, 24 December 1891.

UNKNOWN silk, to be used for the warp of a fabric (the weft of which may be silk, wool, or cotton, dyed or undyed) is prepared before weaving with fat and a metallic mordant. The prepared and unprepared fibres are then woven together in any optional pattern, and on dyeing up the fabric the warp and weft give shades or colours different the one from the other.—W. E. K.

Improvements in the Production of Azo-Colours on Fibre. B. Willcox, London. From the "Farbenfabriken vorm. F. Bayer and Co.," Elberfeld. Eng. Pat. 22,641A, December 28, 1891.

UNMORDANTED cotton is dyed with the tetrazo-dyestuff formed by the combination of one molecular proportion of a tetrazo-compound of benzidine, its homologue or analogue, with (a) two molecular proportions of Clève's alpha-naphthylamine-mono-sulpho acid (either beta- or delta), or (b) one molecular proportion of each of these acids, or

(c) one molecular proportion of either of these acids and one molecular proportion of an amine, phenol, &c. of the benzene or naphthalene series. The dyestuff thus fixed on the fibre is next diazotised by immersion in an acidified solution of sodium nitrite; and the resulting diazo- or tetrazo-product is then coupled with an amine, phenol, amidophenol, &c. of the benzene or naphthalene series, by immersion in its acid or alkaline solution.—W. E. K.

VII.—ACIDS, ALKALIS, AND SALTS.

PATENTS.

Process and Apparatus for the Manufacture of Cyanides. G. T. Beilby, Slatford. Eng. Pat. 4820, March 18, 1891.

IN this process ammonia gas is caused to pass over or to bubble up through a fused mixture of anhydrous carbonate of an alkali and finely-divided carbon, to which a sufficient proportion of alkaline cyanide has been added to make the mixture fuse at a low temperature. When carbonate of potassium is used, the reaction goes on satisfactorily at a temperature somewhat below the melting point of pure carbonate of sodium. The cyanide may be tapped from the bottom of the vessel in which the operation is conducted, and the mixed materials are fed in at the top. In this way cyanide containing 70 per cent. of potassium cyanide can be obtained. Or the temperature and duration of the operation may be adjusted so that the cyanide is sublimed. Various forms of apparatus are described and drawings of them are given. A melting pot of cast iron may be used, with an inlet tube at the bottom for the ammonia and a delivery tube at the top by which the gases escaping are carried away. These are subsequently treated to recover sublimed cyanide and unaltered ammonia. Another form of apparatus is fitted with revolving arms, which move the melted mixture over a series of superimposed shelves, so that it drops downwards from shelf to shelf, meeting a stream of ammonia gas as it falls. The carbon may be supplied by charcoal, lamp-black, gas-black, coke, or pitch, &c. By using pitch or coke made from the basic tars or from the crude oils of shale, coal, or peat, a large part of the nitrogen they contain may be recovered as cyanide. The specification also provides for the use of "volatile alkaloidal bases" as a source of the nitrogen.—H. S. P.

Improvements in Generators to be used in the Production of Hydrogen Gas. W. Hawkins, T. Hawkins, H. Fuller, and W. H. Fuller, Portsmouth. Eng. Pat. 13,379, July 21, 1891.

THE apparatus consists of a copper or lead box divided into four partitions, the upper two containing the solution of an acid, and the two lower ones the zinc or other metal to be acted upon.—H. A.

New Solid Compounds of Sulphur Trioxide, Water, and the Bi-Sulphates or Acid Sulphates of Sodium or Potassium. G. F. Brindley, Handsworth. Eng. Pat. 17,796, October 17, 1891.

THE object of this invention is to obviate the difficulties of transporting sulphuric acid, and for this purpose it is proposed to heat sulphuric acid of various strengths with potassium or sodium bisulphate; the mass is then carefully evaporated at temperatures between 200°–300° C. The hot liquids are run into drums and allowed to set. The resulting compounds have the composition $\text{H}_2\text{SO}_4 \cdot \text{NaHSO}_4$ or $3 \text{H}_2\text{SO}_4 \cdot 2 \text{NaHSO}_4$ with 1 molecule of water.—H. A.

Improvements in Means or Process for Producing Carbonic Acid Gas. D. Rylands, Stairfoot. Eng. Pat. 18,231, October 23, 1891.

CARBONIC acid may be economically produced by first carbonising coal in retorts, collecting the illuminating gas given off, and then lowering the temperature to about 1,100° F. Air is now admitted in quantities "which can be regulated to the greatest nicety for securing the best results." The carbonic acid so evolved is taken by means of a separate main to a scrubber, and after cooling is passed through a tower provided with shelves, where it meets with a shower of sodium carbonate solution. The resulting sodium bicarbonate is fed into a boiler, the carbonic acid boiled off and collected in a holder, whilst the solution is pumped back on the tower for absorbing fresh quantities of carbonic acid.

An alternate method consists in burning in the retorts a mixture of coke and limestone.—H. A.

Improvements in the Manufacture of Salt. J. E. Bott, Stockport. Eng. Pat. 18,481, October 27, 1891.

The invention refers to the evaporation of brine. The apparatus consists of a cylindrical evaporating vessel suspended on hollow trunnions. One of these acts as part of the main flue from a furnace, in which air is heated under pressure; it is then continued to a chamber formed in the evaporating vessel by means of a diaphragm acting like a false bottom. The air thus heated, now passes through vertical perforated pipes which are covered with the solution. The other hollow trunnion serves for carrying away the steam and air, and for this purpose is separated from the rest of the vessel by means of a pocket reaching almost to the top lid. The waste heat may be utilised for heating up fresh quantities of solution in similar vessels arranged in series. After sufficient evaporation the vessel is disconnected, the lid unscrewed and the vessel discharged by tilting it over on its trunnions.—H. A.

Improvements in the Manufacture of the Oxides of the Alkaline Metals. H. Y. Castner, London. Eng. Pat. 20,003, November 18, 1891.

THE metallic sodium or potassium is placed in aluminium dishes or trays, which are placed on tram carriages running through an iron tube. The tube is built into a furnace and its ends are tightly closed by end-plates. Air is admitted at one end of the tube, passed through the tube and out at the other end. The tube is heated to about 300° C. The air is first freed from moisture and carbonic acid, and by its means a gradual oxidation of the alkaline metal takes place, the metal at the end nearest the entrance of the air being first converted into peroxide, whilst the air in travelling through the tube gradually becomes deprived of oxygen, so that the metal at the air-exit end undergoes oxidation very slowly in an atmosphere containing very little oxygen. As the finished product is drawn out at one end of the tube a fresh charge is inserted at the opposite end, the tram carriages being pushed along the tube to admit of fresh trays being placed in it.

—H. S. P.

Improvements in and Apparatus for the Manufacture of Alkaline or Earthy-Alkaline Bases, and of their Salts or Compounds by the Electrolysis of Saline Solutions. E. Hermite and A. Duboscq, Paris. Eng. Pat. 21,957, December 15, 1891.

See under XI., page 1015.

An Improved Process for the Preparation of Pure Nitric Acid. E. Edwards, London. From O. Guttmann and L. Rohrmann, Muskau, Germany. Eng. Pat. 22,481, December 23, 1891.

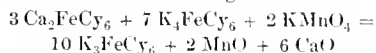
NITRIC acid prepared in the usual way by distillation, contains a varying proportion of lower oxides of nitrogen, such as nitrous acid, depending upon the amount of chlorine in the nitrate of soda used. These lower oxides have always been removed from the finished acid by heating it and blowing air through. This improved process effects the removal of the nitrous acid by blowing air into the gaseous acid before it is condensed. In this way the nitrous acid in the presence of the water in the acid, and air, is converted into nitric acid, the abstraction of the water resulting in a stronger distillate being formed, whilst the creation of a slight vacuum and the more rapid carrying forward of the acid vapours causes a more rapid distillation.

—H. S. P.

Improvements in the Production of Salts of Ferri-cyanogen. A. M. Clark, London. From the Deutsche Gold und Silber-Scheideanstalt, Frankfurt-on-Maine. Eng. Pat. 22,558, December 24, 1891.

IN the manufacture of alkaline ferri-cyanides, such as red prussiate of potash, by the oxidation of the corresponding ferro-salt by means of chlorine or bromine, the ferri-salt is obtained contaminated by the bromides or chlorides which pass into solution with it; or when an electric current is used for effecting the oxidation, caustic alkali is formed, and renders the ferri-cyanide impure. This invention obviates this difficulty by conducting the oxidation in presence of an alkaline-earth salt, preferably calcium ferrocyanide.

The following is stated to be the reaction when potassium permanganate is used for oxidising:—



The manganous oxide and the greater portion of the caustic lime remain undissolved. After filtering, the small quantity of caustic lime in solution may be precipitated by carbonic acid. The electric current may also be used for oxidising, and an equally pure product obtained. If chlorine or bromine be used, a better yield is obtained by introducing the calcium ferrocyanide, although the resulting product is not so pure. A double ferrocyanide of an alkali and alkaline earth may be used instead of mixing the two salts.—H. S. P.

Improvements in the Manufacture of Carbonates of Strontium and Barium. J. Brock and J. T. Marsb, Widnes. Eng. Pat. 22,541, December 24, 1891.

IN the usual method of manufacturing these carbonates, the bases are obtained in solution as sulphides or hydro-sulphides. On treating this solution with carbonic acid gas the base is precipitated as carbonate. But owing to the presence of polysulphides in the solution and of traces of oxygen in the carbonic acid gas, some free sulphur is always precipitated with the carbonate of strontium or barium, and, combining with the carbonate during the subsequent operation of drying, spoils the product.

The patentees remove this sulphur by boiling the precipitated carbonate suspended in water with the corresponding hydrate of the base. About 2 cwt. of strontium hydrate crystals suffice to remove the sulphur from an amount of the precipitated carbonate of strontium equal to one ton of the dry carbonate, and in the case of barium about 2½ cwt. of crystallised barium hydrate is required. The sulphur combines with the hydrate, and the operation is usually effected after boiling for about half an hour. The precipitated carbonate is then separated by a filter-press or in any other way, washed and dried. The solution of hydrate from the press may be used for dissolving a fresh portion of sulphide, and after crystallising out the hydrate, treating the mother-liquor with carbonic acid gas, by which means the strontium or barium in solution is recovered without loss.—H. S. P.

Improvements in Apparatus for Evaporating and Incinerating Spent or Used Alkaline Lyes or similar Waste Products. A. S. Caldwell, Lasswade, N.B. Eng. Pat. 192, January 5, 1892.

THE improved apparatus comprises a "splash" chamber and incinerating furnace. The "splash" chamber has a pan-shaped bottom upon which the more or less concentrated lye is run from a tank. Over one end of the chamber is a circular tower, whilst at the other end are three hearths arranged in steps one below the other, the height of each step being such as to enable a door to be placed at the end of each hearth through which a tool may be thrust for raking the drying material from one hearth down on to the next one below it, and for raking the incinerated material out of the lowest one. On either side of the end of the lowest hearth is a small fire-grate for burning the fuel which dries and incinerates the lye. The hot gases from these grates pass over the hearths and through the splash chamber, up the tower, and then down into a flue, where they are drawn away to a chimney, an increased current being also obtained by means of a fan or blower placed at the bottom of the flue from the tower. In the splash chamber are a number of paddles which throw up the liquor in spray, thus assisting the evaporation of the liquid. When sufficiently dried in this chamber the material is then raked on to the first hearth, and afterwards on to the second, and finally on to the third, where its incineration is completed. To prevent particles of lye being carried away in the opposite direction by the current of gases, screens are hung in the splash chamber, and the object of the tower over the end of the splash chamber is to further allow of the deposition of liquid and prevent it being carried into the flue. By a modified form of tower the deposition of liquid is further assisted by the gases being caused to pass upwards in a helical manner, so that the globules of liquid are thrown against the side of the tower. There are other details of construction, including air passages in the walls of the furnace, where air is heated by radiated heat from the furnace.—H. S. P.

Improvements in Means or Apparatus for the Manufacture of a Mixture of Hydrochloric Acid Gas and Air. La Société A. R. Peehiney et Cie., Salindres, France. Eng. Pat. 8276, May 2, 1892.

THIS improvement refers to apparatus for the production of a mixture of gaseous hydrochloric acid and air from solutions of hydrochloric and sulphuric acids.

The apparatus consists of a vessel where the acid solutions mix and from whence they overflow into a tower packed with flint. A current of air passes up this tower, liberating the hydrochloric acid and eventually mixing with the whole of the gas given off. The resulting gas mixture may be used for the preparation of chlorine by the Deacon process.

The mixing of the acids proceeds in a closed vessel divided by means of a partition wall into two unequal parts, which communicate on the tops and on the bottom. The narrower part is provided with shelves to produce a better mixture of the liquids, which then pass under the partition-wall and rise to a certain height in the second compartment, finally overflowing into the tower. On the other hand, the hydrochloric acid gas given off in the first compartment passes above the partition-wall into the second compartment, and from thence into the tower, forming one stream with the hydrochloric acid gas given off there.—H. A.

Improvements in the Method of and in Apparatus for the Production of Carbonic Acid Gas. W. Stones, R. Bardsley, and T. H. Hayes, Manchester. Eng. Pat. 15,275, August 25, 1892.

THE apparatus is to regulate the supply of gas from a carbonic acid gas generator (in which the gas is generated by acid from a carbonate) according to the required rate of consumption. The gas passes from the generator into the lower part of a closed vessel containing water, whence it is drawn away as required by a pipe at the top of the vessel. There is also a pipe in the lower part of this vessel, which connects it with an open vessel placed on a higher level.

The pressure of the gas on the surface of the water in the closed vessel forces some of the water up into the open vessel, and the level of the water in the latter vessel rises and falls according as the pressure of the gas above the surface of the water in the closed vessel increases or diminishes. By means of a floating ball on the surface of the water in the open vessel, to which a lever is attached, a valve is opened or closed in a third vessel containing acid, so that when the consumption of gas is increased and the pressure in the closed vessel falls, causing a corresponding fall of level of water in the open vessel, the valve in the acid tank is opened, allowing more acid to flow into the generator and thus increasing the supply of gas; and on the contrary, when the consumption of gas is decreased, the ball floats rises and effects the closing of the acid valve, thus diminishing or cutting off the supply of acid to the generator.—H. S. P.

New Process for the Production of the Cyanides of the Alkalis and Alkaline Earth by the Simultaneous Employment of a Hydrocarbon and Ammonia Gases, with the addition, if desired, of Free Nitrogen. H. J. Haddan, Loudon. From the Viscount of Lambilly, Paris. Eng. Pat. 15,513, August 29, 1892.

THE process consists "in the simultaneous decomposition by heat of a mixture of hydrocarbon gas with ammonia gas, to which it is of advantage to add also free nitrogen, in the presence of an easily cyanisable alkali or alkaline earth, such as the carbonates or oxides of potassium, sodium, or of barium."

The free nitrogen is obtained by passing air over copper at a red heat. The hydrocarbon gas may be obtained in any of the known ways, by distillation of coal or animal or vegetable matter, and the distillation should be carried on at as low a heat so as to obtain a gas as richly carburetted as possible. Two methods are described for increasing the proportion of hydrocarbons in the gas, the one by passing the gas over the copper oxide obtained in making oxygen-free nitrogen at a red heat, thus removing a portion of the free hydrogen and a part of the combined hydrogen; and the other, which forms one of the claims in this patent, by passing the gas through a series of cylinders filled with pieces of carbon impregnated with a liquid hydrocarbon, such as coal-tar or heavy oils, or a mixture of carbon and powdered rosin, the cylinders being heated to a temperature below that at which the hydrocarbons commence to distil varying from 40°–50° for petroleum oils up to 300°–350° for rosin. Gas already used for cyanisation may be re-carburetted in this way and so used over and over again. The ammonium gas may be obtained in any known way. It is collected in a gasometer to be mixed either with the hydrocarbon gases alone or with these and with free nitrogen.

The material to be converted into cyanide is prepared by adding "to a concentrated solution of carbonate or oxide of potassium or sodium at least 100 parts of powdered carbon for every 100 parts of alkali. This solution is evaporated to dryness and 20–30 parts of powdered chalk and 50 parts of iron filings added. It is useful to agglomerate this mixture by adding pitch or tar" and making it up into briquettes. This mixture is charged into iron cylinders and heated until gases cease to be evolved, the evolution being assisted by exhausting the cylinders with a pump. When no more gas comes off, the mixture of hydrocarbon, ammonia, and nitrogen gases is passed into the cylinders under slight pressure. After cyanisation the mass in the cylinders is withdrawn and lixiviated as in the ordinary processes to obtain the ferrocyanide of the alkali used. The solid residue is used again in the process, serving as an absorbent for a fresh solution of alkali. (See also this Journal, 1891, 642, and 1892, 604).—H. S. P.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

PATENTS.

Improvements applicable to Furnaces or Retorts used in the Production of Glass and for similar Purposes. D. Rylands, Stairfoot, Yorks. Eng. Pat. 18,230, October 23, 1891.

THE invention relates to utilisation of waste heat in the process of glass manufacture by the action of superheated steam upon sand mixed with chlorides. In the first place a suitable floor is fixed over the crown of the melting furnace, the heat from which evaporates to dryness the solution of chloride of calcium which is brought from the bleach-powder works. The calcium chloride is then mixed with salt and sand in a chamber which is kept at a proper temperature for the dry-mixing of a hygroscopic body by the waste heat from a flue and retort below. It is in this retort where the chemical action takes place, superheated steam being admitted and glass "frit" and hydrochloric acid formed. The frit is passed into the melting furnace and the hydrochloric acid gas is carried over by a pipe and condensed in the usual way.—V. C.

An Improved Process for the Electro-deposition of Metal upon the Surface of Glass, Porcelain, China, Earthenware, and other Materials. A. S. Ford, London. From H. Pottier, Paris. Eng. Pat. 18,256, October 23, 1891.

THE difficulty of obtaining a satisfactory metallic coating by means of electro-deposition upon glass, porcelain, and earthenware, is in this invention overcome by applying to the surface of the article a paste containing borate of lead, finely-divided silver, and oil. The article is then heated in a muffle furnace, after which the surface will receive a firmly adherent deposit by electro-deposition.—V. C.

Improvements in the Construction of Tank Furnaces for the Manufacture of Glass. T. C. J. Thomas, London. Eng. Pat. 19,777, November 14, 1891.

IN a former patent granted to the inventor (Eng. Pat. 12,076 of 1886) a process is described for eliminating impurities in the frit by the action of a blast of oxygen or air.

The present invention relates to the construction of a tank furnace for carrying out this process, the wall of the furnace being provided with one or more downward inclined gas passages, having their outlet ends terminating below the level of the frit. The passages, which are lined with refractory material, are connected with a common supply pipe provided with a regulating valve.—V. C.

A New Product to serve as a Substitute for Pottery for Filtering Purposes, and for the Manufacture of Tobacco Pipes and the like. J. E. G. Méran, Paris. Eng. Pat. 20,861, November 30, 1891.

ASBESTOS fibres are of smaller diameter than any others, whether of animal, vegetable, or mineral origin, and yield on pulverisation particles so fine that when agglomerated and moulded into a suitable form a filtering medium is obtained which will not allow bacteria to pass, and is therefore eminently suitable for sterilising liquids. After a filtration the material may be cleansed by heating. The material is also suitable for the bowls of tobacco pipes and may be used as a substitute for ceramic ware generally.

—V. C.

An Improved Process for Producing Colours on Glass Surfaces. J. C. Duntze, Frankfort. Eng. Pat. 16,241, September 10, 1892.

PREVIOUS to this invention coloured designs produced upon glass by mechanical means have never possessed sufficient transparency to form a perfect substitute for stained glass. In this invention the required transparency is obtained by means of the following process:—The transfer colours are taken off on transparent transfer paper, which before being moistened, is pressed against the surface of the glass by rubbing until the colours begin to adhere. It is then moistened and further rubbed until the moisture has nearly, but not quite, disappeared from the paper, whereupon the paper is taken off.—V. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Portland Cement and Portland Cement Concrete. H. K. Bamber, E. A. Carey, and W. Smith. Proc. Inst. Civil Eng. 107, Session 1891—92.

ONE of the meetings of the last session of the Institution of Civil Engineers was devoted to the reading of three papers upon the subject above mentioned, and two subsequent meetings to the discussion which was taken on all three papers at once, as they were of cognate import. The first paper was by H. K. Bamber, on "Portland Cement, its Manufacture, Use, and Testing." With regard to the testing it is pointed out by the author in this paper, that the usual method of ascertaining whether the cement has been burnt hard enough, namely, the weight per bushel, is fallacious, as many causes other than the true density of the cement particles, affect the results. He urges the substitution of the determination of the specific gravity, stating that a good cement, when new, will have a sp. gr. of 3.1 to 3.15, while if it fall below 2.9 the cement has either been improperly burnt, or has become deteriorated by exposure to the air. He details his method of taking the specific gravity of cement, water being used instead of turpentine, which is generally adopted because of the action of water on cement even when the exposure is short. The alteration is made on the ground that the expansion of turpentine by rise of temperature is inconveniently great. He deprecates the practice of aerating cement with a view of rendering it free from tendency to blow, stating that with a well-burnt cement of proper composition such a process is unnecessary. The fineness should be such that the whole of the cement would pass through a sieve having 2,500 meshes per square inch, and not less than 90 per cent., through one with 5,625 meshes. Experiments were made on the proper proportion of water with which to mix concrete. Blocks composed of four parts of shingle, two of sand, and one of cement, were used, the cement being newly ground. It had the following composition:—

Silica.....	23.32
Alumina and ferric oxide.....	12.13
Lime.....	61.56
Magnesia.....	1.07
Sulphuric acid (sic).....	1.28
Carbonic acid.....	0.30
Organic matter and loss.....	0.34
	<hr/> 100.00

Three sets of blocks of the mixture given above were made in duplicate with varying proportions of water. The first were mixed with as much water as the cement would take up, which proved to be 10 lb. for each block. The second with 7.5 lb. of water, the third pair with 5 lb. After standing for a fortnight one of each of these sets was placed on a sea wall for 12 months, being constantly covered and uncovered by the tide. On breaking them at the end of

the test it was found that the one with 10 lb. of water was hard and sound and dry throughout; that with 7.5 lb. was dry in the middle, but on every side the water had penetrated about 3 in. and had much weakened the block; that with 5 lb. was wet right through, the sea water having been able to percolate through the block and remove much of the lime. It was quite weak. The check experiments were made on the remaining blocks of each set, fresh water being, however, used instead of sea water, the penetration of the water being similar to that observed with the previous specimens. It was noticed that with No. 1 (that with 10 lb. of water) the water in which it stood remained clear; with No. 2 the water became turbid from the presence of carbonate of lime; and in the case of No. 3 the turbidity was greater, and at the end of 12 months the whole block being covered with crystals of carbonate of lime, $\frac{1}{4}$ to $\frac{1}{2}$ in. in thickness. The experiment on the blocks exposed to the sea gave the same results when extended to three years. The influence of the quantity of water in concrete on its porosity was shown by the following experiments. Blocks were made consisting of 5,184 cub. in. of shingle, 2,592 cub. in. of sharp sand, 1,296 cub. in. of cement mixed with 30 lb. of water, and this amount sufficed to exactly fill a box 18 in. cube. Another mass, precisely the same in composition save that 15 lb. of water were used instead of 30 lb., more than sufficed to fill the same box, only seven-eighths of the mixture being contained by it. The obvious deduction is that the latter was more porous than the former. The author concludes that it is necessary, in order to secure sound concrete, to ensure its being thoroughly wet so that it may be non-porous, and the water with which it may be placed in contact be prevented from washing in and out. In the case of sea water this is especially important, because of the well-known destructive action of the magnesium salts therein on the lime compounds in the cement, should it obtain access to the heart of the work. Attempts to make the concrete extra strong by mixing it as dry as possible defeat themselves.

A paper was read on "The Inspection of Portland Cement for Public Works," by A. E. Carey. Dealing with the raw materials the author states that the average proportion of coarse sand as determined by elutriation, is 3 per cent. in gault clay, and in Gillingham mud 7.9 per cent. Grey chalk is more easily washed than white, but needs greater vigilance with the calcimeter owing to its more variable composition. The fine state of division of the carbonate of lime left as a waste product in Chance's sulphur recovery process, recommends it as a raw material for the manufacture of cement. The wash mill should be driven at about 22 revolutions per minute, and the minimum of water should be used; 25 per cent. suffices. Assuming the ordinary semi-dry process to be used, the wet grinding after the cement comes from the wash mill must be sufficient to reduce the raw materials to a point at which the dried slurry leaves not more than 8 per cent. on a sieve having 22,500 meshes per square inch. So good a result is difficult to attain, and it is usual to pass a handful of the slurry through a 1,600 or 2,500 mesh sieve, testing the fineness by the absence of grittiness to the touch. As has been shown by Le Chatelier the spontaneous disintegration of clinker is due to the presence of dicalcium silicate (this Journal, 1888, 567).

The picking out of the pink and yellow underburnt clinker is most important, and in one specification mentioned it is insisted that this shall be done by daylight. As long ago as 1865 Sir F. Bramwell pointed out that the specific gravity of cement is one of the data by which its quality can be judged. The weight per bushel should be abandoned as too inexact to be useful, and the determination of the specific gravity adopted to its stead. With regard to the fineness of cement the old demand for a residue not exceeding 10 per cent. on a sieve with 2,500 meshes per square inch is fast becoming obsolete, as it is really only the floury part of cement that has any cohesive properties. The residue left on a sieve with 32,257 meshes per square inch (5,000 per square cm.) has practically no cementitious value. The increased value of a finely-ground cement is more apparent with sand than with neat tests. The practice of sifting the cement as it comes from the stones does not necessarily conduce to finer grinding, as the miller, trusting to his sieves

to reject the coarser particles, might set his stones so as to produce a cement of coarser average than would be possible if grinding without sieves. The following figures show the effect of fine grinding. The cement used had a specific gravity of 3.125, and was gauged with three parts of standard sand to one of cement, and 10 per cent. of water, at a temperature of 46° F. The mean results for six briquettes for each test at 28 days were:—

	Tensile Strength Lb. per sq. in.
Original cement, 9 per cent. on a sieve with 2,500 meshes.....	220
Cement with residue above mentioned removed.....	304
With residue on a 5,025 sieve removed.....	311
With residue on a 32,257 sieve removed.....	360

Cement, as it leaves the stones, has a temperature of 150°—160° F., and in grinding to a fineness corresponding to a residue of 8 per cent. on a 2,500 mesh sieve, a pair of 4½ ft. stones running at 140 revolutions per minute produces 25—32 cwt. per hour, and absorbs 35 to 40 horse-power. Edge-runners do not appear to yield good results, from the absence of the shearing action characteristic of stones. Modern modifications of the edge-runner, however, may give cement that is of higher strength for the same degree of fineness than that from stones, while in one case mentioned the power absorbed per ton per hour was 14.96 horse-power, and the cement left the mill at a temperature of 77°—75° F. In the author's opinion aeration is desirable to remove the baneful effects of free lime, and he suggests that in view of the change that cement often suffers on long voyages, it might in some cases prove convenient to export clinker and grind it at its destination. With respect to testing he is in favour of the 1 in. × 1 in. briquette; even a half-inch size might be useful for rapid testing. He recommends the Dietrich form of calcimeter, and doubts the advisability of introducing compressive tests into ordinary specifications. He deprecates the issue of standard regulations for the testing of cement such as are in use in Germany, France, Russia, and elsewhere, as it might tend to check the progressive improvement in quality that has been so marked a feature of late years when no such standard existed in this country. There is, however, appended to his paper a specification that might serve as a standard, should one be adopted. Its chief point of novelty is the insistence on the necessity of determining the specific gravity, which is fixed at a minimum of 3.1. The Arnold apparatus for making briquettes without hand-trowelling, although ingenious, should not displace ordinary gauging by hand, as the operator is better able to judge the quality of the cement by actual manipulation. An objection to the apparatus is that it is more favourable to a light than a heavy cement, as owing to its greater volume the former is more compressed than the latter. A quick setting cement is put at a disadvantage, as the immersed face becomes set before the water penetrates to all parts of the briquette. Further, as the briquettes are dealt with in a series at one operation, the weight of the water absorbed by each cannot be accurately measured. Its results cannot usefully be compared with those got by hand gauging. Although in gauging briquettes for tensile tests the smallest proportion of water that can be used gives the highest results, yet higher figures are obtained in compressive tests when plenty of water is taken. Thus a cube made of one part of cement and three of normal sand gauged with 10 per cent. of water had a crushing strain of 1,425 lb. per square inch, while one with 20 per cent. of water crushed at a load of 1,679 lb.

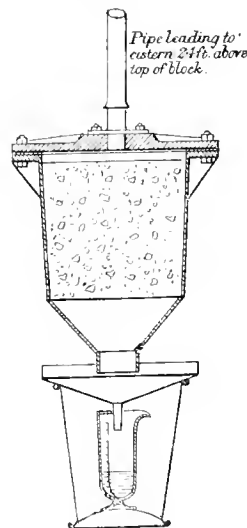
Silt in the water used for making concrete has a deleterious influence on the cement. An experiment was made to show how far this occurred. Six briquettes were gauged neat with 20 per cent. of distilled water (the cement having a specific gravity of 3.1), and took three hours to set, and had an average tensile strength of 480 lb. per sq. in. Another test was made, in which the water was mixed with one-fiftieth of its weight of Thames mud, corresponding to about one-hundredth by volume, and took four hours to set, and broke at 411 lb. Experiments were also made to ascertain the effect of frost on the strength of

cement, and are recorded in one of the appendices of the paper. Briquettes gauged with water at 55°—60° F. and immersed in water of the same temperature, had a tensile strength of 540 lb. at seven days, and one of 585 lb. at 14 and 28 days. Briquettes of the same cement, gauged in the same manner, but subsequently exposed to a temperature ranging from 22°—41° F. had a tensile strength of 357 lb. at seven days, 552 at 14 days, and 595 at 28 days. The deduction is therefore that exposure to frost only delays the increase of strength of cement, but does not affect the final result. (This Journal, 1889, 393.) The influence of frost on concrete may however be serious on account of the disruptive force of the frozen water it contains, and the best means for preventing it has occupied the attention of the Russian and American authorities. It has been found that the addition of common salt to the water, up to the proportion of 8 per cent., enables work to be carried on even in severe weather. The contrary effect to the retardation due to frost, is observed in work exposed to a tropical or sub-tropical climate. The author calls attention to the well-known phenomenon that the tensile strength of cement may fall off while the compressive strength continues to increase, and attributes it to a change in the molecular structure of the cement.

With regard to the effect of magnesia in cement, the author remarks that in the case of notorious failures that have occurred in cements from the presence of magnesia, the percentage of that substance is far in excess of the quantity existing in normal and marketable Portland cements. (This Journal, 1889, 781; also 1890, 943 and 1037.) He quotes the case of a failure of cement not containing excess of magnesia, but over-limed and under-burnt, in which a 6-in. flooring of concrete forced the walls of a building which were 18 in. thick, out of line, and eventually crumpled up the floor itself, causing it to assume a serrated form and finally to disintegrate, as an analogous instance of the blowing tendency of excess of basic material in the cement, whether in the form of lime or magnesia. He draws a clear distinction between the magnesia originally present in cement, due to the use of dolomitic raw materials, and that found in disintegrated concrete which has been exposed to the action of the sea, and has been derived from the sea water by the precipitating action of the lime in the cement, maintaining that the white deposits arising from the latter cause, are themselves harmless, and are only evidence that damage has already been done by the reaction with the lime of the cement aforesaid. Experiment made to test the porosity of concrete and the diminution in porosity by the application of a coat of cement or cement mortar, showed that concrete mixed in such proportions as one part cement, three parts beach, and three parts coarse sand, was fairly porous, an average leakage of one gallon a day through a plug 12 in. thick taking place under a head of 30 ft. of water. Stirring cement into the water resting on the plug, and allowing it to settle, had little effect in diminishing the leakage, as the cement did not set, and acted much as a similar amount of clay might have done. When the surface of the concrete was rendered with a layer of neat cement or of cement mortar laid evenly on, however, the leakage practically ceased. Cement grout run on to the surface of the concrete had little effect. In conclusion some results are given of the influence of sugar, carbonate of soda, and common salt on the strength of cement. The cement used had a specific gravity of 3.03, and left a residue of 9.5 per cent. on a 2,500-mesh sieve. It had a crushing strain at three months of 7,392 lb. per sq. in. when tested neat, and one of 2,112 when mixed with three times its weight of sand. The addition of 5 per cent. of common brown sugar caused three of the test-pieces prepared with it to fall to pieces before they could be placed in position in the testing machine; three others gave an average breakage strain of 2,557 lb. per sq. in. A similar experience is recorded with the sand tests, three of the test-pieces crumbling spontaneously and the remaining three giving a result of 1,358 lb. Twelve test-pieces containing 2.5 per cent. of sugar, with and without sand, all went to pieces; the contraction was more marked than with those containing 5 per cent. of sugar. In all cases a large quantity of

a tasteless gelatinous substance exuded from the blocks: they also contracted greatly on setting, especially the neat samples. With 2.5 per cent. of washing soda, a compressive strength of 2,862 lb. was observed with the neat cement, and 855 lb. with the sand, the figures becoming 2,841 and 1,241 respectively when the amount of soda was doubled. 2.5 per cent. of common salt gave a strength of 3,590 lb., and 932 lb. with neat and sand test-pieces.

The third paper was by W. Smith on "The Influence of Sea Water upon Portland Cement Mortar, and Concrete." The author recounts the nature of the damage done at Aberdeen, where a failure of concrete work occurred some years ago which has been the immediate cause of the anxiety that has been displayed in this country, both as to the effect of the presence of magnesia in Portland cement, and that of the action of the sea on its chemical and mechanical stability. The matter was reported upon by the late Prof. Brazier. The deduction drawn by engineers from this case and others is that it is of paramount importance to make concrete structures exposed to flowing water, and in particular sea water, impervious, so that in- and out-percolation may not take place and produce the destructive effects that have been observed when this condition has not been fulfilled. Accordingly the author carried out some experiments to ascertain what was the permeability of concrete mixed in different proportions. The apparatus shown in the Figure was



APPARATUS FOR TESTING THE PERMEABILITY OF CONCRETE.

used. It consists of a cast-iron box in which to mould and contain a cubic foot of concrete. It is provided with a conical bottom, ending in a square pipe, and is fitted with a water-tight cover, having a socket for the reception of the end of the pressure pipe connected with an overhead tank 21 ft. above the top of the block of concrete, and containing sea water. The results of the experiments, which are given in the form of an appendix at too great length to transcribe, show that to obtain an impermeable concrete (1) the cement must be finely ground, leakage occurring with a cement that left a residue of 10 per cent. on a 2,500-mesh sieve, while one that left only 2.5 per cent. on a 5,800-mesh sieve, made up in the same way was much less pervious. Coarse Roman cement was also very far from impermeable. (2.) That the cement should not be present in a smaller proportion than 1 to 6 of sand and stones. (3.) That the concrete should have sufficient time (at least three months) to set before the application of the pressure. If any of these conditions are made less favourable to the impermeability of the concrete, the remainder must be altered in the opposite direction. The author emphasises the innocuousness of the quantity of magnesia

present in Portland cement of good quality, and with regard to that deposited by the double decomposition of the magnesium salts in the sea water with the cementitious lime compounds in the concrete, points out that the continuance of the reaction, and the consequent destruction of the work, can only take place where, on account of the influence of a head of water or the extreme porosity of the concrete, the sea water has constant access to it, and thus continually introduces fresh quantities of magnesium salts. The rate of hydration of magnesia has been determined by H. T. Jones of Aberdeen University, who found that in 24 hours it absorbed 36 per cent. of water, in 48 hours 38.74 per cent., and in nine days 44.3 per cent., theory demanding 45 per cent. calculated on the original magnesia, showing that the rate of hydration was more rapid than that of Portland cement. No information is given as to the temperature at which the magnesia had been burnt. Analyses are given of a sample of Roman cement containing 2.47 per cent. of "sulphuric acid," the quotation of the figures being apropos of the alleged effect of quantities of sulphuric anhydride of this order of magnitude on the stability of cement concrete. In this instance no ill effects could be traced to its presence.

Dealing with preventive and remedial measures, the author demonstrates the futility of trusting to the impermeability of a film of calcium carbonate on the concrete, whether produced by exposure to air or more rapidly by washing the blocks with a solution of ammonium carbonate, as this is not sufficient to resist the entrance of sea water under pressure. He considers that the exclusion of the water by a film of Portland cement mortar cannot be permanently effective. Any accidental imperfection in the impervious coating will admit water and allow the destruction of the concrete beneath it. A lining of fine concrete 2-3 feet thick is more satisfactory, but again mischief may arise from the penetration of sea water through accidental openings to the porous hearting of the work. He concludes that the only certain way of building large masses of concrete or masonry for immersion in sea water under variable pressure, is to make the entire mass impermeable. It then becomes a question of expense whether Portland cement concrete may be more suitable for any work in sea water than masonry. Taking local prices (Aberdeen), he estimates the cost per cubic yard of the former at 11.0s. 2d., and of the latter, using cement mortar, at 19s. 8d. The forcing out of place of massive blocks of concrete may be traced in some cases to the presence of cavities in the work, which allow of sudden compression of the air in them by the waves and subsequent release, the action being purely mechanical, but sufficiently vigorous to eject blocks whose adhesion has been weakened by previous chemical decomposition.

A lengthy discussion on the three papers took place, certain portions of which are suitable for abstraction. H. Hayter endorses the necessity of adopting the determination of the specific gravity of cement in place of that of the weight per bushel. He quotes the case of the destruction of concrete at Belfast, in which analysis showed that the creamy deposit found in the damaged portions contained 80 per cent. of magnesium hydrate, and draws attention to the utility of the Deval hot test for excess of lime (this Journal, 1891, 255). L. Williams points out that as a rule Thames and Medway cements are to be preferred to those from the North country. T. Pevan mentions a case of a sample of cement weighing 112 lb. per bushel when shipped, and only 102 lb. on its arrival in the interior of Australia. E. W. Young contributes some figures obtained in testing cement at Cockatoo Island, New South Wales, in which the effect of a long sea voyage in lowering the specific gravity is evident. The highest observed was 3.15 and the lowest 2.63 (*sic*), while the mean was 3.075. H. Faija demurs to the supposition that magnesia in cement can be regarded as a passive diluent, and is of opinion that it should be regarded as so much lime. An instance of the decomposition of blue lias lime by sea water is given by C. Harrison. At West Hartlepool, concrete composed of 1.5 parts of blue lias lime, 1.5 of clean sand, and 0.5 of forge clinders was used for the construction of dock walls and entrance locks. After being in place for seven years from the time when water was admitted to the docks, the

whole of the mortar below high water-mark was found to have become soft. Commenting on this, J. W. Barry observes that such failures are due to the omission of thorough slaking of the hydraulic lime before use. At Barry Docks the lime, after having been drawn from the kilns, was completely wetted in sheds, and covered up with sand for not less than seven nor more than 14 days before being used. H. C. Seddon mentions an instance of the decomposition of concrete by ferruginous water, which percolated through comparatively porous mixtures, and in so doing became coloured green (due to the presence of ferrous sulphide), and contained sulphuretted hydrogen.

In the correspondence upon the papers the following views are worth recording. W. Sowerby states that in India certain lime nodules, supposed to be remnants of broken up coral reefs, are calcined, mixed with burnt clay, calcined ironstone and sand in about equal proportions, and incorporated in a mortar mill, the mixture serving as hydraulic mortar. The same purpose has been served by mixing calcined iron ore with lime. In Madras, where shells are used as the raw material for mortar, coarse sugar is added with good effect (this Journal, 1889, 545).

W. Matthews suggests the precipitated calcium carbonate produced by the Clark process for softening water, as a raw material for cement. P. J. Neate contributes the following figures for the expenditure of energy in grinding clinker. Taking the specific heat of cement as 0.155, a ton of cement raised in temperature by grinding from 60° to 200° F., would require the expenditure of 37,500,000 ft. lb. A pair of mill stones, 4.5 ft. in diameter and running at 140 revolutions per minute, would grind 25 cwt. of cement per hour and absorb 40 I.H.P., of which 23.7 horse-power would, from the above calculation, appear as sensible heat in the cement. A better result has been obtained with a large four-runner mill, having all its runners acting on the same inclined path in succession, 14 horse-power being used, and the cement delivered at a temperature of 70° F. The thermal economy of a cement kiln is considered by B. H. Thwaite. Taking the specific heat of the raw materials as 0.18, and the clinkering temperature as 3,000° F., the theoretical expenditure of heat necessary to raise them to this temperature is 1,209,600 heat units. The actual expenditure is from five to 10 times as much, so that the degree of economy is very poor. H. K. G. Bamber gives a table showing the decrease of specific gravity of cement on keeping, but as no information is given as to the conditions of exposure of the samples to the air, no end can be served by quoting it. W. G. Margetts has experimented with the Deval hot test (this Journal, 1891, 255), but has adopted the boiling point of water in place of 80° C. (176° F.) prescribed by its originator, and endorses the results obtained by him. H. N. Draper recalls the work of Le Chatelier (this Journal, 1888, 567, 847), and from the results arrived at by the French chemist, calculates that the theoretical quantity of water for the complete hydration of the tri-calcium silicate and tri-calcium aluminate present in a sample of cement of normal composition, is 41 per cent., an amount greatly in excess of that generally used in gauging test briquettes. The supposed disintegration of concrete exposed to sea water by the expansion of the magnesium hydrate resulting from the double decomposition between the lime compounds in the cement and the magnesium salts in the water, is proved to have no foundation in fact from the following considerations. The specific gravity of freshly formed calcium hydrate is 2.12, and that of freshly formed magnesium hydrate in its bulkiest form 1.65, and so far the figures favour the above-mentioned theory. But the molecular weight of calcium hydrate is 74, and that of magnesium hydrate 58, whence it follows that the space occupied by one molecule of magnesium hydrate is to that occupied by one molecule of calcium hydrate as 35.14 is to 34.8. As magnesium hydrate may exist in denser forms, e.g., as brucite, sp. gr. 2.35, it is possible that it may occupy even less space relative to that taken by the lime. W. F. Reid insists upon the necessity of drying turpentine to be used for taking the specific gravity of cement by allowing it to stand over fresh Portland cement before use, and also on the futility of giving the percentage of total

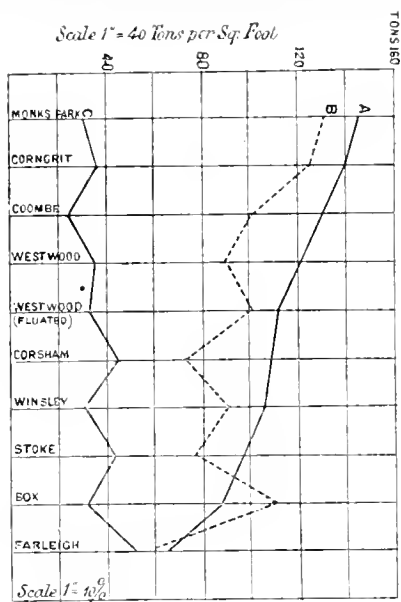
silica only in a clay when it is to be employed for cement making, as it is of importance to know what proportion is present as sand. Japp's volumeter (this Journal, 1891, 1029) or Lunge's new nitrometer (this Journal, 1891, 1031; also 1892, 1033) is preferable to the older calcimeters for testing the slurry for its percentage of calcium carbonate. The addition of salt to concrete to allow of work being carried on at low temperatures, is not advisable, as it sometimes leads to the deterioration of the cement. The mixture of crushed limestone with concrete has been known to hinder the action of sea water upon it. A criticism that may be urged to the experiments of H. T. Jones, upon the absorption of water by magnesia, is that the hydraulic properties of that substance depend wholly upon the temperature at which it has been calcined. At the clinkering temperature of cement it becomes almost devoid of hydraulic properties, and absorbs water very slowly. The apparent strength of a concrete mixture must always be considered in the light of the fact that, on account of its coarse grinding, English cement contains only about 50 per cent. of matter that has cementitious properties, so that a nominal 1:8 mixture is really only about 1:16. R. Feret, commenting on Bamber's assertion that the lime in the cement acts upon the silica of the sand grains with which it is mixed, remarks that actual experiment and observation of the grains of quartz embedded in Portland cement mortar, prove that they remain quite unattacked, and that the alleged action does not take place. He gives the results of experiments in which the portions of cement removable by sifting through a sieve of 5,800 meshes per square inch and through one of 32,300 meshes per square inch were replaced by an equal amount of sand, which shows that, except in the case of neat cement, the substitution of sand for the coarser cement does not decrease its strength, while even with the finer cement the decrease in compressional strength is not proportional to the amount of undoubtedly inert matter substituted, and the tensile strength is even slightly higher when sand is used in place of the comparatively coarse cement. The results bear out Reid's statement that about half the weight of English cement is practically inert on account of its coarseness. The most economical degree of fineness is indicated by the work of the same author, recorded in *Annales des Ponts et Chaussées*, 6, 19, 346. There is for any given mixture of a definite cement and sand, a proportion of water which gives the greatest strength, and another somewhat in excess of this which gives the most plastic consistency. The same relation holds good for maximum impermeability. A table, too voluminous to transcribe, contains the results of experiments on which these statements are based. W. Kidd, dealing with the cost of fine grinding, concludes that an extra cost of 3s. per ton in grinding only adds 8d. to the cost of a cubic yard of 5:1 concrete, while increasing the strength of the mortar about 50 per cent. As the eight pennyworth of cement is only half a cubic foot, or about 10 per cent. of the total amount used, a reduction of the quantity of cement might be made to this extent, and still give a stronger concrete than the coarser cheaper cement. C. Colson raises the question of the size of the wire of which the sieves for testing the fineness of cement are made. Strictly, the size of the wire must be specified as well as the number of meshes per square inch. Standard sand must not only be sized but washed with hydrochloric acid to free it from calcareous matter, which tends to raise the strength of the cement tested with it. The injurious action of oils upon cement is mentioned by Dyckerhoff. The addition of slaked lime to Portland cement helps it to withstand the action of sea water. The experience of M. Fitzmaurice in the building of the Chignecto Ship Railway in Nova Scotia, leads to the belief that concrete can be made and used in severely cold weather, provided that it is mixed under cover, and is kept thawed by the use of jets of steam and similar means at the time of its being put into place. If these precautions be disregarded, the concrete will not set and harden at all, even after the frost has ceased. W. Shield, trying the effect of exposing test-pieces of cement to the action of boiling water, finds that well aerated cement, such as that which is slightly caked at the surface of a heap, does not crack, while those

made from cement from the heart of the same heap fail, pointing to the need for aeration on a large scale to avoid the evil effects of underburnt and overlimed cements.—B. B.

The Building Stones of Great Britain. T. H. Beare.
Proc. Inst. Civil Eng. 107, Session 1891—92.

THE following data for the stones examined were ascertained. Crushing strength, density (by which is meant apparent density, as determined by weighing a block of known size, as opposed to true specific gravity), absorptive power, effects of low temperature, and alteration of the modulus of elasticity with increasing pressure. The experiments were made on 2½-in. cubes, as larger specimens could not, by the testing machine available, be crushed. The test-pieces were cut at the quarries whence they came, and were allowed to become air-dry in the laboratory before being tested, to allow the quarry-water to evaporate. The pressure was applied, unless expressly stated to the contrary, perpendicular to the planes of the quarry bedding, an important difference in the capability of the stone to resist weathering dependent on the preservation of this position, leading builders to take care that it is laid with its surfaces in this direction. The surface of the stone in contact with the dies of the testing machine was covered with a thin film of plaster of Paris to ensure even bedding. The use of compressible material such as sheet lead and soft wood in place of the plaster of Paris, was eschewed, as it was found that the lateral flow of such materials under the crushing strain produced tensile strains in the test-pieces, and induced their fracture at a smaller load than would otherwise have been the case. Proof of the existence of this influence was afforded both by the actual crushing loads of test-pieces which had been mounted in this manner, and by the character of their fracture, which departed from the ideal one consisting of six pyramids with their apices in the centre of the cube, and became that of a series of prisms parallel to the axis of pressure. The adverse effect of the presence of a sheet of lead ranged from 35.5 per cent. to 52.6 per cent. calculated on the strength determined without the use of lead, the difference being, as was to be expected, greatest in the case of the hardest stones, that is to say, when the total load was greatest. The result is of much practical importance, as illustrating the serious decrease in resistance to crushing strains that may be caused by bad bedding in structures. The mean crushing strengths in tons per square foot for the various classes of stones tested are as follows:—Granite, 1112.2 tons, mean of 13 varieties and 49 samples; oolites, 141.3 tons, mean of 18 varieties, 57 samples; sandstones, 489.8 tons, mean of 25 varieties, 88 samples; dolomites, 500.5 tons, mean of 4 varieties, 16 samples. The results are, generally speaking, higher and more concordant than those of previous experimenters. The "density," as stated above, was really a translation of weight per cubic foot, the weight of a cubic foot of water being taken as unity, as no attempt was made to estimate the true volume of stone free from air and moisture, in the blocks that were measured and weighed. The amount of water absorbed was estimated by weighing the blocks before and after immersion, New River water being used for a few of the earlier tests, and distilled water for the later members of the series. Some slight action by the water was perceptible in the case of the oolites, the water in which they had been immersed being turbid, and containing a distinct sediment. The author is of opinion that the absorptive power of the specimens "must be a very good guide to the relative weathering power of stones, since it shows to what extent deleterious agents in rain water and fogs will penetrate the stone, and furthermore a very absorbent stone must be very liable to the destructive action of frost." The mean results were that the average absorption of 27 oolites was 8.96 per cent. of their dry weight; dolomites, 4 samples, 5.43 per cent.; sandstones, 26 samples, 4.68 per cent.; granites, 14 samples, 0.27 per cent.

Fig. 1 shows the relation between compressive strength and absorption of 10 samples of Bath stone. The specimen marked "Westwood (fluted)" has been treated with



Curve A, crushing strengths; Curve B, ditto, after immersion in water for seven days and re-drying. Curve C, percentage of water absorbed.

Kessler's preservative solution, which is said to have proved very successful in France in checking the decay of oolitic and other limestones. A few specimens were tested by exposure after saturation with water to the low temperature prevailing last winter, the temperature varying from 20° to 32° F. Thawing and freezing were alternated 10 to 12 times, and the cubes were afterwards left exposed to the rain and weather for some two or three weeks. The loss of weight of the granites by this treatment was inappreciable, while with the other stones it was quite small, amounting to 0.002 lb. as a maximum, the original weight of the cubes being about 1 lb. There was also no loss of strength. The determination of the modulus of elasticity was difficult, owing to the small quantities to be measured, and a special form of gear was devised by A. G. Ashcroft for the purpose, which multiplied the actual alteration in height 2,358 times. It was found that there was a comparatively large permanent set, and the figures for the test first made are therefore lower than those obtained in repeating the test when this factor had been eliminated. The mean value for all the sandstones tested was, for the first test, 108,040 tons per square foot, and for the second test 132,280 tons, corresponding to 1,680,600 and 2,057,700 lb. per square inch respectively,—about $\frac{1}{15}$ to $\frac{1}{27}$ the value for steel. The mean values for the magnesian limestones were 254,500 and 321,000 tons per square foot respectively. For limestones the figures are 133,530 and 150,750 tons, while for granites they were 479,009 and 522,100 tons, or about one quarter the modulus of elasticity of steel.

The following table gives a few typical figures selected from the results recorded by the author:—

Name of Stone.	Locality of Quarry.	Remarks.	Mean Crushing Load.	Weight.	Absorption.
				Per Cu. Ft.	Per Cent.
Sandstones.	Prudham	Hexham, Northumberland.	455.3	142.5	4.00 (4.33)
	Polmaise	Bannockburn	551.5	141.7	4.58
	Bamie	Lanlithgowshire	569.1	135.1	5.22
	Hermant	Middlethian	457.4	142.6	4.70
Dolomites.	Yellow magnesian limestone.	Mansfield Woodhouse Quarry.	577.4	145.4	4.62
	Auston	Kiveton Park, Sheffield.	301.9	132.2	7.50
Oolite.	Portland	Isle of Portland	287.0	137.6	6.84
Granites.	Kenmay	Aberdeenshire	1,088.5	164.1	0.42
	Bridge	Bridge	1,211.1	161.9	0.21
	Rubislaw	Aberdeen	1,098.8	163.7	0.09

—B. B.

PATENTS.

Improvements in Processes for making Plastic Compounds or Composition. J. U. Robertson, Willesden Green. From C. W. Kennedy, Philadelphia, U.S.A. Eng. Pat. 17,050, October 7, 1891.

WASTE products such as "salt hay, grass straw, reeds, rushes, common hay, leaves, twigs, husks," are utilised in their green or dried state. Wood chips, splinters, sawdust, hair, waste paper, junk and scraps of fibre, such as hemp, jute, flax, coir, &c., may also be employed. Long fibres of the latter class of material are placed in a tank with water, and "a quivering or vibratory" motion imparted to the mixture, causing the fibres to fall together. "Finely-powdered silica or lime cements" are added, though "glutinous (*sic*) cements may also be used if desired." Any suitable waste scraps are incorporated as filling and the mass taken from the tank and moulded by pressure. With the addition of sand and hydraulic cement, or by enclosure in a "frame of molten metal," or by coating with approximately equal parts of "gluten, gelatin, pitch,

resin, or silicates of sodium or potassium" and subsequent immersion in a bath of calcium chloride, the composition may be rendered fit for use as paving or flooring. The manufacture of artificial wood and railway sleepers, and the renovation of worn-out sleepers, are also among the purposes contemplated by the patentee.—B. B.

Making Coloured Stucco, Coloured Concrete Blocks, and Tiles. D. Ward, Hewton. Eng. Pat. 19,106, November 5, 1891.

THE patent is for "the mixing together of colours with cement or lime, sand, or rubble with water to form stucco, concrete blocks, or tiles of a permanent colour, as the colour will permeate the coloured mixture and when dry and hard will be imperishable."—B. B.

Improved Process for Producing Liquid Clay or Slip for Casting in Moulds. E. Edwards, London. From K. Goetz, Karlsbad, Bohemia. Eng. Pat. 15,911, September 5, 1892.

Slip, from which articles of porcelain or stoneware are to be prepared by casting in moulds, is mixed with "an aqueous solution of one of the bases of soda, potash, lithia, oxide of ammonium" or with an aqueous solution of "a carbonate or multicarbonate of three bases—but not including the carbonates of soda—as also the silicates and fluor salts of these bases." Three parts by weight of such a solution suffice for 100 parts by weight of clay. Cinnabar sufficient to give the solution a weak rose tint may be added to prevent the formation of a grey colour sometimes observed on porcelain after burning. The pateated mixture contains less water than is usually necessary, is said to cast better and allow the moulds to be used oftener and dried sooner. The cast articles may be burned at a lower temperature than is generally necessary, and the grinding of the slip takes 16 hours instead of 22 or 24 hours. Colours can readily be burned in.—B. B.

X.—METALLURGY.

The Estimation of Manganese in Spiegel Iron and Ferro-manganese. M. C. Bastin. Monit. Scient. September 1892, 639.

See under XXIII., page 1037.

Nickel Analysis. S. H. Emmens. Eng. and Mining J. November 26, 1892, 510—511.

See under XXIII., page 1035.

PATENTS.

Improvements in Adding Metallic and Non-Metallic Substances to Steel and Iron or any other Liquid Metals. J. Colley, Bilston. Eng. Pat. 18,990, November 4, 1891.

THE improvement consists in adding carbon, enclosed in a box or receptacle, preferably of wood, to the charge, after the blowing is completed, or nearly so, and before it leaves the furnace or converter. The carbon may be added all at once or in separate portions, and ferro-manganese may be added with it when necessary.—J. H. C.

A Process of Separating Cobalt from Nickel. G. Selve, Altema, Germany. Eng. Pat. 19,573, November 11, 1891.

COBALT is separated from nickel when in hydrochloric or sulphuric acid solution, after separation of other bodies by well-known methods, by adding to the solution a precipitating liquid prepared as follows:—

To an aqueous solution of hypochlorite of soda—composed of 100 kilos. of chloride of lime and soda, 60 kilos. of calcined soda dissolved in water are added. When the precipitated carbonate of lime has settled the liquid is drawn off for use. The cobalt and nickel solution is boiled and stirred and the precipitating liquid is slowly added until a sample shows that the whole of the cobalt is separated in the shape of a black deposit (of Co_3O_4), the nickel remaining in solution.

Small quantities of nickel oxide precipitated at the same time may be redissolved by means of dilute sulphuric or hydrochloric acid.—J. H. C.

Improvements in Gas Furnaces. H. E. Newton, London. From R. N. Oakman, jun., Greenfield, U.S.A. Eng. Pat. 21,634, December 10, 1891.

THE furnace described in this patent is adapted for heating pipes for welding the longitudinal seam, and also for heating iron or steel bars for forging and welding. The principal

objects aimed at are to ensure a uniform heating of the pipes, bars, or blooms, and to utilise the waste heat from the furnace.

The welding furnace chamber may be described as somewhat pear-shaped in longitudinal section. It is heated by a series of nozzle burners fixed in inlet flues which are built into the top of the narrower end of the furnace; these burners are fed with a mixture of fuel-gas and air, both of which are supplied under pressure. The flames and products of combustion first pass along the crown of the furnace; they are then deflected downwards by the arched crown and side, and are caused to pass over and in contact with the pipes, bars, or blooms, which are arranged on the hearth; finally they escape by a narrow outlet flue, placed parallel to and underneath the inlet flue, whence they pass into a second chamber. The advantage of this method of heating is that the outgoing flames or currents pass through the furnace chamber between the materials to be heated and the inflowing flames, so that the latter are not chilled by the cool pipes or other materials. As, moreover, the pipes, &c., are introduced into the furnace near the outlet flues and are then gradually moved along the hearth to the other end of the furnace, their temperature is gradually raised to a welding heat, whereupon they are withdrawn and welded in the usual manner.

The outlet flues for the gases from the welding chamber pass directly into a heat-restoring chamber, in which the skelp is raised to the requisite temperature for rolling; in order that the flame may be prevented from impinging upon the skelp the flues are made to incline upwards just before they enter the heat-restoring chamber.

The waste gases from the heat-restoring chamber are finally passed into a second chamber, in which the air necessary for the combustion of the fuel gas is heated.

—F. S. K.

Improvements in Gas Puddling Furnaces. H. E. Newton, London. From R. N. Oakman, jun., Greenfield, Mass., U.S.A. Eng. Pat. 21,633, December 10, 1891.

THE claim is for a double-hearth furnace consisting of two separately-heated chambers with curved walls communicating with each other by an inclined or tangential flue, and each supplied with a valved escape flue. The heating is effected by the combustion of gas and air introduced near the crown of the chambers or furnace, and under pressure. The waste gases from the working operations in the first chamber are used for heating up the second, and thence pass to a heater where they are used for heating the air blast which supplies the burners.—J. H. C.

Improvements in the Manufacture of Ingots, Bars, Rods, Wire, and the like from Bronze. G. G. M. Hardingham, London. From C. Berg, Eveking, Westphalia, Germany. Eng. Pat. 22,337, December 21, 1891.

COMPOUND ingots for electrical conductors and similar purposes are made by casting soft bronze projections or coverings around hard bronze cores and *vice versa*, or the combinations may be threefold, and of brass, copper, aluminium, or other alloys and metals. The contact surfaces are formed with ribs or projections, to facilitate the uniting or welding.—J. H. C.

Improvements in or relating to the Purification of Steel or of Iron during its Conversion into Steel. E. H. Saniter, Wigan. Eng. Pat. 8,612, January 21, 1892.

IRON is purified from sulphur during its conversion into steel by adding, while it is molten and in the furnace, a mixture of chloride or fluoride of an alkaline earth with the oxide, hydrate, or carbonate of an alkaline earth; the latter in sufficient quantity to form and maintain a slag having from 50 to 60 per cent. of lime.

Chloride of calcium and limestone are recommended in general, but other corresponding substances may be used in special cases.—J. H. C.

Improvements in or relating to the Purification of Iron.
E. H. Saniter, Wigan. Eng. Pat. 8612x, January 21, 1892.

THE molten iron is brought into sufficiently prolonged contact with a mixture of chloride of calcium and lime, or their chemical equivalents.—J. H. C.

Improvement in the Means for Tempering and Hardening Metals. J. S. Darning, Emsworth, Pa., U.S.A. Eng. Pat. 12,965, July 14, 1892.

THE metals are first coated with a mixture of flour, prussiate of potash, and a liquid concoction from the laurel plant; then heated and plunged into water or into a similar liquid concoction.—J. H. C.

Improvements in the Process of Reducing Unsmelted Ore, including Roasted Ore, Furnace Cinders, and like Material. J. T. Wainwright, Chicago, U.S.A. Eng. Pat. 16,17x, September 9, 1892.

THE improvement consists in operating on the ores by generating gases at successively increasing temperatures, passing these gases downward through the ore, and maintaining it in an unreplenished condition.

In general a shaft furnace is used, having a collecting space or slag hearth at the bottom, and an inverted siphon outlet or gas flue at the side. The furnace is fed from the top through an aperture which is then securely closed, intermittent heats being made, and the furnace re-charged for each heat. Operating on iron ore, and commencing with an empty furnace, the lower contracted portion of the furnace is bridged over with an open mass of charcoal or other solid carbonaceous fuel. On top of this is placed a charge of mixed ore, flux, and fuel, in suitable proportions, and above this carbonaceous fuel, which may be cheaper or different in grade to that charged with the ore, and may be mixed with suitable flux. A hot or cold blast of air or other gases containing free oxygen is then thrown on the top of the ignited fuel layer, the cover is closed, and the blast is maintained. The gases resulting from the fuel combustion are forced downwards through the mixed charge and fuel, so producing a gradually increasing temperature which, besides facilitating reduction, prevents scaffolding and congestion.

The effect produced upon the ore by forcing the gases downwards through it is to maintain a reducing action, and also to keep the upper parts of the ore-charge in a hotter and more reduced condition than those below; consequently, when the reducing action reaches that stage when the cinder separates from the spongy metal and gravitates from the same, this isolation of the metal will progress from above downwards, so that the slag will collect in the hearth without having been in contact with the metal at a high temperature. In this way the impurities of the ore remain in the cinder, and do not contaminate the metal. When the slag is more fusible than the metal it may be drawn off at an early stage through a tap-hole, after which the blast may be continued for the purpose of maintaining the temperature of the metal which has collected in the hearth, and also for scouring the shaft. In other cases, the metal, being more fusible, may be run out first, and the slag afterwards run out at a higher temperature.

To facilitate working, the hearth may have a series of tap-holes at different heights, and also a large opening with a cover at the side, through which fuel, fluxes, or metals for alloy may be added in certain cases.

Another mode of operation is to use two shafts placed side by side and communicating at the top. The first is charged with cheap solid fuel and used with an upward draught as a gas producer; and from this the ignited gases pass into the second and downwards through the ore-charge, as already described.—J. H. C.

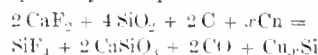
XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

The Influence of Arsenic, Antimony, and Silicon on the Ductility, Absolute Strength, and Electrical Conductivity of Copper. W. Hampe. Chem. Zeit. 16, 726–728.

THE pure copper employed by the author was prepared by adding caustic potash to copper sulphate solution until a considerable precipitate was obtained; the solution was then heated for some time, filtered, and the filtrate electrolysed. The deposited copper, after treatment with boiling water and repeated washing, was dried and fused with copper oxide, first in a current of carbon dioxide, whereby any residual copper sulphate is dissociated and the sulphur expelled as SO_2 , and finally in a stream of dry hydrogen, whereby any oxide is reduced to metal. The copper so obtained contains no impurity beyond traces of antimony.

Pure arsenic is prepared by adding ammonia and magnesia mixture to potassium arsenate solution; the precipitated ammonium magnesium arsenate is filtered off, washed, dissolved in hydrochloric acid, and re-precipitated by ammonia. After washing, the precipitate is converted into magnesium pyro-arsenate by heating; pure arsenic sublimes from this salt on heating it in a stream of hydrogen. Pure antimony is prepared by heating an intimate mixture of tartar emetic (5–6 pts.) and nitre (1 pt.) in a porcelain crucible. The residual antimony is washed with water and fused in a current of hydrogen.

An alloy of silicon and copper (silicon-copper) has been previously prepared by the author by heating a mixture of silica, fluorspar, purified lampblack, and copper in the proportions required by the equation—



The yield of silicon in the alloy is frequently only one-half of that indicated by the equation, and is not appreciably increased by the employment of more silica. Practically, no reduction of silicon occurs if carbon be excluded from the mixture. Silicon copper is not obtained by heating copper in a stream of hydrogen containing silicon tetrafluoride. On melting a mixture of fluorspar and silica, silicon tetrafluoride is at once obtained—



The alloys were prepared by fusing the pure copper with arsenic, antimony, or silicon copper, in a closed crucible under a layer of lampblack free from manganese. The following table gives the absolute strengths, relative conductivities, and densities of the various alloys examined:—

		Absolute Strength per 1 sq. mm. cross-sectional Area.	Relative Conductivity.	Density.
Pure copper.....		Kilos. 31'6	100	8'9565
Alloy I. containing 0'2161 per cent. As		41'6	61'05	8'944
" II. " 0'351 " "		51'1	50'15	8'947
" III. " 0'808 " "		48'9	29'96	8'962
" IV. " 0'260 " Sb		52'0	68'67	8'948
" V. " 0'529 " "		54'9	56'5	8'946
" VI. " 0'526 " Si		50'0	28'11	8'870
" VII. " 3'472 " "		95'3	6'5	8'471

The ductility of the alloys was about the same as that of pure copper with the exception of sample No. III., which was somewhat less ductile. The toughness and ductility of copper seems hence to be little affected by the presence of very appreciable quantities of arsenic or antimony.

The sample No. VI. of silicon copper resembles pure copper in appearance and properties.

When the percentage of silicon reaches 1.5–2.0 the metal has a reddish-yellow colour, and, though still ductile, is harder than pure copper. Sample No. VII. has almost the composition Cu_2Si , possesses a light bronze colour, and a glistening fracture; it is very ductile and malleable. Copper containing 6 per cent. of silicon shows a light grey crystalline fracture, is hard and brittle, and dissolves completely in nitric acid; the solution gelatinises when concentrated. An alloy containing 8 per cent. of silicon is silver-white and very brittle; it may be readily crushed to powder. Copper containing 11.7 per cent. of silicon is as brittle as glass; it is white in colour and rapidly tarnishes brown in the air. It is almost completely soluble in nitric acid.—W. J. P.

PATENTS.

Improvements in Apparatus for Use in Electro-Metallurgical Operations. C. Hoepfner, Giessen, Germany. Eng. Pat. 13,735, September 1, 1890. (Amended.) (This Journal, 1891, 839.)

THE inventor wishes it to be understood that he does not claim anything which is described or claimed in Eng. Pat. 12,208 of 1888.—J. C. C.

An Improved Process for the Electro-Deposition of Metal upon the Surface of Glass, Porcelain, China, Earthenware, and other Materials. A. S. Ford, London. From H. Pottier, Paris. Eng. Pat. 18,256, October 23, 1891.

See under VIII., page 1007.

A Depolarising Liquid for Galvanic Batteries. O. Schlesinger, Bow, Middlesex. Eng. Pat. 18,477, October 27, 1891.

THIS liquid is for use in two-fluid cells and consists mainly of a sulphuric acid solution, crystals of chromic acid, and nitrous acid solution. The following is a suitable example of making up the liquid: 20 oz. of sulphuric acid (1.8 specific gravity) are diluted with 11 oz. of water, and, while the solution is still hot, from 2 to 3 oz. of chromic acid crystals and from 15 to 25 oz. of nitrous acid solution (sp. gr. about 1.360) are added. The mixture is ready for use when cool. If the carbons of a zinc-carbon battery are immersed in such a solution, and the zincs immersed in water or acidulated water, the current developed is of great constancy. The liquid may be used in gutta-percha cells without injury to the cells.—D. E. J.

Improvements Relating to the Application of Depolarisers in Electrolysis. J. C. Richardson, London. Eng. Pat. 19,704, November 13, 1891.

THE object of this invention is to maintain the depolarising action of a compound, such as an insoluble oxide, next the cathode in electrolytic work. The cathode consists of a broad band of any desired construction and surface, upon which as it enters the electrolyte a depolariser is introduced, and as it leaves, the spent depolariser is removed; or instead of the cathode itself moving, the depolariser may be made to move on it. This patent is adapted to the process described in Eng. Pat. 2,296, 1890 (this Journal, 1891, 699), in which oxide of copper is employed in the electrolysis of salt; the oxide of copper in this case being introduced next the cathode at one point, and the reduced copper being removed at another.—G. H. R.

Improvements in and relating to the Construction of Electrodes of Large Dimensions for Accumulators, and to supporting the same in their Cells. W. P. Thompson, Liverpool. From A. V. Kerekhove, Brussels, Belgium. Eng. Pat. 21,702, December 11, 1891.

THE invention consists in the adaptation of electrodes of normal dimensions to cases or rigid gratings so constructed as not easily to be put out of shape, and which are neutral as regards their chemical reactions. The normal electrodes are arranged in successive cases of the frame, and soldered at two points by one of their sides in such a way as to preserve between their three other sides and the cross bars of the frame a sufficient space to allow of dilation and extension. Small projections on the opposite sides of the edges of the plate or of the cross-bars of the frame, and cast thereon, at the same time prevent the electrodes from becoming displaced during working. The squares, gratings, or frame may be of any suitable form and composed of any suitable material which offers sufficient rigidity, conductivity, and neutrality to the action of electrolysis. Large electrodes are allowed to rest at a greater or smaller number of points throughout their entire length on strips of glass, ebonite, or any other insulating material, or even on a series of insulating pegs or wedges arranged in the same plane; the strips or wedges are placed in the bottom of the cells, and are of a height corresponding to the space which it is desired to leave free between the bottom of the cells and the lower edges of the electrodes.—G. H. R.

Improvements in and Apparatus for the Manufacture of Alkaline or Earthy Alkaline Bases and of their Salts or Compounds by the Electrolysis of Saline Solutions. E. Hermite and A. Duboseq, Paris. Eng. Pat. 21,957 December 15, 1891.

"It is known that when an electric current is passed through a solution of any salt of any alkaline or earthy alkaline base, the acid and oxygen pass to the positive pole and the metal passes to the negative pole." It has been proposed to utilise this principle for the purpose of separating the alkalis and bases of the alkaline earths (for example, potash and caustic soda), from their compounds, but in order to do so it is necessary to provide some means of at once removing the separated base from the acid to prevent re-combination. Two methods have been adopted to do this, of which the first was abandoned. In the second method mercury is employed as the negative pole, which forms an amalgam with the deposited metal. It is, however, necessary to devise some means of removing the amalgam thus formed, as otherwise re-combination will take place and the energy of the current will be expended uselessly. The object of the present invention is to provide such a means. The inventors describe the principle of their arrangement by reference to an ideal electrolytic cell impossible to realise in practice. In this imaginary cell the negative pole is of mercury floating on the surface of the electrolyte, the positive pole being at the bottom of the vessel. Floating on the mercury is pure water. Suppose the electrolyte be a solution of a sodium salt. When the current passes, an amalgam is formed at the surface of the mercury, which, being lighter than the mercury, rises to the surface of the latter, where it comes into contact with the water and is decomposed into caustic soda and mercury, the soda remaining in solution. Such a cell, if it could be constructed, would be all that is required, and it is to a means capable of realising the conditions of this theoretical arrangement that the invention relates.

The new arrangement is as follows:—Mercury is made to drop from a suitable tank through a series of fine tubes on to two inclined iron plates which form the negative pole. The object of the tubes is to distribute the mercury in a thin flat sheet over the surface of the plates, which are amalgamated to ensure an even flow of the mercury, which would otherwise roll down in globules. The positive pole consists of two plates of platinum parallel and very close to the iron plates. When the current passes an amalgam is formed which flows to the bottom of the iron plates into a suitable trough containing bisulphide of carbon or other

liquid lighter than the amalgam and denser than the electrolyte, which screens it from the action of the acid. Now an amalgam of mercury and another metal becomes lighter in proportion as it contains more of the metal. Hence the mercury containing little of the metal sinks to the bottom of the trough and is discharged through a tube into a reservoir. The richer amalgam rises to the top of the trough and passes through a suitably-placed tube into a cistern of water, where it is decomposed into the base and mercury. The base remains in solution, while the pure mercury sinks to the bottom of the cistern and passes into the reservoir. From the reservoir it is lifted by means of any suitable elevator (such as a series of buckets on an endless rope) and returned to the distributing tank to be discharged once more on to the negative plates.—D. E. J.

Improved Jar or Cell for Galvanic Batteries. W. P. Thompson, Liverpool. From O. Hirsch, Weiswasser, Germany. Eng. Pat. 22,145, December 18, 1891.

In battery jars hitherto employed it has been necessary to adopt special devices for the purpose of securely insulating the two electrodes from one another, such as, for instance, the insertion of special porcelain pieces between zinc and carbon, which were firmly retained in their places by india-rubber bands. Such bands, however, rotted away, and moreover, crystals were deposited on the porcelain pieces. Various attempts to remove these drawbacks have been made by forming on the square jar an almost circular projection connected with the remaining space only by a narrow opening, into which projection would be inserted the zinc bar. Such cells are both inconvenient and costly, and have therefore not been much used. This invention relates to a glass jar or cell having none of the above drawbacks. The cell is square in form, and while in a semi-fluid condition, impressions, projecting towards the inside of the cell, are made at a suitable distance from the corner destined to receive the zinc bar, which serve to enclose the zinc bar and prevent all possibility of its coming into contact with the carbon plate.—D. E. J.

Improvements in the Manufacture of Porous Carbon for Batteries and for Filters. W. Hellesen, Copenhagen. Eng. Pat. 22,708, December 29, 1891.

This invention relates to a method of manufacturing porous carbon suitable for batteries and filters. To increase the porosity of the carbon for galvanic batteries, it has been the custom to mix with it such organic substances as sawdust, fat, flour, or the like. For filtering carbons, the carbon-producing substances have been mixed with clay, finely-divided silica, or the like. It has been recently proposed to use a mixture of lignite, clay, and chaff. The inventor has found that infusorial earth mingled with hydrocarbon-yielding substances, such as tar, produces when highly heated a more efficacious porous carbon than any of the mixtures above referred to, and which is suitable both for batteries and for filters, with or without the addition of graphite or of animal substances. A satisfactory mixture may be composed as follows:—40 to 50 parts of infusorial earth, the same quantity of coal-tar or some similar hydrocarbon-containing material, and 5 to 10 parts of horn or some similar substance. If graphite is to be added the quantity of infusorial earth must be reduced.—D. E. J.

Improvements in Secondary Batteries. W. Main, Brooklyn, U.S.A. Eng. Pat. 16,461, February 15, 1892.

In this cell the positive electrodes consist of vertical compound plates formed of thin sheets of lead, and the room necessary for the increase of thickness of the plates due to oxidation is provided by coating the thin sheets with a soluble material which is afterwards dissolved out. The material preferred for this purpose is a mixture of oxide of zinc and graphite, as the former dissolves during charge and yields a deposit of zinc on the negatives where it is required.

The negative electrodes are U-shaped perforated sheets of copper amalgamated with mercury and plated with zinc. Sheets of zinc are placed between each pair of copper plates to maintain the supply.—G. H. R.

Improvements in the Means for and Method of Melting Metals and other Materials by Electricity. A. F. W. Kreinsen, Ottensen, Germany. Eng. Pat. 15,477, August 29, 1892.

ACCORDING to these improvements, the fusion of the material is effected in electrically heated carbon or plumbago crucibles consisting of insulated or non-insulated pots, surrounded by platinum conductors, or it may be primarily fused by being brought into contact with a carbon electrode through which a sufficient electric current is caused to pass. The material to be melted forms the negative electrode. Both of the electrodes are moveable and adjustable so that they may be moved towards or withdrawn from each other as may be required. They are arranged above the centre of the crucible, and are covered by a shield to prevent the escape of sparks and splashes from the fusing material, which drops into the cavity of the crucible, and is there either re-melted or kept in a state of fusion by the heat generated by the passage of a shunted portion of the current through a spiral of platinum wire embedded in the walls of the crucible, or the crucible may have an outer lining of very thin platinum similarly maintained at a high temperature.—G. H. R.

An Improvement in Galvanic Batteries. E. Nunau and J. W. Nelson, London. Eng. Pat. 15,739, September 2, 1892.

THIS is a zinc carbon battery, the zinc forming the outer case of the cell. The carbon is partially coated with tin foil and is embedded in a mixture consisting of the following ingredients:—

	Parts.
Pulverised carbon.....	35
Pulverised peroxide of manganese.....	30
Sal ammoniac.....	10
Chloride of zinc, or analogous material that has the power of readily absorbing moisture from the atmosphere.....	1
Water.....	20

The zinc cylinder is lined with a compound prepared as follows:—

	Parts.
Chloride of zinc.....	10
Sal ammoniac.....	10
Plaster of Paris.....	30
Water.....	20
Starch or flour.....	$\frac{5}{16}$
Pulverised alum.....	$\frac{1}{16}$

which are poured in after the coated carbon has been placed in position. Suitable means are provided for making contact, and the cell is closed with a mixture of Egyptian pitch and plaster of Paris.—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

PATENTS.

An Improvement in what is commonly called Dry Soap or Soap-Powder and intended for Use for certain Purposes. W. H. Horton, Bowden, and E. M. Taylor, Prestwich. Eng. Pat. 16,018, September 7, 1892.

A SUITABLE quantity of "blueing powder" such as "Reckitt's blue" is incorporated with ordinary soap powder with a view to enable articles to be washed and blued in one operation.—K. E. M.

Improvements in and relating to Apparatus for Expressing Liquids from Vegetable, Animal, or Mineral Substances. H. H. Lake, London. From La Société Anonyme du Compresseur Jourdan, Paris. Eng. Pat. 17,886. October 19, 1891.

WITH the view of dispensing with bags or sacks for extracting purposes, the inventor makes use of an apparatus essentially characterised by the employment of removeable or non-removeable tubes constituting channels in the thickness of the walls of the cylinder of the compressor, one of the faces of each tube being provided with saw cuts, and covered by joining wires of any section between which the liquid, resulting from the compression of the material, filters. A filter cloth in certain cases may be placed between the wires and the exterior surface of the outflow tube, or channel. In combination with this a preparatory press serves as a lifter, and has two small pistons, one at the top and the other at the bottom of the apparatus for the introduction of the material, and a third piston of larger diameter for its removal. The cylinder is provided with wheels to render it portable.—J. C. C.

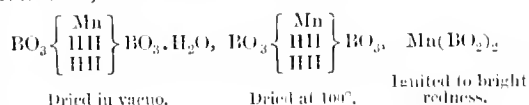
Improvements in Candles and Night-Lights. F. G. Griffith, Cowbridge. Eng. Pat. 21,378, December 7, 1891.

IN order to prevent any waste in the burning of a candle, each candle contains a cup-shaped socket at the end, which has a tube surrounding the wick. This tube extends to the top of the socket and has a slit down one side. When, therefore, the candle is burned down to the socket the remaining part will burn as an ordinary night light till all the grease is consumed.—K. E. M.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Manganese Borate, its Constitution and Properties. W. N. Hartley and H. Ramage. Proc. Chem. Soc. 116, 201—202.

PARTICULARS are given of the properties of manganese borate, prepared in various ways from manganese sulphate and alkaline borates. Manganese borate dried *in vacuo* over sulphuric acid is found to lose water to the extent of 11.84 per cent. of its weight when heated at 100°; when heated from 100° to redness, it loses 19.65 per cent., which is water of constitution, the compound being a tetrahydric orthoborate, thus:—



The solubility of manganese borate in various saline solutions was investigated: it was found to possess a maximum solubility at or about 18°, and a minimum at 80°, so that when cold saturated solutions are heated, they deposit the salt at the latter temperature.

It is believed that this is caused by the dehydration of the salt in solution, namely, $\text{MnH}_3(\text{BO}_3)_2 \cdot \text{H}_2\text{O}$, which becomes $\text{MnF}_4(\text{BO}_3)_2$, and this, being less soluble, is deposited: such a change being known to occur, and to be complete at 100° when the salt is heated in air.

PATENTS.

Improved Composition applicable as a Dressing for Belting and other Purposes. S. Kenyon, Warrington. Eng. Pat. 17,811, October 17, 1891.

REFUSE india-rubber or gutta-percha is incorporated by the aid of heat with vegetable tar, with or without the addition of varnish foots.—F. H. L.

Improvements in and relating to Paints and Lacquers. A. O. and W. S. Gill, Aberdeen. Eng. Pat. 22,610, December 28, 1891.

THIS patent refers specially to gold, silver, and bronze paints, as the varnish for which the inventors use collodion.—F. H. L.

Improvements in the Construction of Moulds for Vulcanising India-Rubber Tyres and other Rings. H. H. Waddington, Hyde, Chester. Eng. Pat. 10,171, May 28, 1892.

THESE moulds are built up by the super-position of a number of metal discs, having in their adjacent faces a series of semicircular annular grooves, in which the tyres to be vulcanised are placed, and having also a number of apertures through which the steam can circulate. The steam is prevented from reaching the tyres by the discs having smaller grooves running parallel with the larger, in which asbestos packing rings can be placed.—F. H. L.

An Improved Solvent for Gums and Resins, and Method of making the same. W. Read, Needham, Mass., U.S.A. Eng. Pat. 11,174, June 14, 1892.

EQUAL parts of coal-tar, naphtha, and petroleum-naphtha are taken, and about one-eighth of alcohol added. A precipitate consisting of the creosote oil and carbolic oil of the former and the dead oil of the latter is thrown down, and the clear spirit, which may be "deodorised" by a suitable essential oil, forms the improved solvent. The precipitate is valuable as it is suitable for use as an oil for dissolving gums.—F. H. L.

Improvements in and relating to the Manufacture of White Lead. A. J. Smith, Kingston-on-Thames. Eng. Pat. 14,656, August 13, 1892.

LEAD cuttings of suitable dimensions, after preparation by dipping in "basic cream," are placed upon trays or grids and inserted in the converting chamber, and there alternately subjected to the action of acid vapour, mixed with steam and atmospheric air, and to the action of carbonic acid gas; from time to time applying to the charge a spray of "basic cream" as occasion may require. The "basic cream" is prepared by digesting to the consistency of thin cream lead oxide in weak pyroligneous, acetic, or other suitable acid.—J. C. C.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENTS.

Improvements in Apparatus or Appliances for Use in Drying Sheets of Glue, Gelatin, and the like. W. P. Thompson, Liverpool. From F. Krauseder and A. Lentsch, Munich, Germany. Eng. Pat. 20,755, November 28, 1891.

THE drying chamber is provided with adjustable trays having longitudinal strips upon which the sheets of glue, &c., to be dried, are placed. The trays are made thicker in cross section towards the exit end, and in consequence the air spaces are narrowed; by this means the speed of the air is accelerated as it is drawn through the apparatus by the fan and in consequence a uniform amount of evaporation takes place over the whole surface.—J. C. C.

A New Process for Tanning and Apparatus relating thereto. G. V. Haeclit and C. Obozinski, Brussels, Belgium. Eng. Pat. 21,774, December 12, 1891.

THE apparatus consists of a vat containing a perforated casing the lower part of which forms a false bottom to the vat; the lid of the vat fits air-tight and carries a pressure gauge, a vacuum gage, and an escape cock. Through openings in the sides of the vat pass pipes, provided with cocks and connected with a pressure pump, a vacuum pump, a high level tank for supplying liquor, and a low level tank for receiving liquor, respectively. An attached water-gauge indicates the level of liquid in the tank.

The skins are arranged in the perforated casing as follows:—a layer of wood-wool, previously impregnated with tannin, is placed on the bottom; a sheet of wool or other fabric, also impregnated with tannin, is spread upon the wood-wool; the skin to be tanned follows; on this is another sheet of wool and then another layer of wood-wool. This order of layers is repeated until the vat is full. The wood-wool forms a very porous material which serves to keep the layers apart, but to avoid unequal action of the tanning liquor due to the direct contact of the skin with the inequalities of the wood-wool, the sheet of fabric is interposed. When the vat is full of skins, the air in it, together with that in the pores of the skins, is pumped out by the vacuum pump. The tanning liquor is then allowed to flow in from the high level tank and pressure is applied by the pump for that purpose. After a sufficient time the liquor is allowed to run into the low level tank, whence it can be pumped into the high level tank, to be strengthened up or used again for a fresh batch of skins.—A. G. B.

XV.—MANURES, Etc.

Interaction of Ferrous Sulphate with the Phosphates of Calcium employed in Agriculture. P. Cazeneuve and A. Nicolle. Mont. Scient. May 1892, 334—337

SINCE the application of ferrous sulphate of "copperas" has been found advantageous in the case of the vine and certain other plants, it has become the custom of manufacturers of manures to mix this salt with the other ingredients of a manure, more especially in the case of phosphates. The object of this investigation was to ascertain whether the solubility of the phosphates is modified by the addition of ferrous sulphate in such a way as to render them less readily assimilated.

It was found that ferrous sulphate, which in contact with moist air is oxidised to ferric sulphate, does interact with some of the various phosphates of calcium which are employed in agriculture, bringing about the formation of

ferric phosphate; as the last-named compound is soluble in ammonium citrate, and slightly soluble in water containing carbonic acid, it should, theoretically, be capable of being assimilated by plants, but whether it is so or not has yet to be ascertained experimentally. It would seem probable, therefore, that the addition of ferrous sulphate may have a deleterious action on superphosphates, that is to say on mono- and bicalcium phosphates, especially when the iron salt is present in a very finely-divided condition.

When precipitated tricalcium phosphate is treated with ferrous sulphate, a considerable portion of the phosphoric acid is rendered soluble in ammonium citrate, so that in this case the action of the iron salt would appear to be beneficial; ferrous sulphate seems, however, to have no action on tricalcium phosphate in the form of bone-ash, mineral phosphates, &c.—F. S. K.

PATENT.

A Composition for Firing Ammoniacal Nitrogen used in Agriculture. J. T. Knowles, London. From L. Buroni and P. Marchand, Piacenza, Italy. Eng. Pat. 12,432, July 5, 1892.

It is proposed to prevent the loss of ammoniacal nitrogen from animal excreta by means of sulphuric acid, which is employed in the form of a composition termed "azotol." The composition is obtained from organic substances containing hydrogen and oxygen in the same proportion in which they are contained in water, such as dry straw, sawdust, &c. 25—50 per cent. of these are mixed with 50—75 per cent. sulphuric acid, allowed to stand until cold, and reduced to powder. The charred mass contains in this state up to 75 per cent. free sulphuric acid, and may be scattered upon dunghills or left exposed in stables.—H. A.

XVI.—SUGAR, STARCH, GUM, Etc.

Identification of Xylose and Distinction from Arabinos. G. Bertrand. Bull. Soc. Chim. 7—8, 1892, 499.

See under XXIII., page 1038.

The Estimation of Invert Sugar by Soldaini's Solution. Striegler. Zeits. Rübenz. Ind. 42, 1892, 457.

See under XXIII., page 1038.

PATENTS.

Improvements in and connected with Pans for Boiling or heating Sugar or Compounds thereof or similar Substances. R. Morton and T. Morton. Eng. Pat. 19,762, November 14, 1891.

THE patentees claim that they effect a great saving of heat by the combination of a high and low pressure steam pan in such a manner that the exhaust steam of the high pressure pan is utilised in the low pressure pan. They likewise claim the insertion of a perforated coil between the jacket and pan, and of a non-perforated coil within the pan to expedite the boiling in the case of the high pressure pan.—A. R. L.

Improvements in Evaporating or Concentrating Saccharine Liquids and in Apparatus therefor. D. Stewart, Glasgow. Eng. Pat. 20,887, December 1, 1891.

THE patentee describes a new form of apparatus in which saccharine solutions are drawn up an exhausted feed-pipe which passes within a "main pipe" through which latter steam is introduced at its lower portion, to accomplish the

heating. The "main pipe" is curved at its upper portion and is connected by another pipe, which descends, to a condenser or receptacle, and leads the condensed vapours thereto, the whole system being exhausted by a vacuum-pump. The feed-pipe terminates within a chamber forming the top portion of the "main pipe," and the heated liquid overflows into this chamber, passing downwards through gratings in the form of a shower. These gratings lead to a series of pipes which are also in direct communication with the vacuum pump; they are placed within the "main pipe" and are packed round the feed-pipe running parallel to it. As the liquid descends, this series of pipes, the heat of the steam circulating in the "main pipe" causes rapid evaporation, which is accelerated by the diminished pressure. The vapours or gases give out their heat as they rise. The "main pipe" is preferably encased to diminish loss of heat by radiation.—A. R. L.

Improvements in Apparatus for Evaporating Saccharine or other Solutions or Liquids. P. Labric, Paris, France. Eng. Pat. 22,089, December 17, 1891.

THE patentee claims the combination with an evaporating (vacuum) apparatus of a pipe passing into the pan and terminating within it near the upper portion, for continuously supplying the liquid to be evaporated, and of a second pipe of lesser diameter placed within the first for carrying off the vapours to an exhauster. The space between the two pipes is sealed off at the upper portion, and the liquid, already heated by having passed over the exterior surface of the inner pipe at the same time as the hot vapours are passing through it, is delivered into the pan by a small descending pipe joined to outer pipe. The termination of the inner pipe within the pan is above that of the outer one, and its end is open to receive the vapours. The invention may be applied to existing apparatus.—A. R. L.

Improvements in Refining Sugar. E. Langen, Cologne, Germany. Eng. Pat. 420, January 9, 1892. (Amended.) (This Journal, 1892, 448.)

THE amendment forms no part of the invention, but relates to a more minute description of the Wulff or Bock process (*loc. cit.*).—A. R. L.

A New or Improved Process and Apparatus for the Treatment and Purification of Raw Sugar and its Conversion into Blocks or Ingots. C. M. Lafontaine, London. Eng. Pat. 15,816, September 3, 1892.

RAW sugar crystals are subjected to the action of steam in a closed centrifugal machine for about 15 minutes, to free them from molasses, so far as to allow of their being subsequently converted into a "malleable" mass by pressure. About 3 per cent. of a solution of gum tragacanth (0.5 per cent.) and syrup (5 per cent.) is now added, and the mixture rotated in the centrifugal machine for a further 3 or 4 minutes. In this state the mass is conveyed to a consolidating apparatus to be moulded by pressure. The claims refer chiefly to the invention of this apparatus, which is minutely described.—A. R. L.

Process and Apparatus for the Production of Invert Sugar and Dextrose. A. Rümpler, Tschanchelwitz, Germany. Eng. Pat. 15,897, September 5, 1892.

THIS invention relates to a process for the inversion of sugar or the saccharification of starch by means of volatile or gaseous acids in such a manner that the acids may be recovered and used over again. The plant described consists of two or more vessels or autoclaves, heated by steam coils, and capable of withstanding a pressure of 12–15 atmospheres. Sugar (100 parts) is dissolved in water (25 parts) and after introducing the syrup into one of the vessels, it is treated best with such a quantity of SO_2 that a 5 per cent. solution of the acid is obtained. The whole is now heated for about 30 minutes at 100° C. The invert sugar solution thus produced has the consistency of honey, and is ready for use. The saccharification of starch is effected by similarly heating a mixture of starch and water (equal parts) at a temperature of 120° C. for three hours. The vessels are connected together with a condensing apparatus by means of which the acid may, after the inversion is effected, be distilled from one vessel into the other.—A. R. L.

XVII.—BREWING, WINES, SPIRITS, Etc.

The Lixiviation of Apples in Cider-making. M. H. Jay. Monit. Scient. September 1892, 636–639.

THE author has analysed the liquids obtained by pressing apples and afterwards treating the pressed residue with water, pressing this and adding the filtrate to fresh-pressed apples and again pressing, treating the first pressed residue with water, again pressing it, rejecting the residue, and treating the second-pressed residue with the filtrate, pressing the residue and adding the filtrate to fresh-pressed apples, and so on.

He finds that working in this way he is practically able to exhaust the apples without obtaining the extract in an inconveniently dilute condition.

A curious fact was noted, viz., the juice of pressed apples is levo-rotatory, but the extract obtained after treating the pressed residue with water and again pressing is dextro-rotatory.—A. L. S.

The Hops of the Year 1891. M. Levy. Chem. Ztg. 16, 1892, 839–840.

Morphological Examination.—Fifty hop cones were dried at 50°–60° C. for half a day.

The cones were picked to pieces by pincers, and the leaves, perigons, seeds, and lupulin separated by sieves of appropriate mesh. This is easy to do if the cones have been properly dried. The various portions were then weighed, and the results are shown in the following table:—

Description of Hops.	Weight of 100 Cones.	Lupulin.	Hop Leaves.	Stalk.	Perizon.	Seeds.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Saaz, Town.....	18.2	14.32	71.66	11.23	4.23	0.64
Saaz, Suburbs.....	19.8	14.56	71.88	10.32	3.6	0.68
Saaz, Neighbourhood.....	17.0	13.27	72.53	9.58	2.9	0.58
Spalt, Town.....	13.82	12.12	71.28	15.71	2.52	0.51
Spalt, Country (heavy land).....	15.71	13.08	73.23	11.12	3.32	0.58

Description of Hops.	Weight of 100 Cones.	Lupulin.	Hop Leaves.	Stalk.	Perigon.	Seeds.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Spalt, Country (light land)	1374	9.7	74.88	15.64	1.78	0
Bavarian Mountain Hops.....	1992	9.78	68.6	16.21	4.1	0.7
Kindlinger.....	1378	9.8	76.5	12.12	2.86	0.4
Wohnzacher.....	1376	13.28	73.79	9.43	1.91	0.7
Auer.....	1574	13.78	71.31	9.93	3.88	6.2
Hollbauer.....	1477	8.9	71.35	15.37	4.6	0.59
Roth Auschauer.....	1379	9.3	70.54	15.49	4.91	0.53
Baden.....	1992	12.28	76.93	8.57	1.23	1.37
Wurtemberg.....	1670	11.96	71.23	10.78	2.43	0.91
Alsace.....	1537	11.35	72.05	11.45	3.92	0.76
Posen.....	1971	12.72	71.65	11.89	3.8	0.4

Chemical Examination.—The hops were dried for 6 hours at 90—100° in a drying oven, weighed, and then dried again until they ceased to lose weight. Five grms. of hops were boiled with 250 grms. of water for $\frac{1}{2}$ of an hour; the hops were filtered off and dried and the aqueous extract calculated from the loss in weight. Five grms. of hops were extracted for 2 hours in a Soxhlet apparatus with 91 per cent. alcohol. The alcoholic extract is calculated from the loss of weight of the hops, and also from the weight of the extract obtained on drying at 60—70° for 3 hours. In this way some hops yield fine yellow crystals. The ethereal extract was obtained in the same way. The ether used was dried over sodium.

The hop oil was determined by boiling 10 grms. of hops in a reflux condenser with 150 cc. of water. The whole is then extracted with ether, the ethereal solution separated, the ether evaporated, the residue dried at 50°–60° C., and weighed. The colour communicated to the worts by boiling with the specified hops was determined by boiling 1 gm. of hops with 300 grms. of water for $\frac{1}{2}$ hour; 160 cc. of this solution were placed in a cylinder and distilled water in another cylinder was brought to the same colour by adding $\frac{N}{100}$ to the solution.

The following results were obtained:—

Description.	Water.	Aqueous Extract.	The same calculated from the Dry Residue.	Alcoholic Extract.	The same calculated from the Dry Residue.	Ether Extract.	The same calculated from the Dry Residue.	Hop Oil.	Colour in terms of $\frac{N}{100}$ Iodine Solution.
	Per Cent.	Per Cent.		Per Cent.		Per Cent.		Per Cent.	
Saaz, Town.....	9.36	31.98	35.28	26.34	29.06	23.08	25.46	0.521	4.63
Saaz, Suburbs.....	9.14	31.78	34.97	26.53	29.2	23.24	25.58	0.537	4.59
Saaz, Neighbourhood....	9.39	32.66	36.01	25.12	27.72	22.98	25.33	0.561	4.32
Spalt, Town.....	9.88	28.93	32.1	22.72	25.21	19.53	21.67	0.325	1.07
Spalt, Country (heavy land)	9.57	26.13	28.88	20.73	22.92	18.34	20.28	0.495	3.98
Spalt, Country (light land)	9.9	29.99	23.29	20.59	22.85	21.12	23.44	0.476	3.8
Bavarian Mountain Hops.	9.83	26.78	29.60	23.5	26.05	19.23	21.79	0.483	2.7
Kindlinger.....	7.57	25.39	27.47	21.18	23.24	16.99	18.38	0.438	2.9
Wohnzacher.....	10.5	22.23	24.84	25.02	28.07	15.38	17.18	0.412	1.8
Auer.....	7.93	29.91	22.71	20.00	21.82	14.72	15.90	0.372	3.8
Hollbauer.....	9.48	19.78	21.15	18.72	20.68	14.12	15.59	0.443	3.0
Roth Auschauer.....	7.66	17.12	18.51	16.21	17.55	13.98	15.14	0.352	3.06
Baden.....	9.39	30.5	33.66	22.47	24.79	17.25	19.03	0.462	4.04
Wurtemberg.....	9.45	27.53	30.4	21.36	23.59	16.26	17.95	0.397	3.0
Alsace.....	12.18	31.45	35.81	24.06	27.39	17.35	19.76	0.432	4.0
Posen.....	11.77	25.93	29.39	23.72	26.3	19.23	21.79	0.398	4.5

As the amount of moisture present in hops varies greatly, it is important that the results be expressed in terms of the dry substance.

It is evident that the percentage of alcoholic extract is the important factor in the chemical examination of hops; in the best hops this lies between 24 and 29 per cent., in

medium quality hops, between 20–24 per cent., and in poor hops, below 20 per cent.

The samples of Auer, Hollbauer, and Roth-Auschauer were badly dried, whilst the sample of Wohnzacher appears to have suffered from rain.

GENERAL EXAMINATION.

Description.	Cleanliness.	Size of the Hop Cones.	Colour.	Lustre.	Taste.	Power of Adhering.
Saaz, Town.....	Moderate amount of stalk and leaf.	Medium	Yellow-red	Very bright	Slightly bitter	Strong
Saaz, Suburbs.....	Little stalk	Large	Yellow	"	Aromatic and harsh	"
Saaz, Neighbourhood.....	Moderate amount of stalk.	"	Yellow-green	"	Harsh and bitter	"
Spalt, Town.....	Much stalk	"	Green	Bright	Slightly aromatic	Moderate
Spalt, Country (heavy land)	Little stalk	Medium	Yellow-red	Slightly bright	Strongly bitter	"
Spalt, Country (light land)	"	Small	Red-green	Dull	Slightly aromatic	Slight
Bavarian Mountain Hops.	Moderate amount of stalk.	Medium	Green-yellow	Slight	Aromatic and bitter	Strong
Kindinger	"	"	Green-red	Dull	Slightly aromatic	Slight
Wohnzacher	Little stalk	Small	Red	Slight	Harsh and bitter	"
Auer.....	Moderate amount of stalk.	"	"	Very dull	Slightly aromatic	Small
Holledauer	Little stalk	Very small	Red-green	"	Slight	"
Roth Anschauer	"	Medium	Green-yellow	"	Slightly harsh	Moderate
Baden	Little stalk and leaf.	"	"	Bright	Strongly bitter	"
Württemberg	"	"	Red-yellow	"	Slightly bitter	"
Alstee	"	"	Green	Slight	"	Strong
Posen.....	"	"	Green-yellow, some red.	Bright	Strongly aromatic	Small

—A. L. S.

On the Formation of Dextrase from Starch by Ferments.
C. J. Lintner. Zeits. ges. Brauw. 1892, 15, 123.

WHILST Cuisinier (this Journal, 1887, 829) found a ferment (glycase) in barley, which converts starch into dextrose, yet the author (this Journal, 1889, 560) has previously denied the existence of this, since although he found maltose, he found no dextrose.

Further experiments have shown Lintner that he is wrong. Barley and wheat contain a little glycase, but maize contains it in quantity.

To prepare dextrose, a boiled or unboiled starch conversion is made into a thin paste with coarsely-ground maize and kept at 60° C. for 30–48 hours; the optical activity will then have sunk to $[\alpha]_D = 53^\circ$ and the filtrate when concentrated will crystallise.

Glycase, although it only exists in an insoluble condition in maize, exists in a soluble condition in malt. Amongst the conversion-products of starch, dextrose can be recognised, although the amount is but small when compared with the amount of maltose.—A. L. S.

On the Preparation of Iso-Maltose from Starch Transformation Products obtained by Diastase. C. J. Lintner and G. Dill. Zeits. ges. Brauw. 1892, 15, 145.

ONE of the authors has previously (Zeits. ges. Brauw. 1892, 15, 6; this Journal, 1892, 627) given a general method for the preparation of iso-maltose; he now gives a detailed account of its preparation as follows:—250 grms. of potato starch are mixed with 500 cc. of diastase solution at 55° C., containing 0.5 gm. of diastase (this Journal, 1887, 296), and 2 litres of water at 75° C. After complete solution, another 0.5 gm. of diastase is added and the reaction allowed to proceed for three hours at 65°–69° C.

The iodine reaction is reddish-brown, $[\alpha]_D = 170^\circ$ approximately.

The solution is evaporated to a syrup, saturated with 80 per cent. alcohol and poured into hot alcohol. Sufficient alcohol must be used, so that every 100 parts of 80 per cent. alcohol do not contain more than 10 parts of dry substance. After cooling, the clear solution is decanted and the alcohol distilled off. The residue is diluted to a

20 per cent. solution and yeast added—in order to destroy the maltose and dextrose. This is found to have taken place in about 20 hours. The fermented solution is filtered, decolorised with animal charcoal, evaporated to a syrup and precipitated with 85 per cent. alcohol; there must be 100 cc. of 85 per cent. alcohol for every 5 grms. of dry substance. The solution is evaporated and the syrup treated in the same way but with 90 per cent. alcohol, so that 100 cc. of alcohol are present for every 3 grms. dry substance. The clear alcoholic solution contains iso-maltose with at the most but a trace of dextrose. This may be removed by fractionation with alcohol. To obtain the iso-maltose in a solid condition it is preferable to mix the syrup with powdered glass and dry at 100° C. In this way 20 per cent. of the starch are obtained as iso-maltose.

—A. L. S.

The Estimation of Glycerin in Fermented Beverages.
B. Proskauer. Pharm. Centr. H. N. F. 13, 1892, 369.

See under XXIII., page 1038.

The Determination of Glycerol in Sweet Wines. M. T. Lecco. Ber. 25, 1892, 2074.

See under XXIII., page 1038.

The Estimation of the Intensity of Colour of Beers and Malt Extracts. C. J. Lintner. Zeits. ges. Brauw. 1892, 15, 213.

See under XXIII., page 1038

The Hydrolytic Functions of Yeast. (Part II.) James O'Sullivan. Proc. Chem. Soc. 1892, 147. (This Journal, 1892, 628.)

A FURTHER series of experiments on the hydrolytic activity of healthy yeast cells are described, the following being a summary of the conclusions arrived at:—

1. The hydrolytic action of yeast at ordinary temperatures (12° to 20° C.) follows the same course as that of a simple

chemical interchange, and is not influenced by either air or carbon dioxide.

2. A time curve representing the action would correspond with that given for invertase under the most suitable conditions of acidity by O'Sullivan and Thompson (this Journal, 1890, 816 and 1049). The rate, therefore, differs from that at which the alcoholic fermentation of yeast takes place, which would be represented by a straight line (Dumas, Ann. Chem. Phys. [3], 1874, 81; and A. J. Brown, this Journal, 1892, 257).

3. Any interference involving either an increase or a diminution of the natural acidity of the yeast cell diminishes its action. This is a very important matter, and should always be considered when dealing with organisms or cellular membranes possessing the power of hydrolysing cane sugar. Dumas observed that both acids and alkalis interfered with alcoholic fermentation, and that in the case of alkalis the yeast possessed the power of overcoming the alkalinity, the liquid again becoming acid and fermentation recommencing. It is found that a quantity of potassium hydrate which completely arrested the hydrolytic action of yeast for three to six hours was neutralised by the yeast in about 24 hours, the solutions eventually becoming acid and hydrolysis recommencing.

4. It is inferred from experiments on the effect of rupturing the cell on the velocity of the hydrolytic action, and also from the rate at which the change proceeds, that the whole of the invertase of the yeast cell comes into action as soon as the cane sugar is added to the yeast, and that it continues to act during the progress of the hydrolytic action.

5. The power which yeast possesses of producing alcoholic fermentation is not influenced by the yeast having first hydrolysed cane sugar, this being the case whether the hydrolytic action is brought about in the first instance in the presence of air or carbon dioxide.

PATENTS.

Improvements in the Production of Alcoholic Ferments and of Fermented Liquids thereby. J. Takamine, Chicago, U.S.A. Eng. Pat. 17,374, October 12, 1891.

THE basis of the invention is the convenient use of a mould which the inventor proposes to call *Aspergillus Koji*, which has the power of secreting a diastatic ferment and also of producing the alcoholic fermentation of sugar. There are other moulds which likewise possess these properties. *Aspergillus Koji* is well known in Japan and is called Moya-shi or Tane-Koji. To prepare this in quantity, any suitable cereal is ground and steamed, until the starch cells are burst, cooled to 26°–30° C., and a small quantity of the mould spores well mixed with it.

When the mould has fully matured, the product may be used, or if it is required to preserve it, the spores are sifted out, dried and mixed with gypsum or roasted starch, when they will keep for a long period.

To produce the diastase, any convenient cereal is ground, steamed, and cooled to 30° C. The mould is mixed with this and allowed to grow on it. When sufficient growth has taken place, the mass is extracted with water. The liquid contains the ferment cells in suspension and the diastase in solution; they are separated by filtration.

The cereals to be converted are heated with water until the starch is thoroughly gelatinised and then cooled to 60°–75° C.; the solution containing the diastase is added and in about one hour complete conversion has taken place.

When cold the ferment cells, which were previously filtered out, are added, and the usual alcoholic fermentation takes place. This ferment will grow in solutions containing considerable quantities of alcohol, so that it is possible to obtain a fermented liquid containing about three times as much alcohol as usual.—A. L. S.

Improvements in the Manufacture of Beer and Porter or like Beverages. J. Hillyard, Liverpool, and E. Dugdale, Liverpool. Eng. Pat. 17,395, October 13, 1891.

MALT with or without other flavouring matter, is mashed at a high temperature and after standing two hours is boiled with hops until the malt "breaks." The boiling liquor is then run into casks and the casks shived. When the liquid has become fine it is ready for consumption and forms a non-intoxicant beer.—A. L. S.

An Improved Process for Filtering Beer and other Liquids, and Apparatus therefor. J. Sutton, Islip, New York, U.S.A. Eng. Pat. 18,488, October 27, 1891.

BETWEEN the vat and the filter is placed a tall stand-pipe up which the liquid may be forced by pressure; this pipe is bent over at the top and continues downwards to the filter, the liquid is only forced part way up the stand-pipe by pressure, it being drawn over the bend by the siphoning action of the descending pipe. By this means the inventor claims that the liquid is freed from much of its sediment and heavy matter before entering the filter. Several methods and apparatus for employing this system are described in detail in the specification.—J. C. C.

Improvements in Pneumatic Malting and in Machinery or Apparatus therefor. R. H. Leaker, Bristol. Eng. Pat. 18,538, October 28, 1891.

AN attenuating coil is placed in the vessel which contains the drum usually employed in pneumatic malting. By means of this the temperature of the grain in the drum may be regulated as required. Over the drum is fixed a trough, containing an attenuator, and the edges of a fibrous blanket dip into the water in this. The air supplied to the drum has to pass through this blanket, and thus may be supplied to the grain with any degree of moisture or heat required.—A. L. S.

Improvements Relating to the Manufacture of Beer. P. A. Roche, Paris. Eng. Pat. 19,849, November 16, 1891.

THE invention has for its objects the rendering of beer ferruginous. This is done by passing an electric current through beer, into which iron in the form of thin wire has been introduced.—A. L. S.

Improved Process for the Production of Yeast and Spirit by the Employment of Ozonised Air or Oxygen. W. P. Thompson, Liverpool. From O. E. Nycander and G. Francke, Hamburg and Berlin, Germany. Eng. Pat. 20,566, November 26, 1891.

By the employment of ozonised air the use of crude materials is rendered possible for the production of German yeast and a commercial spirit.

Such materials are molasses, bran, malt-combs, linseed cake, animal refuse, &c.—A. L. S.

A Method of and Appliances for the Collection, Purification, and Utilisation of the Carbonic Acid Gas given off during Fermentation of Saccharine and other Substances. J. Pullman and H. S. Elworthy, London. Eng. Pat. 22,248, December 19, 1891.

IN applying this process to an open fermenting vessel, the latter must be provided with a wooden or metallic cover, having a deep flange or rim which fits into a corresponding deep gutter fixed round the outside of the vat and a little below the top. This channel is partially filled with some liquid, such as water, mercury, &c., which prevents the escape of gas or the entrance of air. One cover may thus serve for several vats, being transferred from one to the

other by means of an overhead railway and a system of pulleys and ropes. In the case of large fermenting vessels the cover may be formed of waterproof or oiled canvas, suitably secured at the edges. The gas escapes from the vat through a valve, which is set to open at a certain pressure (2–3 inches of water), and is then preferably collected in a gasometer. Subsequently the gas is submitted to the following purifying processes. It is passed through—

1. A cylindrical scrubber containing coke, pumice, &c., over which a slow stream of water is made to flow by means of an automatic sprinkler. Soluble impurities, such as alcohol, acetic ether, &c., are thus removed from the gas.

2. A similar scrubber, in which the gas encounters, instead of water, a current of melted paraffin wax, or vaseline, &c., which absorbs the ethereal impurities.

3. A desiccating chamber charged, preferably, with potassium carbonate or calcium chloride.

4. A series of pipes maintained at a red heat. The first of these pipes contains coke, metallic copper, iron, or zinc, and is intended to retain any free oxygen present in the gas. The remaining pipes are charged with copper oxide or some other suitable oxidising material, and serve to oxidise any organic impurities still present. By these means the carbonic acid gas is rendered perfectly pure, and after cooling, may be compressed or liquefied in the usual way.

—H. T. P.

Improvements in or in the Preparation of Extracts for use in the Manufacture of Yeast and Spirits. W. Thompson, Liverpool. From O. E. Nyeander, Berlin, Germany. Eng. Pat. 22,399, December 22, 1891.

THE object of this invention is the production of a yeast-food suitable more particularly for use in distilleries and yeast manufactories, from various nitrogenous materials hitherto not employed for this purpose, such as raw and dried slaughter-house and fish refuse, oil-cake and meal, &c. The nitrogenous bodies are rendered assimilable (peptonised) by heating the material employed under pressure, with or without the addition of organic or inorganic acids. Or peptonisation may be effected at 30°–50° C. by treatment with pepsin, malt, malt-extract, lactic acid, &c. The extract thus obtained is added to worts, saccharine solutions, &c., which are then fermented in the usual way.—H. T. P.

Improvements in Apparatus for Cooling and Attenuating Beer during Fermentation. H. Prior, Linton, Cambs. Eng. Pat. 301, January 6, 1892.

THE apparatus consists of a shallow, closed, circular vessel, in the interior of which are placed one or more cooling coils. The ends of the coils extend through the shell of the vessel, the inlet end being provided with a tap for regulating the flow of water. The tray, being filled with water, is lowered into the vat, level with the surface of the beer, and cold water is circulated through the coils. The water in the tray is cooled to an even temperature, and a large and uniform cooling surface is thus exposed to the beer. It is claimed that by this means a more uniform distribution of temperature is obtained and greater control over the beer, as well as a larger development of yeast than hitherto possible.—H. T. P.

Improvements in Apparatus for Drying Brewers' Grains and similar Substances. H. H. Lake, London. From E. M. Parker, New York, U.S.A. Eng. Pat. 15,559, August 30, 1892.

THE apparatus consists of a cylinder made of three curved plates which do not quite meet, and leave a longitudinal opening for the escape of steam, &c. Through the axis of the cylinder passes a hollow screw for conveying the grains and furnished with longitudinal paddles to prevent the grains lying at the bottom of the cylinder. The walls of the

screw cylinder are pierced, and hot air being injected into the screw passes through the perforations into the grains and thence through the opening in the top of the cylinder.

—A. L. S.

Improvements in Malt Beverages. E. Adam, Philadelphia, U.S.A. Eng. Pat. 17,258, September 27, 1892.

BOILED, hopped, and cooled wort prepared in the ordinary way from high-dried malt or other suitable material, is stored in an air-tight vessel in which it is fined and allowed to deposit its suspended matters. The wort is then mixed in a suitable apparatus with some fermented or distilled liquid, such as alcohol, wine, cordial, &c., and at the same time charged with carbonic acid gas. Finally, the liquid is filtered under pressure and stored for consumption.

—H. T. P.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOODS.

Is Milk Acid or Alkaline? A. Vaudin. Bull. Soc. Chim. 7—8, 1892, 483—492.

THE author has examined the milk of various animals, and gives the following summary of his investigations:—

1. The milk of mammals has an acid reaction at the moment of its escape from the mamme.

2. The acidity of normal milk, furnished by animals of the same species, undergoes relatively little variation.

3. All influences (gestation, parturition, food, &c.) which can cause disturbance of the lactic secretion bring about a change in acidity.

4. The acid reaction of milk is due principally to the proteid constituents which it contains.

5. The variations in the acidity, which take place in the course of lactation, depend on the modifications, both in nature and in proportion, which the various proteids and mineral constituents of the milk undergo at the same time.

—F. S. K.

A New Colour Standard for Natural Waters. A. Hazen. Amer. Chem. Jour. 14, 300.

See under XXIII., page 1037.

PATENTS.

Improvements in the Preparation of Mineral Salts for Bathing and Drinking Purposes. C. W. Vincent, Holloway. Eng. Pat. 18,700, October 29, 1891.

OBJECT of this invention is to "imitate, at pleasure, the various celebrated sodio calcarco, magnesio, sulphuretted, aerated, ferruginous and other waters of France (including Savoy), and Germany, Bohemia, Austria, &c." To this end various proportions of sodium sulphate, coal, and calcium (magnesium or iron) carbonate are roasted together. The product containing chiefly the sulphate, carbonate, and sulphide of soda, and calcium sulphide, is ground up and used in the proportion of 1 oz. to 15 gallons of water. If desired, it may be exposed on shelves to the action of carbonic acid gas, until sufficiently bicarbonated.—H. A.

Improvements in Detection of Foreign Fats in Butter. W. Johnstone, London. Eng. Pat. 20,956, December 1, 1891.

See under XXIII., page 1039.

Improvements in the Smoking or Curing of Fish, Meats, and other Articles of Food. B. Piffard, Hemel Hempstead, Herts. Eng. Pat. 21,305, December 5, 1891.

THE inventor prepares an antiseptic liquid by burning wood in a suitable furnace and conducting the smoke into a tube or chimney through which steam is propelled from a boiler. The vapours are then condensed in a suitable apparatus.

The woods employed vary according to the nature of the food and the flavour it is desired to impart. The patentee uses oak for pork, peat for fish, birch for tongues, and so on.

The length of time which the food is immersed in the liquor varies according to the nature of the article and the strength of the antiseptic. When the liquor is of a dark straw colour, the time is from three to six days for pork, a few hours for fish, and one minute for imported preserved meat.—L. de K.

Process for Preserving Organic Substances and for Disinfection. O. Imray, London. From "the Farbwerke Meister, Lucius, and Brüning, Hoechst-on-the-Main, Germany." Eng. Pat. 21,706, December 11, 1891.

THE inventors have noticed that formaldehyde possesses remarkable antiseptic properties, and that putrefaction bacteria, ferment germs, mildew fungus, and the like, are completely impeded in their development by the said substance.

Meat and similar substances are immersed for a few seconds in an aqueous solution of formaldehyde: liquids are mixed with $\frac{1}{250000}$ part of it. Solid substances may also be exposed to the formaldehyde vapour. Considering the minute quantity employed, there seems not the slightest objection to its use: moreover, meat, vegetables, and similar articles of food, when treated with it, do not lose anything of their appearance or freshness, or suffer in any other respects.—L. de K.

Improvements in Gelatinous Food Products. G. Parker, Birmingham. Eng. Pat. 14,349, August 9, 1892.

THE object of the invention is to provide a gelatinous product or mass in which a portion, or all, of the flavouring material required for the mass will be contained, without being mixed with the gelatin, and which will require only water or milk to prepare it for use.

The flavouring ingredients are placed in a cavity inside the jelly. As regards the composition of the mass, or its final shape, the inventor does not limit himself to any particular description, but a desirable formula is: glucose, 1 lb.; sugar, 5 lb.; gelatin, $1\frac{1}{2}$ lb.; citric acid, 1 oz. In preparing it, the gelatin is dissolved in a suitable quantity of water, the glucose and sugar boiled, the citric acid added, and the whole mixed so as to form a solid mass, body, or compound.—L. de K.

Improved Process for Preserving Meat and other Articles of Food. G. Hartmann, Frankfurt a M., Germany. Eng. Pat. 14,601, August 12, 1892.

THIS process dispenses with the use of antiseptics, and consists in three steps: preliminary sterilisation, germinating period, and final sterilisation. The first step consists in subjecting the preserves to a temperature of 100° – 120° for a short time; the second, to keep them for some days at a temperature of 20° – 30° .

This will develop any germs or bacteria which have not been destroyed in the primary sterilising process, but they are too weakly and too poor to rapidly multiply and form colonies, and if no time is given them to properly develop, they will be utterly destroyed by a second sterilisation process (3rd step).

Preserves of almost unlimited durability are thus obtained.—L. de K.

A Process for the Disacerbation of Kola-Nut Powder. H. Hoffmann, Berlin, Germany. Eng. Pat. 16,765, September 20, 1892.

THE invention has for its object the removal of the bitter taste of kola nuts so as to render them fit for food. Hitherto the disacerbation has been usually effected by treatment with alkalis, but now hydrogen peroxide is proposed.

The powder obtained from the slightly-roasted kola nuts is moistened with water and mixed with "10 per cent. (ten-hundredth parts) of peroxide of hydrogen." The reaction is somewhat energetic, and the temperature rises to 35° . After a few hours the reaction is completed, and the bitter principles, chiefly tannins, are oxidised and destroyed. The resultant pulp is then dried at a slow heat and is ready for use.—L. de K.

(B.)—SANITARY CHEMISTRY.

Microscopic Examination of various Forms of Carbon; Identity of Lung-Pigment with Soot. J. Wiesner. Monatsh. 13, 1892, 371–410.

THE author has examined microscopically the behaviour of various forms of carbon on treatment with potassium bichromate and sulphuric acid at the ordinary temperature; the following is a summary of his observations:—

The principal constituent of lignite is a brown transparent substance, which becomes colourless when treated with a mixture of sulphuric acid and potassium bichromate, being converted into a web-like skeleton of an indefinite histological character, and which shows the reactions of cellulose; as this residue does not withstand the action of chromic acid, the lignite, excluding mineral constituents, is finally completely oxidised.

All the other kinds of carbon which were investigated, namely, anthracite, coal, charcoals, soot, and graphite, contain as a rule only a small quantity of substances which are readily oxidised by the chromic acid mixture: the residue behaves like amorphous carbon, and is only extremely slowly acted on by chromic acid at the ordinary temperature.

Anthracite consists for the most part of a black substance which is practically unacted on by the chromic acid mixture: it also contains a dark brown transparent substance, which is slowly oxidised, but which does not yield cellulose.

Coal behaves like a mixture of lignite and anthracite, and on treatment with chromic acid gives a small quantity of cellulose.

Red charcoals, obtained by carbonising wood at a relatively low temperature, is completely decomposed by sulphuric acid and potassium bichromate; at a certain stage in the decomposition process there is formed a well-preserved woody skeleton, in which are seen long dark threads and delicate rings; by this behaviour it can be distinguished from lignite. Black charcoal is hardly acted on by the chromic acid mixture.

Soot, freshly deposited from a flame, consists partly of exceedingly small black particles of carbon, which are not oxidised by the chromic acid mixture, and partly of oily drops. Soot deposited from the air consists partly of fine particles, partly of dendritic or irregular aggregates, of carbon.

The black pigment which collects in the human lung, especially in the interlobular connective tissue, consists of smaller or larger particles of soot, which, on treatment with chromic acid, are simply resolved into small granules without any further action taking place. Melanines can be readily distinguished from the particles of lung-pigment as they are rapidly destroyed by the chromic acid mixture.

Chemically pure, amorphous carbon, prepared from soot, and containing 99.3 per cent. of carbon, behaves towards chromic acid like the other substances consisting of amorphous carbon, which have been mentioned; it is, however, much more readily oxidised, probably owing to its fine state of division.—F. S. K.

PATENT.

Improved Apparatus for the Purification of Gaseous Fumes, Air, and the Like, and the Deposition of Solid Particles therefrom. M. F. Purcell, Dublin, and G. Purcell, Los Angeles, California. Eng. Pat. 21,730, December 11, 1891.

THE apparatus described in this patent may be employed for the purification of smoke or of other waste gases containing solid particles, as, for example, the air containing dust from screened grain; also for the purification of deleterious gases from various manufactures.

It consists of an ordinary exhaust fan, into the casing of which a number of nozzles are introduced; water mixed with suitable chemicals or not, as the case may be, is caused to impinge on the vanes of the rotating fan, and in this way is immediately broken up into a fine mist in contact with the gaseous fumes. This method of treating the fumes not only cools them and reduces their volume, but removes all solid matter; in case ammonia or any other readily-soluble gas is present in the mixture it is dissolved, and the escaping gases are transparent and innocuous.—F. S. K.

(C).—DISINFECTANTS.

Formaldehyde ("Formol"). M. Trillat. Monit. Scient. July 1892, 490—494.

HITHERTO it has been thought that the most powerful antiseptic bodies belonged to the hydroxyl compounds of the aromatic series of hydrocarbons and to the metallic salts. Formaldehyde is, however, a very powerful antiseptic, the author finding it to be superior to bichloride of mercury in this respect. This result is unexpected, as acetaldehyde does not possess this property.

It had been previously noticed in 1888 that the presence of a minute quantity of this substance in urine effectually preserved it from putrefying. Similar results having been obtained with other bodies, the author was led to the further study of this aldehyde, with special reference to its probable use in the preservation of fermentable products.

Preparation and Manufacture of Formaldehyde.—Fischer and Löw prepare small quantities of formaldehyde by allowing the vapours of methyl alcohol to come into contact with a spiral of platinum, previously heated. The platinum remains incandescent, whilst in its vicinity the alcohol is oxidised to aldehyde.

The industrial apparatus is constructed to work out the following principle:—A conical jet discharges the alcoholic vapour from a narrow opening. The proportion of air mixed with alcohol increases in proportion as the base of the cone is enlarged, i.e., in proportion as the distance increases from the apex of the cone. In the different parts of the jet a zone is found in which the mixture of air and alcohol is in the most favourable condition for oxidation, which is stimulated by the presence of a red-hot porous surface. It is easy to understand that the portions of the alcoholic jet near to the summit of the cone, and which only contain little oxygen, will only undergo imperfect oxidation, whilst those very far away, but very rich in oxygen, will be almost completely burned. But between the two extremes is the portion best adapted for the oxidation, the process being regulated by estimating the distance which should separate the orifice of the jet from the red-hot porous body.

Methyl alcohol, heated under pressure, escapes from a horizontal jet which operated in a copper tube, the opening of which is conical, so as to allow of the in-draught of air. After the passage over the oxidising substance the vapours are at once condensed by various processes. Thus a mixture of water, methylic alcohol, and formic aldehyde is obtained, and also traces of formic and acetic acids. A rational process of purification is next proceeded to. Löw, Fischer, and Tollens propose as oxidising agents platinum, platinised asbestos, and oxide of copper. The author also finds many metals and most porous bodies, as coke, retort-carbon, porcelain, &c., similarly efficacious.

Mention is made of the formation of trioxymethane when a solution is evaporated to a greater strength than 36° — 40° C. In noticing its action on wines the author proposes to found a method of analysis on the results obtained; the tannin and colouring matters being precipitated by the aldehyde.

It is found that the addition of 1—50,000 of meat extract has a decided preservative action, while with 1—25,000 no change could be noticed in the extract after the lapse of four days. Bichloride of mercury in these proportions has no effect, the extract showing change in 24 hours. With 1—12,000 the extract is kept good for several weeks, while change takes place in five days when using equal weight of bichloride of mercury.

Several kinds of bacilli are destroyed by a solution of 1—25,000, among which may be mentioned that of the saliva, &c.

Preservation of Meat.—Three methods are described: (1) by immersion in the aldehyde solution; (2) by means of the vapour of the aldehyde; (3) by wrapping the meat or other perishable goods in coverings soaked in aldehyde solution.

The following results were obtained by (1):—

Strength of Solution 1—500.

Time of Immersion.	Time of Preservation.
60 minutes.	25 days.
40 "	18 "
30 "	16 "
15 "	13 "
10 "	12 "
5 "	8 "

and

Strength of Solution 1—250.

Time of Immersion.	Time of Preservation.
5 minutes.	20 days.
2 "	16 "
1 "	12 "
30 seconds.	10 "
2 "	10 "

The above experiments were performed on ribs of beef, which were allowed to remain exposed to the air, at a temperature of 23° — 30° C.

The vapour of aldehyde was found to stop all decomposition, keeping meat fresh for months and stopping fermentation in organic liquids.

Pieces of veal were wrapped in coverings soaked in 1—250 solution with success.

Analyses of the meat juices and microscopical examination of meat tissues showed that no alteration had taken place from the action of the aldehyde.—W. P. D.

XIX.—PAPER, PASTEBOARD, Etc.

PATENTS.

Improvements in and relating to the Manufacture or Production of Paper Pulp and Textile Fibre. C. G. Hagemann, Ludwigshafen, Germany. Eng. Pat. 18,470, October 27, 1891.

It is found that the rush *Arundo Donax* is sufficiently purified by a relatively weak solution of caustic alkali at the ordinary temperature for utilisation as a cellular substance or paper pulp. Thus this particular vegetable fibre is not weakened and turned brown by the alkali, as are other fibres, which can only be purified by such strong solutions of alkali and at such high temperatures as have the deleterious effects indicated. The *Arundo Donax* is comminuted and immersed in a solution of caustic soda of 4—6° B., for 4—6 days; the fibrous mass is then washed, crushed by rolls, edge-runners, or stampers, ground with water, but without chemicals, in a rag-engine, and finally bleached, washed, and dried in the known manner. To produce a textile fibre the rush is split into long strips by light rolling: the strips are treated with alkali as described above, washed, and beaten with wooden beaters upon wooden supports; carding, heating, or thrashing, as applied to hemp, complete its conversion into a fibre which can be spun. To obtain a very soft fibre the beaten strips are allowed to rot in water in the same manner as is carried out in the case of hemp, flax, &c., the finishing processes being the same as those described above. The waste from the conversion into textile fibres may be made into paper-pulp as detailed.—A. G. B.

Improvements in the Method of and Apparatus for making Parchmentised Fibre Tubes. R. P. Frist and C. G. Ruper, Newcastle, Delaware, U.S.A. Eng. Pat. 22,628, December 28, 1891.

HERETOFORE parchmentised paper tubes have been made by winding the paper strips, which have been immersed in the parchmentising liquid, on a mandrel. The ease with which the wet paper is torn renders this process a difficult one. By this invention the dry strips are wound on the mandrel and subsequently parchmentised by being passed, on the same mandrel, through a bath of the parchmentising liquid; the moist paper is then consolidated by passage between pressure rollers. Thicker tubes are made by winding fresh paper over the first layer as soon as this has passed through the bath and then passing both layers through a second bath before consolidating. There are also claims for other methods for applying the liquid, such as contact with a roller surmounted by a drip-pan, and for various combinations of apparatus.—A. G. B.

Improvements in Pulp-Catchers or Savers. A. J. E. Füllner, Warmbrunn, Prussia. Eng. Pat. 13,893, July 30, 1892.

THE pulp-catcher described consists in an inverted truncated conical vessel having an annular channel above its upper edge, from which the water containing the pulp is caused to flow down the sides of the cone by means of an inner conical ring. In doing so the water deposits the pulp, the clear liquid rising up the centre and is drawn off by a second annular channel, a sieve being, if necessary, interposed to catch any remaining pulp. The pulp deposited is drawn off by a pipe which enters about half way down and terminates at the bottom near the centre of the vessel. The outer portion of this pipe may be raised or lowered in order to regulate the rate of discharge.—J. C. C.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Transformation of Gallic Acid into Pyrogallol; Melting Point of Pyrogallol. P. Cazeneuve. Bull. Soc. Chim. 7—8, 1892, 549—551.

WHEN gallic acid is heated with twice its weight of aniline, carbonic anhydride begins to be evolved at about 120°, and the whole of the gallic acid can be decomposed without raising the temperature much above this point. If the heating be continued until the evolution of gas is at an end crystals of aniline pyrogallate $C_6H_5O_3 \cdot 2 C_6H_5 \cdot NH_2$ are obtained on cooling; this compound is very unstable and melts at 55°—56°; when treated with benzene or toluene it is decomposed, aniline passes into solution, and pyrogallol remains in a practically pure condition.

Pure pyrogallol melts at 132°, not at 115° as generally stated.—F. S. K.

On some Ferruginous Medicinal Preparations. H. Le Chatelier. Compt. rend. 115, 1892, 124—125.

THE author finds that many mineral ferruginous waters, as they occur in commerce at the present time, contain little if any iron. Also that many pharmaceutical preparations of iron are of very uncertain composition, both as regards the presence of iron and the condition of oxidation in which it is present.—A. L. S.

Investigations on Coca Leaves. O. Hesse. Annalen, 271, 1892, 180—228.

FIVE kinds of coca leaves are to be distinguished, viz.:—(1) Broad-leaved coca from Peru and Bolivia (*Erythroxylon coca*, Lamarek); (2) small-leaved coca from Northern Peru, and exported from Trujillo, hence known as "Trujillo," or "Truxillo coca" (*Erythroxylon coca*, var. *novagranatense*, Morris); (3) a coca from South America; formerly sent to Paris, and which stands between the above two varieties in its physical character. This variety has not been an article of commerce for the last five or six years. (4.) Broad-leaved coca from British India and Ceylon (*Erythroxylon Bolivianum*, Burck), only occurring to a small extent in commerce: (5) small-leaved coca from Java (*Erythroxylon coca*, var. *spruceanum*, Burck.); 20,000 kilos. of this variety were imported last summer. The last two varieties have been cultivated from seeds, and it is uncertain whether they are indigenous or not.

The Coca Alkaloids (this Journal, 1889, 566):—

1. *Cocaine*.—Reference is made to Einhorn's work on this alkaloid in regard to the decomposition of the alkaloid into benzoyl ecgonine and methyl alcohol by means of water (this Journal, 1886, 40; 1887, 605). This decomposition appears to take place in coca itself when it is not quite dry, and when damaged by water, the leaves were found to contain considerably less cocaine than fresh coca. Ecgonine itself, when heated to 140°—160° C. with 25 per cent. sulphuric acid, is converted into anhydro-ecgonine, the hydrochloride of which, $C_{14}H_{17}NO_2 \cdot HCl + HO_2$, melts at 238°—240° C. when dehydrated.

2. *Iso-cocaine*.—This dextro-rotatory cocaine does not occur in coca, and Liebermann's statement to the contrary is incorrect. It has only been obtained synthetically.

3. *Cinnamyl-cocaine*.—This alkaloid is seldom found in the broad-leaved coca from South America, and then only in small quantity, but always occurs, and often in considerable quantity, in the small-leaved Truxillo coca; it is an especially prominent constituent of the East Indian coças. Java coca, yielding 1.9—2.1 per cent. of alkaloids, was found to contain about 1 per cent. of cinnamyl-cocaine.

In order to isolate it from the mixture of alkaloids obtained from Java coca, the whole is precipitated from acid solution with a small excess of ammonia and the resinous precipitate covered with alcohol or ether in the cold, when crystals of cinnamyl-cocaine separate, which can be re-crystallised from hot alcohol. They dissolve with difficulty in alcohol, ether, acetone, and petroleum ether, and melt at 121°C . Of the salts of the alkaloid, the hydrochloride and the platinum and gold double chlorides are characteristic; it also forms a methiodide, $\text{C}_{19}\text{H}_{21}\text{NO}_4 \cdot \text{CH}_3\text{I}$. Cinnamyl-cocaine was first obtained synthetically by Liebermann.

4. *Cocamine* was obtained by the author in 1886 from the South American variety formerly sent to Paris, and was found to form about one-half of the total alkaloids present. To separate it, the mixture, dissolved in acetic acid, was treated at 50°C . with ammonium and petroleum ether, and this treatment repeated with the precipitate obtained, until it was finally obtained in a micro-crystalline, flocculent form. When heated the alkaloid is decomposed, but the decomposition is effected better by means of dilute acids, when ecgonyl-cocaine acid, $\text{C}_{27}\text{H}_{39}\text{NO}_5$, results as the first product of decomposition, which is itself readily decomposed further into eegonine and cocaine acid. This last acid is best purified by converting it into the ammonium salt; it melts at $266^{\circ}-267^{\circ}\text{C}$., and is regarded as a polymeride of cinnamic acid. The molecular weight of cocaine as determined by Raoult's method corresponds to the formula $\text{C}_{14}\text{H}_{23}\text{NO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$.

5. *Iso-cocamine* occurs in all varieties of coca, but especially in Truxillo coca, and is contained in the mixture of bases which is precipitated from the acid solution that results after the removal of cocaine and cinnamyl-cocaine by means of ammonia or of sodium carbonate. It could not be isolated successfully owing to lack of material, but its properties are known owing to its having been synthesised by Liebermann under the name of β -truxillin. It is isomeric with cocaine and closely resembles the latter in all properties and reactions, being decomposed by acids with the formation of ecgonyl-iso-cocaine acid and iso-cocaine acid successively. The iso-base is somewhat more soluble in petroleum ether than cocaine. Cocaine and iso-cocaine acids can be readily distinguished by the action of barium or calcium chloride on their ammoniacal solutions, when the salt of the latter is precipitated, that of the cocaine acid remaining in solution. The iso-cocaine acid can then be isolated from the precipitate by decomposing it with hydrochloric acid and extracting with ether.

6. *Homo-cocamine* occurs in small quantity in Truxillo coca and in the broad-leaved South American coca, judging from the formation of homo-cocaine acid as a decomposition product of the mixed alkaloids by means of acids. The properties of this acid and its method of separation from cocaine and iso-cocaine acid are detailed. It has the same empirical formula as cocaine and iso-cocaine acids, $\text{C}_{19}\text{H}_{21}\text{O}_4$, which formula also represents its molecular weight, whilst that of the two other acids corresponds to $\text{C}_{17}\text{H}_{19}\text{O}_4$. The salts of homo-cocaine acid are all amorphous; a methyl-ester and a mononitro-derivative are described.

7. *Homo-isococamine* only exists to a very small extent in coca, and was detected by the formation of homo-iso-cocaine acid as a decomposition product. The properties and method of isolation of this acid are given. It is isomeric with homo-cocaine acid.

β -cocaine acid, $\text{C}_{15}\text{H}_{16}\text{O}_5$, is formed by fusing cocaine acid with caustic potash at a high temperature. It is isomeric with cocaine acid, and crystallises in needles from alcohol or from hot water, which melt at 180°C . The acid is hardly attacked by potassium permanganate; of its salts the copper and silver salts are amorphous precipitates, the potassium salt is crystalline and readily soluble. A methyl-ester and a mono-nitro-derivative are described. β -iso-cocaine acid is obtained in a corresponding way from iso-cocaine acid; it is identical with Liebermann's δ -truxillie acid. It melts at 172°C ., and is best crystallised from dilute acetic acid. The barium salt is crystalline and soluble with difficulty. The molecular formula is $\text{C}_{15}\text{H}_{16}\text{O}_5$; the acid yields a mono-nitro-compound.

8. *Benzoyl-pseudo-tropeine* is contained in Java coca, and is separated from the other alkaloids by precipitating the latter from acid solution by a slight excess of ammonia, when the benzoyl-pseudo-tropeine remains in solution and can be separated by the addition of caustic soda. After extraction with ether the base is converted into the hydrochloride, which can be purified by recrystallisation from alcohol. Its properties as described by Liebermann are confirmed except in regard to the nature of the base formed by decomposition with hydrochloric acid, which the author does not consider identical with Ladenburg's *Pseudo-tropeine*. In opposition to Geisel's results the author was unable to detect the presence of *Hygrine* in any of the varieties of coca (*Pharm. Zeit.* 36, 419).

Indifferent Constituents of Coca Leaves.—A red colouring matter, probably *Carotin*, was isolated six years ago from a sample of Bolivian coca, but owing to the ease with which it undergoes decomposition no analysis of the product could be made, and the author has been unable to isolate it since from any of the varieties he has examined. The presence of *Coca wax* was first pointed out by Niemann, and was regarded as probably identical with "*Grass wax*" and with Mulder's "*Syringa wax*," but the present investigation has shown that the wax contained in Truxillo coca, the broad-leaved South American coca, and in the small-leaved Java coca is not identical. To extract the wax the finely-ground coca is moistened with sodium carbonate solution, and then extracted with petroleum ether. The resulting solution is treated with sulphuric acid to remove the alkaloids and then distilled with the addition of water. The wax remains behind and is purified by repeated crystallisation from hot alcohol. That obtained from Truxillo coca consists of *palmityl- β -amyirin*, and melts at 75°C ., whilst the wax from the broad-leaved South American coca contains a ketone $\text{C}_{35}\text{H}_{70}\text{O}$ (β -*Cerettione*) in addition to the above ester. The wax melts at $69^{\circ}-70^{\circ}\text{C}$. Java coca wax melts at 77°C . and contains in addition to the above two substances which are readily soluble in cold ether, a mixture of bodies insoluble in cold ether, which was found to contain a *hydroxy-cerotic acid* $\text{C}_{27}\text{H}_{44}\text{O}_5$, *cerin*, the ceryl ester of cerotic acid, and *Myristyl- β -Amyrin*, the first of which most probably occurs as an ester. (*This Journal*, 1889, 131, 132, 133, 305, 567; 1890, 100, 541, 543, 599, 646, 1060; 1892, 177 (Geisel).)—C. A. K.

Carotin. O. Hesse. *Annalen*, 1892, 271, 229—230.

THE author throws doubt upon Arnaud's statement that carotin always accompanies chlorophyll (*Compt. rend.* 104, 1293), and considers his method of determining the colouring matter colorimetrically unreliable, especially as rubidin, another red colouring matter, has been shown by Negri to exist in various plants (*Gazz. Chem.* 9, 506). The insufficiency of the analytical data on which the proposed formula $\text{C}_{26}\text{H}_{34}$ is founded, is also referred to.

—C. A. K.

Antiseptics and Medicinal Products derived from Coal Tar, or from Aromatic Oils. A. Trillat. *Monit. Scient.* May 1892, 338—351.

AT the close of a series of articles on antiseptics and medicinal products the author gives the following table, in which a scientific classification is adopted, the phenols of the benzene series appearing first, being followed by naphthalene and the naphthols. Then come antiseptics, containing the carboxylic group, &c. Subsequently appear antiseptics containing nitrogen, commencing with acetanilide (antifebrin), these pass into pyridine, quinoline, and similar derivatives:—

Commercial Name.	Scientific Name and Formula.	Method of Formation.	Distinctive Properties.
Carbolic acid, phenol, phenic acid.	Phenol— $C_6H_5.OH$	By distilling tar	Melts at 44° . Slightly soluble in water, soluble in alcohol, ether, and alkalis. 20 parts of phenol and 10 parts of alcohol give with one part of ferric chloride a green coloration, which becomes violet on adding water. With lead acetate an abundant precipitate. With sulphuric acid no coloration; when the acid contains nitric acid a reddish-brown or greenish coloration. On introducing vapours of bromine into an aqueous solution of phenol, tribromophenol (m.p. 95°) is precipitated in colourless crystals.
Aseptol	An ill-defined mixture of phenyl ethers and sulphomated phenols.	By the action of sulphuric acid on phenol in presence of alcohol.	
Thymol	Propylmetacresol— $C_6H_3 \begin{cases} \text{CH}_3 \\ \text{C}_3H_7 \\ \text{OH} \end{cases}$	Extracted from essence of thyme.	Melts at 44° . Very sparingly soluble in water, soluble in alcohol and ether. 5 mgrms. of thymol, 1 cgr. of sodium nitrate, and 2 cc. of sulphuric acid, give a yellow coloration (nitrosotymol) which, after an hour, changes into a stable green coloration. When 1 part of thymol and 1 part of soda is treated with 10 parts of chloroform, a red unstable coloration. A caustic soda solution of thymol gives, when poured into a solution of potassium iodide in potassium iodate, a reddish-brown precipitate of aristol.
Sozoiodol	Sodium di-iodoparaphenol sulphate— $C_6H_2I_2 \begin{cases} OH \\ SO_2Na \end{cases}$	By the combination of sodium paraphenolsulphonate with iodine.	Soluble in alcohol, sparingly soluble in ether. Suspended in water and exposed to light gives a deposit of iodine after an hour. When warmed with nitric acid and the solution evaporated, gives picric acid and sulphuric acid.
Aristol, Amidaline	Di-iododithymol— $\begin{array}{c} C_3H_7 \\ | \\ CH_3.C_6HI \begin{cases} OH \\ | \\ CH_3.C_6HI \begin{cases} C_3H_7 \\ OH \end{cases} \end{cases} \end{array}$	By the combination of thymol with iodine.	Melts at 60° . Insoluble in water, soluble in chloroform with a red coloration. Heated in a closed tube, vapours of iodine evolved. Its alcoholic solution gives no coloration with ferric chloride in the cold; on evaporating, a black residue, soluble in chloroform with a brown coloration.
Europhen	Isobutylresolhydriodide— $\begin{array}{c} O.C_6H_3(C_4H_9).CH_3 \\ | \\ HI \\ | \\ O.C_6H_3(C_4H_9).CH_3 \end{array}$	By the combination of isobutylorthocresol with iodine.	Begins to soften at 70° . Insoluble in water and alkalis, soluble in alcohol and ether; in its alcoholic solution water produces a yellow flocculent precipitate. Separation of iodine on prolonged boiling with water, and on treating with sulphuric acid. Warmed with zinc dust gives iodide of zinc.
Resorcin	Resorcinol— $C_6H_4 \begin{cases} OH \\ OH \end{cases}$	By fusing sodium benzenedisulphonate with caustic soda.	Very soluble in water, alcohol, and ether, sparingly soluble in chloroform. Violet coloration with ferric chloride. No coloration with ferrous sulphate (distinction from pyrogallie acid). Sulphuric acid containing a trace of nitric acid gives a violet coloration. With chloral hydrate and caustic soda a red coloration.
Guaiacol	Monomethylpyrocatechol $C_6H_3 \begin{cases} OH \\ OCH_3 \end{cases}$	Extracted from the creosote obtained from beech wood.	Boils at 200° . Very sparingly soluble (1 in 200) in water but soluble in alcohol, ether, and alkalis. In aqueous solutions ferric chloride produces a brownish turbidity; in alcoholic solutions a fine blue coloration. Warmed with sulphuric acid it gives an orange coloration. On shaking 4cc. of guaiacol with milk of lime, containing 0.1 grm. of lime in 10 cc. of water, colourless crystals of a calcium derivative are formed.
Pyrogallol	Pyrogallol, pyrogallie acid. $C_6H_3 \begin{cases} OH \\ OH \\ OH \end{cases}$	By heating gallic acid	Fairly soluble in water and alcohol, only sparingly in benzene and chloroform. Gives with ferric chloride a yellow coloration, and with ammonium vanadate a yellow coloration which changes to brown. Potassium ferricyanide give crystals of purpurogallin on keeping for a day. Does not precipitate salts of quinine.
Naphthalene	Naphthalene— $C_{10}H_8$	Extracted from coal-tar.	Melts at 80° . Insoluble in water, soluble in alcohol and ether. Gives with sulphuric acid containing a trace of nitric acid a brown coloration. On gently warming a mixture of 1 cc. of sulphuric acid, 1 cc. of chloroform, and 0.05 grm. of naphthalene the sulphuric acid is coloured red, whilst the chloroform remains colourless. Gives with an alcoholic solution of picric acid crystals of naphthalene picrate, which are sparingly soluble in acids.
β -Naphthol	β -Naphthol— $C_{10}H_7 \begin{cases} OH \\ CH=CH \end{cases}$	By fusing α -naphthalene- β -sulphonic acid with caustic soda at a high temperature.	Melts at 123° . Sparingly soluble in water, soluble in alcohol, ether, and alkalis. Gives with sulphuric acid a reddish-yellow coloration. When agitated with milk of lime gives, after filtering, a highly fluorescent solution. When warmed with an alcoholic solution of picric acid, orange crystals are deposited on cooling. On adding 5 drops of caustic soda at 50° to a solution of 0.01 grm. of β -naphthol in 5 drops of chloroform the alkali turns blue.
α -Naphthol	α -Naphthol— $C_{10}H_7 \begin{cases} OH \\ CH=CH \end{cases}$	By fusing naphthalene- α -sulphonic acid with caustic soda.	Melts at 94° . Gives most of the reactions of β -naphthol. Its distinctive characters are:—On filtering a mixture of α -naphthol and milk of lime and then adding bromine-water there is produced a lilac coloration, which changes to violet. Two parts of α -naphthol, and 2 parts of mercuric chloride give a bright red precipitate when warmed with a solution of 1 part of sodium nitrate; under the same conditions β -naphthol gives an amorphous reddish-brown compound.

Commercial Name.	Scientific Name and Formula.	Method of Formation.	Distinctive Properties.
Meriodine	Chiefly composed of the sodium derivative of β -naphthol; also contains phenols.	By the action of caustic soda on β -naphthol at a high temperature.	Soluble in water with a slight fluorescence. Strongly alkaline reaction. When treated with sulphuric acid gives a precipitate of β -naphthol.
Benzoic acid.....	Benzoic acid— $C_6H_5.CO_2H$	By the action of nitric acid on chlorinated toluene.	Melts at 121° . Very sparingly soluble in cold water, more readily in alcohol and ether. Sublimes. Melted with caustic soda yields benzene and sodium carbonate. Gives formic acid on treatment with sulphuric acid and manganese dioxide.
Salicylic acid	Orthohydroxybenzoic acid $C_6H_4 \begin{cases} OH \\ COOH \end{cases}$	By the action of dry carbon dioxide on sodium phenate.	Melts at 156° . Sparingly soluble in water, soluble in alcohol and ether. With ferric chloride gives a violet coloration. No coloration with cold sulphuric acid, but on adding sodium nitrate, a red coloration is produced. With nitric acid, on warming, it gives a red coloration (nitro-salicylic acid). A solution of 0.16 gram. of salicylic acid and 0.11 gram. of borax in 1 cc. of water deposits crystals.
Salol.....	Phenol salicylate— $C_6H_5 \begin{cases} OH \\ COOC_6H_5 \end{cases}$	By the combination of phenol and salicylic acid.	Melts at 42° . Insoluble in cold water, but soluble in alcohol and ether. Gives with warm sulphuric acid a yellow coloration, but no reaction with nitric acid. When warmed with ammonia it gives a solution which is coloured violet by ferric chloride. A mixture of 0.05 gram. of salol and 0.08 gram. of sodium nitrate gives a greenish-blue coloration with 1 cc. of sulphuric acid; with sodium nitrite, instead of the nitrate, there is produced a red coloration, which first changes to brown and then to greenish blue.
Betol; naphthalol	β -Naphthol salicylate— $C_{10}H_7 \begin{cases} OH \\ COO.C_6H_5 \end{cases}$	By the combination of salicylic acid and β -naphthol.	Melts at 95° . Almost insoluble in water, and sparingly soluble in alcohol, but soluble in ether. With sulphuric acid and sodium nitrate it gives a greenish coloration; with sodium nitrite a reddish coloration. Is insoluble in warm caustic soda (distinction from salol). Gives with warm milk of lime, after filtering, a blue fluorescent solution which, after acidifying, is turned violet by ferric chloride.
Hydroxynaphthoic acid	Hydroxynaphthoic acid— $C_{10}H_7 \begin{cases} OH \\ COOH \end{cases}$	By the action of dry carbon dioxide on the sodium derivative of naphthol.	Melts at 186° . Sparingly soluble in water, soluble in alcohol and ether. With nitric acid gives a yellow coloration and liberation of carbon dioxide. Its potassium salt gives a blue coloration with ferric chloride.
Dermatol	Sub-gallate of bismuth— $C_7H_7O_7Bi$	By the action of bismuth nitrate on gallic acid.	Insoluble in water, alcohol, and ether. When ignited it gives a residue containing bismuth.
Hypnone	Acetophenone, methyl phenyl ketone— $CH_3.CO.C_6H_5$	Produced by the dry distillation of a mixture of benzoate and acetate of calcium.	Melts at 245° . On oxidation with sulphuric acid and potassium bichromate gives benzoic acid and carbon dioxide. Warmed with sulphuric acid it yields benzoic acid. Warmed with ammonium sulphide it gives phenyl-acetic acid.
Benzosol.....	Benzoylbenzylalcol— $C_6H_5 \begin{cases} OCH_3 \\ O.CO.C_6H_5 \end{cases}$	By the combination of benzoyl chloride and guanacol.	Melts at 50° . Almost insoluble in water, and only sparingly soluble in acetic acid, but soluble in alcohol and chloroform.
Benzoylnaphthol	Benzoylnaphthol— $C_{10}H_7O.CO.C_6H_5$	By the combination of benzoyl chloride and β -naphthol.	Melts at 110° . Sparingly soluble in water, soluble in alcohol.
Antifebrin	Acetanilide— $C_6H_5.NH.CO.CH_3$	By the action of acetic acid on aniline.	Melts at 118° . Sparingly soluble in water, soluble in alcohol and ether. On warming a mixture of 0.1 gram. of acetanilide, 1 cc. of caustic soda, and 3 drops of chloroform the disagreeable smell of phenyl isocyanide is emitted. With nitrate and nitrite of sodium a red coloration. No reaction with cold nitric acid, an orange coloration on warming.
Exalgin.....	Methylacetanilide— $C_6H_5.N \begin{cases} CH_3 \\ CO.CH_3 \end{cases}$	By the action of acetyl chloride on monomethylaniline.	Melts at 162° . Sparingly soluble in water, soluble in alcohol. Does not yield phenyl isocyanide when warmed with chloroform and caustic soda. Its solution in sulphuric acid gives a yellowish green coloration on the addition of sodium nitrate.
Phenacetin ..	Acetylparaphenetidine— $C_6H_4 \begin{cases} OC_2H_5 \\ NH.CO.CH_3 \end{cases}$	By the combination of paramidophenetol and acetic acid.	Melts at 135° . Very sparingly soluble in cold water, more readily in alcohol. No coloration with ferric chloride. Dissolves in sulphuric acid, giving, when pure, a colourless solution. A mixture of equal parts of phenacetin and sodium nitrite gives with sulphuric acid a violet coloration, which changes to green. When warmed with zinc dust yields salicylic acid. With caustic soda and chloroform it gives phenyl isocyanide.
Phenocoll hydrochloras	Amidoacet paraphenetidinehydrochloride— $C_6H_4 \begin{cases} CO.C_2H_5 \\ NH.CO.CH_3.NH_2 \end{cases} (HCl)$	By the action of ammonia on the compound obtained from paraphenetidine and acetyl chloride.	Carbonises at about 200° . Soluble in 18 parts of water. Gives most of the colour reactions of phenacetin. Dissolves in sulphuric acid with a yellow coloration; on adding sodium nitrate a brownish-red coloration. Its solutions are precipitated by a solution of iodine. Gives with mercuric chloride and sodium nitrate a yellow amorphous precipitate.

Commercial Name.	Scientific Name and Formula.	Method of Formation.	Distinctive Properties.
Salophen	Acetylparamidophenol salicylate— $\begin{array}{c} \text{OH} \\ | \\ \text{C}_6\text{H}_4 \\ | \\ \text{COO.C}_2\text{H}_5.\text{NH.CO.CH}_3 \end{array}$	Salicylic acid is treated with phosphorus oxychloride and paramitro-phenol; the product is reduced and then acetylated.	Melts at 188° . Sparingly soluble in cold, more readily in hot water; soluble in alcohol and ether.
Sulphaminol	Thiohydroxydiphenyl- amine— $\text{OH.C}_6\text{H}_5 \begin{array}{c} \diagup \text{N} \diagdown \\ \text{S}_2 \end{array} \text{C}_6\text{H}_5$	By the combination of sulphur with methahydroxydiphenylamine.	Melts at 133° . A yellow, amorphous, tasteless, odourless powder, insoluble in water, but soluble in alcohol, alkalis, and glacial acetic acid. Gives a blue coloration with nitric acid. The presence of sulphur can be easily detected.
Saccharine	Saccharine— $\text{C}_6\text{H}_4 \begin{array}{c} \diagup \text{CO} \diagdown \\ \text{SO}_2 \end{array} \text{NH}$	By the oxidation of toluenesulphonamide.	Melts at 226° . Fairly soluble in hot water, soluble in alcohol and ether. No coloration with ferric chloride. When warmed with potassium carbonate gives a smell of bitter almonds. Treated with lime it gives ammonia. When heated with solid sodium acetate vapours are evolved which blacken paper moistened with lead acetate; the residue, after solution in nitric acid, gives a precipitate of barium sulphate on the addition of barium nitrate.
Benzoylamidophenyl- acetic acid.	.. ..	By treating amido-phenylacetic acid with benzoyl chloride.	Melts at 175.5° .
Hydracetic, pyrodon ..	Acetylphenylhydrazine— $\text{C}_6\text{H}_5.\text{NH.NH.CO.CH}_3$	By the combination of phenylhydrazine and acetic acid.	Melts at 128° . Sparingly soluble in water. Reduces Fehling's solution in the cold. Gives a blue precipitate with ferric chloride and potassium ferri-cyanide. With sulphuric acid containing nitric acid it gives a carmine-red coloration.
Iodol	Tetridopyrroline— $\text{NH} \begin{array}{c} \diagup \text{Cl} \diagdown \\ \text{Cl} \end{array}$	By the combination of iodine and pyrroline.	Decomposes at 110° . Insoluble in water, soluble in alcohol and ether. Gives a black precipitate with mercuric chloride. When treated with hydrochloric acid, iodine is liberated. With alcohol and ferric chloride it gives a greenish-blue coloration.
Pyridine	Pyridine— $\text{C}_5\text{H}_5\text{N}$	Formed by the dry distillation of nitrogenous matter.	Boils at 111.8° . Miscible with water. Gives a crystalline precipitate with a solution of iodine in potassium iodide, and abundant precipitates with bromine water and with tannic acid. With mercurous chloride in the cold it yields a crystalline substance.
Quinoline	Quinoline— $\text{C}_9\text{H}_7\text{N}$	By heating aniline with glycerol and sulphuric acid.	Boils at 238° . Sparingly soluble in water, soluble in alcohol. Gives with mercury cyanide a crystalline precipitate, soluble in hydrochloric acid. Gives with mercurous chloride a grey coloration, and with bromine water an abundant precipitate. Precipitates the hydrates of the metals from solutions of copper sulphate and of alum.
Thallin	Sulphate of tetrahydro- paraquinanisol— $\text{C}_9\text{H}_{10}\text{N.OCH}_3$	By reducing paraquinanisol.	Melts at 106° . Gives with chlorine water a green coloration and a flocculent precipitate; after a very short time the coloration becomes violet. No coloration with sulphuric acid and nitric acid. Is precipitated from its solutions by ammonia. With ferric chloride it gives, after an hour's time, a green coloration which first changes to red, then to brown. Potassium ferri-cyanide produces first a green and then a red coloration.
Kaërin	Tetrahydrohydroxymethyl- quinoline— $\text{C}_9\text{H}_9\text{N} \begin{array}{c} \diagup \text{OH} \diagdown \\ \text{CH}_3 \end{array}$	By reducing hydroxy-quinoline with tin and hydrochloric acid and then methylating.	Gives the same reactions as thallin.
Orexin	Phenyldihydroquinazoline hydrochloride— $\text{C}_6\text{H}_4 \begin{array}{c} \diagup \text{CH}_2.\text{N.C}_6\text{H}_5 \diagdown \\ \text{N} : \text{CH} \end{array} \quad \text{HCl} + 2 \text{H}_2\text{O}$	By reducing ortho-nitrobenzylformanilide.	Melts at 86° . Fairly soluble in methyl alcohol, sparingly in ether. Gives precipitates with ammonia and with acids. When treated with sodium nitrite and sulphuric acid, it gives a brown coloration which changes to green; with sodium nitrate, first a red and then a yellow coloration.
Antipyrin	Dimethylphenylpyr- azalone— $\begin{array}{c} \text{C}_6\text{H}_5 \\ | \\ \text{CO}-\text{N} \\ | \quad \diagup \quad \diagdown \\ \text{CH}=\text{C} \quad \text{N}-\text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$	By methylating the product of the action of phenylhydrazine on ethyl-aceto acetate.	Melts at 113° . Fairly soluble in water and alcohol, insoluble in carbon bisulphide. Dissolves in acids yielding colourless solutions. Gives with sodium nitrite and acetic acid a greenish-blue coloration, and then nitrosoantipyrin. With ferric chloride a flocculent precipitate, which dissolves in alcohol with a red coloration.

A Simple Extraction and Condensing Apparatus
K. Farnsteiner. Chem. Zeit. 16, 1030.

See under XXIII., page 1034.

PATENTS.

Improvements in Obtaining or Separating Oxygen from Atmospheric Air. J. H. Parkinson, Stretford. Eng. Pat. 14,925, September 22, 1890.

A REPRINT of a former specification (this Journal, 1891, 947) in consequence of an amendment made by the Comptroller, the inventor now claiming the use only of a spongy mass of potassium or sodium permanganate "or lower oxides thereof" for this purpose.—J. G. W.

Manufacture of Vanilloyl Carbonic Acid and of Vanilline by its Transformation. O. Imray, London. From La Société de Laire et Cie., Paris. Eng. Pat. 17, 137, October 8, 1891.

When acetylugenol—



or acetyl-iso-eugenol—



is oxidised for the production of vanilline, a substance to which the name of vanilloyl carbonic acid is given, is formed. Crude vanillin often contains this body which can be separated by agitating an ethereal solution of the mixture with water containing magnesium carbonate or a carbonate of the alkaline earths in suspension, or with a solution of sodium or of potassium bicarbonate, when a soluble salt of the acid is formed. Another method of separation is to fractionally precipitate the aqueous solution of the compounds of the two bodies with alcohol, when that of the acid separates first. The acid dissolves in ether and can be crystallised from benzene. It melts at 134° C. and has the formula $\text{C}_6\text{H}_5 \cdot (\text{CO} \cdot \text{CO} \cdot \text{OH}) \cdot \text{OCH}_3 \cdot \text{OH}$. When heated vanillin and carbonic acid result.—C. A. K.

Improvements relating to the Manufacture of Perfumes. R. A. Chesebrough, London. Eng. Pat. 20,851, November 30, 1891.

The invention consists in forcing perfume-laden air surrounding flowers, growing plants or other odoriferous substances into vessels containing a suitable absorbent such as alcohol. The perfume is thus obtained free from the contaminating effect of the scent of any juices or decay that may have taken place amongst crushed or dead leaves.

—C. A. K.

Improvement in the Production of Pure Saccharine. C. Fahlberg, Salbke, near Magdeburg, Prussia. Eng. Pat. 22,787, December 30, 1891.

CRUDE saccharine, as prepared according to the inventor's previous patent (Eng. Pat. 6626, 1885; this Journal, 1885, 608), consists of a mixture of 60 per cent. anhydro-orthosulphamine-benzoic acid (ortho-acid) and 40 per cent. parasulphamine-benzoic acid (para-acid), the sweetening power of the former being 40 per cent. greater than that of the latter. The separation of the two has heretofore presented considerable difficulty owing to the solubility of the acids and their salts, in water and other solvents, being nearly the same.

This is a method for effecting the separation of the two, based on the fact, discovered by the inventor, that the ortho-acid has a greater affinity for the alkalis and alkaline earths than the para-acid. The process may be conducted in two ways; first, to a concentrated solution of the alkaline salts of the two acids, a mineral acid (HCl), or the ortho-acid, or a mixture of the ortho- and para-acids (crude saccharine) is added in quantity sufficient to displace

the para-acid from its salt. The para-acid separates out, leaving the salt of the ortho-acid in solution. In the other method, dry, crude saccharine is added to a solution of an alkali or an alkaline carbonate, containing a sufficient quantity to neutralise the ortho-acid, which dissolves, forming its alkaline salt, and leaving the para-acid unacted upon. From the solution of its alkaline salt, the ortho-acid, or pure saccharine, is obtained by acidulation with a mineral acid.—J. G. W.

Improved Process for Extracting Iodine from Natural Saline Waters, Mother Liquors, or other Liquids containing Iodine. W. P. Thompson, Liverpool. From R. Campani, Pisa, Italy. Eng. Pat. 16,942, September 22, 1892.

A PROCESS for extracting pure iodine from saline liquors, without previous concentration, by means of iodide of starch. Starch paste is added to the liquor and then a sufficient quantity of bleaching-powder solution to liberate the whole of the iodine. After standing ten hours, the precipitate of iodide of starch is filtered off, washed and treated with sulphurous anhydride, forming hydriodic acid and leaving a deposit of starch, which can be used again. The solution of hydriodic acid, containing a little sulphuric acid, is neutralised with sodium carbonate, and the iodine then liberated by potassium bichromate and sulphuric acid in a sufficiently pure state to dispense with sublimation.

—J. G. W.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

A New Process for Photo Dyeing. A. Villain. L'Amateur Photographe, 1892.

THIS process is based on the experiments of Kopp. The sensitive salt used is bichromate of ammonia, to which is added a little meta-vanadate of ammonia, this being a more energetic mordant.

The composition of the sensitising bath is as follows:—

Water	1,000 cc.
Bichromate of ammonia	50 grms.
Meta-vanadate of ammonia	5 grms.

After immersion the tissue is dried at a low temperature 25—30° C., away from all white light. After exposure under a negative the details appear clearly defined, the print is then thoroughly washed to remove all traces of the unaltered salts, and in this state it may be dried and preserved, it being merely sufficient to steep in warm water before dyeing. The print having been placed in the dyeing-bath, which is heated to boiling for 10 or 15 minutes, is taken out and washed; if the whites are then not pure the print is passed through a warm bath of carbonate of soda, or a cold bath of chloride of lime to which a few drops of hydrochloric acid have been added. After a thorough washing the print is finished.

The colouring matters chiefly used are: artificial alizarin, alizarin blue S, alizarin black S, alizarin black R, galloflavin, purpurin, anthracene blue, alizarin orange, cerulein S, gallein, alizarin green, alizarin yellow, alizarin maroon, &c.

The prints thus obtained offer great resistance to the action of light, alkalis, and acids.—J. C. C.

PATENTS.

The Preparation and Employment of Aromatic Amido Compounds as Developing Means in Photography. J. Hauff, Stuttgart, Germany. Eng. Pat. 15,434, September 11, 1891.

THE amido phenols used for developing have to be used in caustic alkali solution, which is in many ways unsuitable in practice. By substituting the hydrogen of the amido group by alkyl groups this objection is avoided, as the resulting bodies can be employed in solutions of the alkaline carbonates. The specification covers the preparation of the following bodies:—Mono- and di-methyl and ethyl derivatives of para-amidophenol, ortho-amido-meta-cresol, meta-amido-ortho-cresol, meta-amido-metaxylonol, meta-amido-para-xylonol, ortho-amido-ortho-xylonol and ortho-amido-meta-xylonol (Sym.), also mono-, di-, and tetra methyl or ethyl derivatives of para-phenylenediamine, para-tolylene diamine, para-xylylenediamine, α - β -naphthylene diamine and α - α -naphthylene diamine. Suitable developing mixtures containing the above substances are given.

—C. A. K.

A New Apparatus for Developing, Fixing, and Washing of Photographic Dry Plates without the use of a Dark Room. L. Nievsky, London. Eng. Pat. 17,860, October 19, 1891.

THE plate after exposure is dropped from the camera into a light tight tank provided with red glass windows; the bottom of this tank is connected by three or more tubes to india-rubber balls containing developing solution, washing water, fixing solution, &c. To develop the plate, the tap opening to the ball containing the developing solution is opened and the ball compressed so as to cause the liquid to rise in the tank and cover the plate, when developed the pressure on the ball is relieved and the solution so withdrawn. The plate is then treated in a similar manner with fixing solution, &c.—J. C. C.

Apparatus for Developing, Fixing, and washing Photographs. J. Wagner and G. Bredig, Leipzig, Germany. Eng. Pat. 19,471, November 10, 1891.

THIS apparatus is in the form of a shallow rectangular box, placed upright on its narrow side, and divided into two parts by a perforated division. The front and back are provided with red glass windows and a lid closes it hermetically. The liquid is admitted through a tap-funnel placed at the top of the box and communicating with the lower division which has in addition a draw-off cock. The plate having been introduced into the box, rests with its lower edge on the division plate and the cover is put on; the developing solution is then poured into the lower division by means of the funnel and the tap closed. The box is then turned upside down, the solution running over the plate. In order to examine the plate or run off the solution the position is reversed. In the same manner the plate may be fixed and washed.—J. C. C.

Improvements in Apparatus or Appliances for Use in Drying Sheets of Glue, Gelatin, and the like. W. P. Thompson, Liverpool. From F. Krauseder, and A. Leutsch, Munich, Germany. Eng. Pat. 20,755, November 28, 1891.

See under XIV., page 1018.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENTS.

Improvements in Explosive Compounds. H. E. Newton, London. From A. Nobel, Paris, France. Eng. Pat. 4179, December 2, 1875. (Second Edition.)

By this invention nitroglycerin or other analogous substance is gelatinised by dissolving in it collodion cotton. The solution of this body may be effected directly by heating the two substances together or the collodion cotton may be first dissolved in a "promoting" solvent, such as acetone &c., and the solution mixed with the nitroglycerin. On evaporating the solvent an explosive jelly is left. Suitable proportions are seven parts of collodion cotton and 93 parts of nitroglycerin. The rate of explosion of this gelatin may be decreased and regulated by incorporating with it from half to thirty per cent. of acetic ether or nitrobenzol &c.

Cheaper explosives may be made by mixing the gelatin with, for instance, sawdust and a nitrate.—W. M.

Preparation of Explosive Compounds. A. V. Newton, London. From A. Nobel, Paris, France. Eng. Pat. 226, January 20, 1879. (Second Edition.) (Provisional protection only.)

It is proposed to produce powders of any desired quickness of explosion, by mixing a comparatively slow gunpowder with a quick powder in such proportions as to produce the quickness of explosion needed.—W. M.

Manufacture of Explosive Compounds. H. E. Newton, London. From A. Nobel, Paris, France. Eng. Pat. 2599, June 17, 1879. (Second Edition.)

"THIS invention relates to a method of imparting to highly compressed meal, in contradistinction to grained, gunpowder, that quickness of explosion which it needs to become useful as a blasting agent, and which also facilitates its adaptation as a propelling agent in heavy guns."

Special primers consisting of a small charge of harium or lead picrate, or analogous fulminate equally insensible to percussion, are used in conjunction with cartridges of compressed meal powder. The firing of such primer serves to explode the sluggish meal powder which cannot be exploded in the ordinary way.—W. M.

Improvements in or relating to the Manufacture of Explosive Substances. W. P. Thompson, Liverpool. From E. Landener, Paris, France. Eng. Pat. 19,267 November 7, 1891.

THE improvements consist in coating chlorates with fatty substances, hydrocarbons and their nitric derivatives, for the purpose of rendering them less sensitive to concussion, and insoluble in water, whilst entirely preserving their shattering properties.—W. M.

An Improved Explosive Compound. W. E. Gedge, London. From the United States Smokeless Powder Company, San Francisco, U.S.A. Eng. Pat. 12,415, July 5, 1892.

THE new explosive is a mixture of picrate and nitrate of ammonia with or without nitroglycerin. The proportions are varied according to the explosive force required. One

part of picrate of ammonia with one part of nitrate of ammonia will form a very quick and powerful explosive, and the violence may be varied by increasing the proportion of nitrate of ammonia up to nine parts to one of picrate. For blasting purposes, nitroglycerin is added; if 4 parts of picrate of ammonia and 6 parts of nitrate of ammonia have been used, six parts of nitroglycerin will make an effective mixture. The picrate and nitrate are mixed in any suitable manner, and the nitroglycerin added and mixed in.

—A. G. B.

ADDENDUM.

In the No. 3 of this Vol. XI., page 235, col. 2, the article on the *Preparation of α -Trinitrotoluene*, C. Häussermann, should be referred to under XXII., Explosives, to which Group the substance properly belongs.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

Improvements in the Gasvolumeter. G. Lunge. Ber. 25, 3157—3164.

In this article the author describes some improvements that he has made in his well-known "gasvolumeter" which was described in the *Berichte*, 1890, 449 (this Journal, 1890, 547—549; and 1891, 1031).

Having found that every form of glass tap to the "reduction" tube that he has tried, sooner or later ceased to be gas-tight, and that the alternative plan of sealing off the drawn-out end of the reduction tube is somewhat inconvenient, if through some mishap, or for other reason it becomes necessary to readjust the volume of air in the reduction tube, he has now devised two plans of closing the reduction tube, in such a manner as to ensure a permanently gas-tight closure under either increased or diminished pressure, whilst at the same time they allow of the ready opening of the tube for the purpose of readjusting it when desirable. The first method consists in drawing out the upper end of the reduction tube to a capillary with a stout wall, and with a slight bulge on it (see Fig. 1). The end of the tube is ground square, and a piece of glass rod of the

same thickness as the tube and with a slight bulge on it also is ground square to meet it. A piece of india-rubber tube is slipped over the bulge on the capillary leaving an equal length projecting above the top of the capillary, and the level of the mercury in the reduction tube is then brought to the division on the tube that allows of 100 cc. of dry air at the temperature and pressure of the day entering the tube. A drop of mercury is then poured into the india-rubber tube, the glass-rod is inserted and the india-rubber tube tied with wire and varnished. Fig. 2 shows the second method of closing the tube, which the author considers even more satisfactory than that already described. The reduction tube in this case is widened out at the top into a cup, a stout-walled neck forming the connection. A somewhat conical, thin, glass stopper is accurately ground into this neck. This stopper is well coated with vaselin or paraffin so that it does not seize, and so that it may also close the tube more perfectly. In the lower half of the stopper a vertical groove is cut, so that on turning the stopper this groove may be made to connect with a corresponding groove cut in the upper part of the neck. When the two grooves connect together a small air channel is formed, but on turning the stopper round the passage is at once closed. After adjusting the volume of air in the tube and closing it by turning the stopper, mercury is poured into the eup. To make the seal still more secure and to prevent mercury in the eup from being thrown out by any chance, a cork with a small tube passing through a perforation in it is inserted into the eup and pressed down upon the top of the glass stopper, and bound down, the small tube through the cork, allowing the mercury to enter it and so giving room for expansion and contraction under changes of temperature.

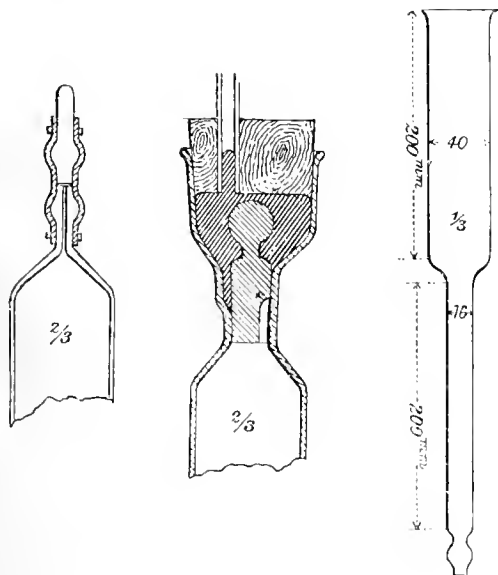
The author further states that he now has the reduction tube graduated somewhat differently to the usual form. Instead of making the tube so that the 100 cc. division comes immediately below the wider part of the tube it is made so that the 95 cc. division comes there and the graduation is continued down the narrow tube up to 125 cc., the length of tube for each cubic centimetre being as nearly as possible 10 mm. By this arrangement a volume of dry gas can very readily be measured against a volume of damp gas in the reduction tube, and vice versa,—operations which are frequently convenient.

The author pointed out how this might be done some time ago (*Zeits. angew. Chem.* 1891, 410; this Journal, 1891, 1031), viz., by placing the reduction tube filled with damp air, when measuring a volume of dry gas, *lower*, and when filled with dry air for measuring a volume of damp gas, *higher* than the normal position by as many millimetres as correspond to the tension of water vapour at the existing temperature. To do this, however, requires the use of a measure which by the new arrangement is avoided. For instance, if it be desired to measure a volume of dry gas at a temperature of 15° against a moist reduction tube, the levelling tube is so placed that the mercury in the reduction tube stands at 100°, but instead of bringing the mercury in the gas-measuring tube on a level with this point it must be brought on a level with the division 98.7° of the reduction tube, the difference between 100° and 98.7 being 13 mm., which is approximately the tension of water vapour at the temperature of 15° (more exactly 12.7 mm.). There is, therefore, in the gas measuring tube a column of mercury 13 mm. higher than that in the reduction tube, in other words the dry gas is compressed more than the damp air in the reduction tube by an amount exactly corresponding to the tension of the water vapour in the latter. Obviously, if it be desired to measure a damp gas against a dry reduction tube, the level of the mercury in the measuring tube must be brought as many millimetres lower than the level of the mercury in the reduction tube as corresponds to the existing tension of water vapour. Moreover, the same result can be arrived at by adjusting the mercury in the reduction tube at so many millimeters higher or lower than 100° as corresponds to the tension of water vapour at the time and then bringing the mercury in the gas measuring tube on a level with the 100° division on the reduction tube.

Fig. 1.

Fig. 2.

Fig. 3.



The new method of graduation from 95 cc. to 125 cc. suffices for all ordinary purposes as a tension of water-vapour exceeding 30 mm. has never to be dealt with. If, however, it be desired to read off directly the weight in milligrammes instead of the volume of gases, the reduction tube must be graduated from 90 cc. to 150 cc. In a tube so graduated the operation is conducted as follows:—

Instead of bringing the level of the mercury in the reduction tube to the 100th division, it must be brought to the division corresponding to the weight of 1 litre of the gas to be measured $\times 100$, e.g.—

For air it must be brought to.....	129.4
For oxygen „ „	113.0
For nitrogen „ „	125.5
For nitric oxide „ „	131.3

When the graduations of the tube do not extend far enough, the mercury in the reduction tube can be placed at the division corresponding to one-half or one-third the product, e.g., in the case of carbonic acid, instead of adjusting the mercury to 196.6°, it must be adjusted to 98.3°, and then each cubic centimetre in the gas-measuring tube = 2 mgrms.

This principle can be further extended. Instead of taking into account the weight of one litre of the gas to be measured, the weight of the substance actually sought for by the analysis may be read; as, for instance, in the case of bleaching powder when decomposed by hydrogen peroxide, each molecule of oxygen, O_2 , generated corresponds to one molecule of available chlorine, Cl_2 . By adjusting the reduction tube to the division corresponding to one-third the weight of 1 litre of chlorine $\times 100 = 105.6$ then each cc. of oxygen generated = 3 mgrms. of chlorine. In the azotometrical estimation of nitrogen, the usual correction of $2\frac{1}{3}$ per cent. must be made, so that the reduction tube must be adjusted to the division $\frac{125.5 \times 100}{97.5} = 128.7$; or if it be desired to read off the corresponding weight of ammonia, then it must be adjusted to the division $\frac{125.5 \times 17 \times 100}{14 \times 97.5} = 156.3$; in the case of urea the correction of 8 per cent. must be made and the product divided by 2, thus $\frac{125.5 \times 60 \times 100}{28 \times 92 \times 2} = 146.2$, when each cc. of gas = 2 mgrms. of urea. In order to read off the weight of calcium carbonate directly from the volume of carbonic acid, the reduction tube must be adjusted to the division $\frac{196.6 \times 100}{44 \times 4} = 111.7$, when each cc. of CO_2 corresponds to 4 mgrms. of $CaCO_3$; or again, if the weight of chlorine is required (as in iron analyses), the reduction tube is adjusted according to the calculation $\frac{196.6 \times 12 \times 2}{44} = 107.2$, in which case each cc. of CO_2 = 0.5 mgrm. of Cl.

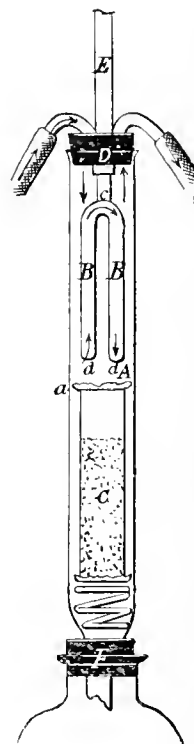
The author remarks, however, that this lengthened form of reduction tube is not so convenient as the shorter form, and moreover the same results can be arrived at more readily with the latter, by taking certain definite weights of the substance to be examined and reading off at once the percentages sought for, as he has already shown (Zeits. ang. Chem. 1890, 143); whilst for any special kind of determinations, such as vapour density determinations and nitrogen estimations in organic substances, specially-graduated forms of the instrument may be advantageously used.

He calls attention also to a modified form of levelling tube, shown in Fig. 3, which effects an economy of mercury, and to a new iron stand by which, through a combination of a thin steel cord, a pulley, drum, and handle, the levelling and reduction tubes can be readily raised or lowered. (See also this Journal, 1891, 1029—1030.)

—H. S. P.

A Simple Extraction and Condensing Apparatus. K. Farnsteiner. Chem. Zeit. 16, 1039.

THE extraction apparatus depicted below may be readily constructed by the chemist.



The bent tube B B has a total length of 60 cm. and is 0.5 cm. wide; it serves as a condenser, a stream of water passing through it. The tube C, in which the substance to be extracted is contained, is 10 cm. long and 2 cm. wide, and rests on the wire spiral placed in the neck of the large tube A. This latter is 32 cm. in length and 3 cm. broad. The holder C is widened at four points at its upper part A, in order more effectually to catch the liquid falling from B.

—W. J. P.

Apparatus for Fractional Distillation. M. Ekenberg Chem. Zeit. 16, 958—959.

THE author has devised an apparatus for the fractional distillation of liquids boiling between 100° and 250°. The construction of the apparatus will be understood from the Figure on next page.

The fractionation column, 900 mm. in length and 4—5 mm. in diameter, is contained in a closed air-bath and is coiled round the glass cylinder which serves as a chimney. The temperature of the bath is regulated by a Stuhl's contact thermometer connected with an electrical thermo-regulator. The temperature of the jacket may be controlled within 0.2° C., and the difference in temperature between its upper and lower parts is only 0.5°. Sample distillations are quoted to demonstrate the great efficiency of the apparatus. It is especially recommended in technical laboratory estimations of xylenes, cumenes, solvent naphthas, anilines, nitrobenzenes or petroleum, &c.—W. J. P.

PATENT.

An Improvement in Analytical and other Delicate Balances also applicable to other Beam Weighing Machines.
G. P. Bidder, London. Eng. Pat. 21,186, December 4, 1891.

THE object of this invention is to supersede the use of "riders" on analytical balances. The invention consists in employing a flexible filament, thread, or light chain, of as nearly as possible uniform section throughout, one end of this chain being fixed to and suspended from one arm of the balance, preferably near the fulcrum, from which point the chain hangs in the form of catenary, the other end being led up through the top of the case and attached to an appliance for raising or lowering it; this may consist of a cylinder around which the chain is wound, and to which is attached a milled head and graduated circle moving past a fixed index; or the end of the chain may be attached to a vertically sliding bar marked with a scale, and worked by a rack and pinion, or by any suitable means.—J. C. C.

INORGANIC CHEMISTRY.—
QUANTITATIVE.

Nickel Analysis. S. H. Emmens. Eng. and Mining. J., November 26, 1892, 510—511.

THE substances usually submitted to analysis for the determination of the contained nickel may conveniently be classified as follows:—

1. Regulus and minerals containing arsenic, viz., speiss and arseniferous ores of nickel. 2. Regulus and minerals

TABLE I.

METALLIC NICKEL, NICKEL MATTE, NICKEL OXIDE, &c.

Substance.	Manufacturer.	Date.	Analyst or Authority.	Percentage of Composition.						
				Ni	Co	Total Ni and Co	Fe	Cu	S	C, SiO ₂ , and other Impurities.
Matte (Swedish) ....	....	..	Wagner's Chem. Tech. 8th ed.	..	..	26.60	16.33	31.67	26.00	..(1)
Do. (Sudbury)....	Canadian Copper Co.	1889	F. L. Sperry	14.84	0.27	14.71	31.00	27.06	26.90	0.92
Do. do.	"	1889	"	13.04	0.20	14.04	31.47	26.76	27.00	0.95
Bessemerised (do.)	"	1892	Canadian Copper Co.,	..	..	35.93	1.69	49.98	19.71	2.29(2)
Bessemerised (New Cal.)	....	..	Thorpe's Dict. of Applied Chem.	..	..	67.17	11.90	..	17.08	3.85
"Fon'e" (do.)	....	..	" ..	..	..	67.95	25.87	..	1.95	2.90
Nickel oxide (Sudbury).	Orford Copper Co....	1891	Hunt and Clapp .....	..	..	74.60	1.51	1.25	..	1.45
Nickel oxide (New Cal.)	Société de Nickel ...	1891	Ledoux .....	..	..	77.92	0.25	0.00	..	..
Artificial nickel ore.	....	1891	E. F. Wood .....	..	..	48.23	23.87	Trace	0.264	27.636 (inc. 0)
Nickel (German) ...	....	..	Lassaigne (Watts' Dict.)	56.75	..	56.75	12.55	27.56	..	3.70
Do. do. ...	....	..	" ..	54.60	..	54.60	11.30	30.10	..	4.00
Do. (English) ...	....	..	" ..	73.30	22.10	95.40	1.00	Trace	..	3.00
Do. (New Cal.) ..	Christoffe	1881	Christoffe and Bouillet	..	..	97.75	0.36 (Mn)	..	..	1.79
Disc do. do. ..	....	..	Thorpe (Dict. of Applied Chem.)	..	..	98.83	0.72	..	..	0.45
Cast do. ....	....	..	Gard (Wagner, 13th ed.).	97.44	Trace	97.44	0.301	..	0.104	2.155
Sheet do. (German).	Fleitman	1891	E. P. Dewey	97.050	1.858	98.108	0.829	0.498	0.612	0.012(3)
Rollad anode (do.) .	do.	1891	"	97.63	1.19	98.82	0.75	0.15	0.04	0.24(4)

(1) Average of three assays.

(2) Ditto.

(3) "It showed by qualitative analysis slight traces of arsenic, antimony, and aluminium, and a perceptible amount of silicon. No other metal or phosphorus was found." Note by Mr. Dewey.

(4) "Showed some silicious residue." Note by Mr. Dewey.

TABLE I.

METALLIC NICKEL, NICKEL MATTE, NICKEL OXIDE, &c.—*continued*.

Substance.	Manufacturer.	Date.	Analyst or Authority.	Percentage of Composition.						
				Ni	Co	Total Ni and Co	Fe	Cu	S	C, SiO ₂ and other Impurities.
Disc nickel	Societe de Nickel...	1891	E. P. Dewey	97.78	1.20	99.08	0.06	0.68	0.013	0.167 ⁽⁵⁾
Cube do.	H. Wiggins and Co..	1891	"	93.757	1.586	95.343	6.32	0.113	Trace	1.224
Grain do.	J. Wharton.....	1891	"	94.988	0.856	95.844	0.354	0.047	Trace	3.755 ⁽⁶⁾
Do. do.	Orford Copper Co....	1892	"	93.20	0.93	94.22	1.92	0.29	0.104	6.556 ⁽⁷⁾
Cast nickel (anode) .	Hanson and Van Winkle Co.	1892	"	83.68	Trace	83.68	7.10	0.15	0.19	8.88 ⁽⁸⁾
Do.	Zucker and Levett..	1891	"	82.776	1.433	84.209	12.091	0.103	0.05	3.847 ⁽⁹⁾

(5) "A small amount of hard, gritty grains left on dissolving the metal." Note by Mr. Dewey.

(6) "It showed by qualitative examination the slightest traces of arsenic and antimony, some aluminium, and considerable silicon and calcium. Distinct grains of slag were found. No other metal phosphorus was found." Note by Mr. Dewey.

(7) "There is some Si and considerable As in this sample." Note by Mr. Dewey.

(8) "It contained a considerable amount of tin, probably 76. There is also considerable silicon present." Note by Mr. Dewey.

(9) "It showed on qualitative analysis slight traces of arsenic and antimony, some aluminium and calcium, and considerable silicon. No other metal or phosphorus was found." Note by Mr. Dewey.

containing no (or but little) arsenic, viz., matte, nickeliferous, pyrrhotite and non-arseniferous ores of nickel. 3. Metallic nickel, nickel steel, German silver, and other alloys of nickel.

In the absence of any generally recognised and accepted system of accurate nickel analysis, Mr. Charles T. Mixer, the chemist of the Emmens Metal Company, has, in conjunction with the author devised the following methods, which were found to be sufficiently trustworthy for all technical and commercial purposes.

METHOD A.—FOR SUBSTANCES HIGH IN NICKEL AND LOW IN COPPER AND IRON, *e.g.*, METALLIC NICKEL, BESSEMERISED MATTE, NICKEL OXIDE, &c.

Operation.	Reagent.	Separation.
1. Dissolve (about 2 grms.) and evaporate.	HNO ₃ + HCl, or fusion with KHSO ₄	..
2. Dissolve and filter	HCl + H ₂ O	SiO ₂ , C. &c.
3. Precipitate and filter	H ₂ S	CuS
4. Dissolve the washed precipitate and evaporate till white fumes are produced.	HNO ₃ + H ₂ SO ₄	..
5. Dissolve and electrolyse ..	H ₂ O + HNO ₃	Cu
6. Boil, filtrate from 3 and peroxidise.	HNO ₃	..
7. Cool and make solution up to 100 cc.	H ₂ O	..
8. Boil half of 7, precipitate and filter.	NH ₃	..
9. Redissolve the precipitate.	HCl	..
10. Precipitate and filter	NH ₃	..
11. Dissolve and reduce the well-washed precipitate.	H ₂ SO ₄ + Zn	..
12. Titrate	KMnO ₄	Fe
13. Precipitate and filter one-tenth (10 cc.) of 7.	NaHO	..
14. Dissolve the washed precipitate.	Dilute H ₂ SO ₄	..
15. Make alkaline.....	NH ₃	..
16. Electrolyse .....	.. ..	Ni + Co

METHOD B.—FOR SUBSTANCES HIGH IN IRON AND LOW IN NICKEL, *e.g.*, PYRRHOTITE AND ONCE-RUN MATTE.

Operation.	Reagent.	Separation.
1. }		
2. }		
3. }		
4. }	Same as in Method A...	.. .. Cu
5. }		
6. }		
7. Precipitate and filtrate ...	NH ₃	Fe ₂ O ₃ .H ₂ O
8. Boil the washed precipitate and redilute.	H ₂ O made faintly acid with H ₂ SO ₄ or HCl	Fe ₂ O ₃ .H ₂ O
9. Precipitate and filter	NH ₄ Cl + NH ₃	Fe ₂ O ₃ .H ₂ O
10. Add together the filtrates from 7 and 9; evaporate to small bulk; precipitate and filter.	NaHO in large excess	..
10. Dissolve the washed precipitate.	Dilute H ₂ SO ₄	..
11. Make alkaline.....	NH ₃	..
12. Electrolyse .....	.. ..	Ni + Co

METHOD C.—Qualitative examination of pyrrhotite and other lean ores of nickel.

1. Reduce to fine powder.

2. Dissolve in *aqua regia*; evaporate to dryness; dissolve in HCl and H₂O; filter off from gangue and insoluble matter.

3. Pass H₂S through the solution to remove Cu.

4. Boil free of H₂S; peroxidise with HNO₃.

5. Precipitate the Fe with NH₃; boil; add HCl until the supernatant liquid is faintly acid; boil sharply for 10 minutes.

6. Make strongly alkaline with NH₃ and note the colour of the supernatant solution. If it be distinctly blue the percentage of nickel in the ore is commercially important.

7. If the solution be colourless, filter and boil down to a small bulk free from the odour of NH₃. Then add a few

drops of a solution of potassium sulphocarbonate, which will give a pink coloration if there be any trace of nickel in the ore.

N.B.—Test 7 is also useful for determining when the electrolytic separation of the Ni is complete in methods A. and B. It was found that the reaction is best observed when the solutions are neutral instead of being alkaline as recommended in the text-books.

A distinguished feature of the process is the treatment of the precipitated ferric hydroxide with a minute quantity of acid. This has the effect of dissolving any Ni or Co hydrate that may have been carried down with the iron; and it is more efficient than the numerous tedious and troublesome repetitions of solution, precipitation, filtration, and washing necessitated by the older methods. At first sight, indeed, it may be doubted whether sulphuric or hydrochloric acid will unite with nickel in preference to iron, seeing that the latter metal oxidises more energetically than the former; but the following thermo-chemical data will make the matter clear:—

Reaction.	Heat generated per Formula Weight.
	Units.
$\text{Fe} + \text{O} + \text{SO}_3\text{Aq} \dots\dots\dots$	93,200
$\text{Ni} + \text{O} + \text{SO}_3\text{Aq} \dots\dots\dots$	86,950
$\text{Fe} + \text{Cl}_2 + \text{Aq} \dots\dots\dots$	99,950
$\text{Ni} + \text{Cl}_2 + \text{Aq} \dots\dots\dots$	93,700
$\text{Fe} + \text{O} + \text{H}_2\text{O} \dots\dots\dots$	68,280
$\text{Ni} + \text{O} + \text{H}_2\text{O} \dots\dots\dots$	60,840

It results from these figures that the heat of formation of one molecule of ferrous sulphate by the union of ferrous hydroxide and dilute sulphuric acid is $93,200 - 68,280 = 24,920$ units; while that of nickel sulphate formed by the union of nickel hydrate with dilute sulphuric acid is $86,950 - 60,840 = 26,110$ units. Under these conditions, therefore, Berthelot's law of maximum work calls for the formation of nickel sulphate in preference to ferrous sulphate. If HCl be the acid, the figures are:—

Formation of nickel chloride.... $93,700 - 60,840 = 32,860$ units.
Formation of ferrous chloride... $99,950 - 68,280 = 31,670$ units.

In the particular case under consideration, the replacing power of nickel is still more marked, as, owing to the iron being peroxidised, its basic efficiency is lessened. The heat values per formula weight of acid, as given by Berthelot (*Mécanique Chimique*, tome 1, 384) are:—

	Units.
Formation of ferric chloride.....	11,500
Formation of ferric sulphate	11,400

The text-books contain very few examples of the analyses of commercial nickel, matte, &c. The Table I., above, is therefore added, which will serve to indicate the general character of the substances that the nickel analyst is called upon to examine nowadays.—W. S.

A New Colour-Standard for Natural Waters. A. Hazen. Amer. Chem. Jour. 14, 300—310.

THE colour of water has been measured by comparing it with the colour produced, by Nesslerising water containing a measured quantity of ammonia. This is open to the objections, that the numbers expressing the colours are not directly proportioned to the colours themselves, and that it is not applicable to very slightly coloured water.

The author suggests in place of this a platinum colour standard which is defined as follows:—"The colour of a water is the amount of platinum in parts per ten thousand, which in acid solution, with so much cobalt as will match the tint, produces an equal colour in distilled water."

To prepare a standard having the value five on this scale, 1.246 grms. potassium-platinum chloride (containing 0.5

grms. platinum), and 1 gm. cobalt-chloride is dissolved in water; 100 cc. concentrated hydrochloric acid added, and the solution made up to 1 litre. Standards for use are made by diluting 1, 2, 3 cc., &c. of this solution to 50 cc. in Nessler tubes, giving colours 0.1, 0.2, &c.; in closed tubes these standards will keep unaltered for a long time.

If the colours do not exactly match the waters, more or less cobalt may be added. With waters of low colour longer tubes may be used. The numbers obtained by this method are practically identical with those obtained by the Nesslerised ammonia standard for colours 1 to 2, but the platinum standard gives numbers proportional to the colours, and may be used for all waters.—A. L. S.

The Estimation of Manganese in Spiegel Iron and Ferro-manganese. M. C. Bastin. *Moon. Scient.* September 1892, 639.

FROM 0.25 to 1 gm. of the material is dissolved in a flask of about 150 cc. capacity, by 50 cc. nitric acid sp. gr. 1.20; 8—10 grms. potassium chlorate are added and the solution boiled for 15 minutes. It is diluted, filtered, and 100 cc. of a solution added containing 6.300 grms. oxalic acid per litre, and 25 cc. sulphuric acid. The mixture is warmed to 80° C. for 10 minutes made up to 1 litre, and the excess of oxalic acid titrated with potassium permanganate solution. One equivalent of oxalic acid decomposes one equivalent of manganese, or $\text{Mn} = \text{oxalic acid decomposed} \times \frac{27.5}{68} = \text{oxalic acid} \times 0.4365$. The permanganate solution is made by dissolving six grms. of permanganate in one litre water. The results yielded are very fairly accurate.—A. L. S.

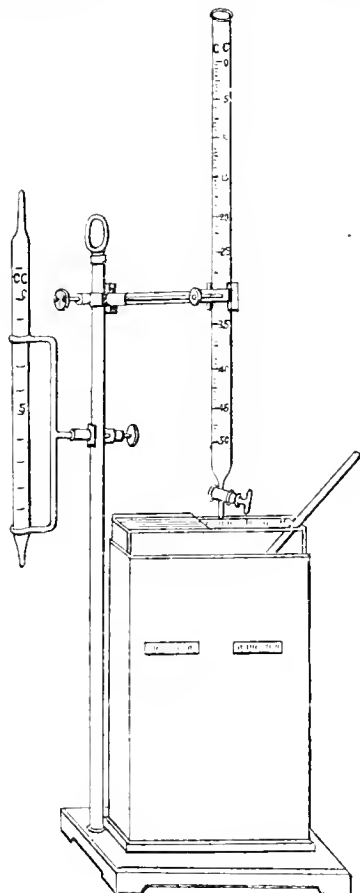
The Estimation of the Intensity of Colour of Beers and Malt Extracts. C. J. Lintner. *Zeits. ges. Brauw.* 1892, 15, 213; *Chem. Zeit. Rep.* 1892, 16, 234—235.

THE author finds it impossible to prepare a single standard solution for colorimetric purposes, owing to the different tints which occur in beers made from kiln-dried and the so-called patent malt, and in those made from ordinary black malt, a yellow tint occurring in the former and a red one in the latter. Iron-ammonia alum is the only substance which complies with both requirements; the addition of sulphuric acid to the aqueous solution giving the yellow tint and the addition of acetic acid the red one. The author describes and figures a simple "Dilution colorimeter," in which the depth of colour of the liquid under experiment is compared with that of the standard. If they are exactly equal, the number 1 is assigned to the liquid as its colour intensity. The apparatus consists of two equal rectangular glass vessels having parallel sides, and fitting side by side into a case of black enamelled tin, which is furnished with two longitudinal slits in the front and in the back which are covered with milk glass. When in use the apparatus is placed against a window, and the depths of colour of the liquids placed in the two vessels are compared with the eye on looking through the slits.

Method of Use: 1. *Beer*.—The standard solution is prepared by dissolving four grms. iron-ammonia alum in 100 cc. distilled water, with the addition of 2 cc. normal sulphuric acid. 5 to 20 cc. of the beer, according to its colour, are placed in one vessel, and water added from a burette until the intensity of colour equals that of the standard solution which is placed in the other vessel. The intensity of colour, F, then $= \frac{a+b}{a}$, where a is the volume of beer used, and b that of the water added.

2. *Malt*.—(a). Kiln-dried malt. 50 grms. of malt are mashed in the usual manner with 200 cc. water, made up to 265 cc. and filtered, and the colour of the wort compared with the above standard solution. (b). Patent colour-malt. 5 to 25 grms. of the malt, according to its colour, are finely ground, boiled with 400 cc. water for ten minutes, cooled, made up to 500 cc. and filtered. The colouring power of the malt is reckoned as 1, when the colour-intensity of the

extract of 100 grms. of malt in 500 cc. water is equal to 1 as calculated above.



3. *Ordinary Black Malt*.—The standard solution in this case consists of 1 gm. iron-ammonia alum in 100 cc. water, with the addition of 7 cc. of 32 per cent. acetic acid. 2.5 grms. of the finely-ground malt are digested with 400 cc. water for ten minutes, cooled, made up to 500 cc. and filtered. The colouring power of the malt is calculated as in the preceding case.—J. G. W.

ORGANIC CHEMISTRY.—QUALITATIVE.

Identification of Xylose and Distinction from Arabinose.
G. Bertrand. Bull. Soc. Chim. 7—8, 1892, 499—502.

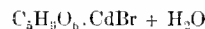
SINCE xylose occupies an important position in the vegetable kingdom, being always found amongst the products of hydrolysis of the incrusting substances of the angiosperms, it is necessary to have some means of identifying it; the author gives a summary of the properties and reactions of xylose, most of which have, however, been described by other chemists.

One hundred parts of water at 20.3° dissolve 117.05 parts of xylose; or, in other words, 100 cc. of a saturated aqueous solution of xylose at 20.3° contain 64.2 grms. of the sugar. Xylose seems to be insoluble in absolute alcohol, but 10 cc. of 90 per cent. alcohol, saturated at 19°, contain 0.329 gm. of the sugar.

The specific rotatory power of xylose is $[\alpha]_D = 20.2$ to 21° according to Koch, $[\alpha]_D = 18.6$ to 19.6° according to Wheeler and Tollens; the author's determinations give $[\alpha]_D = 19.4^\circ$.

Xylose does not ferment with yeast; its reducing power for Fehling's solution is 109.6, when that of dextrose is taken as 100.

A characteristic reaction of xylose, and one by means of which it can be distinguished from arabinose, is the following:—A little xylose is treated with 30—50 times its weight of saturated bromine water, and after keeping for 24 hours the solution is boiled to expel the excess of bromine; after adding excess of cadmium carbonate the solution is filtered, evaporated to a small volume, and mixed with an equal volume of alcohol, when xylobromide of cadmium—



is gradually deposited in crystals; this compound is almost insoluble in dilute alcohol, but much more readily in water, and has no sharp melting point.

Both xylose and arabinose give, as is well known, a violet blue coloration when warmed with hydrochloric acid and a trace of orcinol; the hexoses, on the other hand, give a reddish-orange coloration.—F. S. K.

ORGANIC CHEMISTRY.—QUANTITATIVE.

The Determination of Glycerol in Sweet Wines. M. T. Lecco. Ber. 25, 2074—2075.

By using a large amount of lime, the method of estimating glycerol in wines described by the author (Chem. Zeit. 16, 1892, 504; this Journal 1892, 550) may be applied to sweet wines.

The following method may also be used:—10 cc. wine is mixed with 1 gm. dry powdered calcium hydrate, 10 grms. quartz sand added, and the whole evaporated to dryness on the water-bath. The residue is extracted 4 or 5 times with 96 per cent. alcohol, and the alcoholic solution filtered into a 100 cc. flask. The solution is evaporated on the water-bath and the residue dissolved in 5 cc. absolute alcohol and 7.5 to 10 cc. ether added. When the solution has become clean, it is decanted off, filtered, evaporated, and dried one hour in the water-oven and weighed.—A. L. S.

On the Estimation of Glycerin in Fermented Beverages.
B. Proskauer. Pharm. Central-H. N.F., 1892, 13, 369;
Chem. Zeit. Rep. 1892, 16, 228.

GOOD results are given by the following method;—100 cc. of wine are evaporated to 30 cc., mixed with a few drops of sulphuric acid and 6 cc. of phosphotungstic acid (50 per cent.). The precipitate is filtered off and washed, the filtrate evaporated down on a water-bath with the addition of dry calcium hydrate, and of quartz-sand. The mass in the evaporating dish is then powdered and introduced into a Soxhlet's apparatus. After extracting well with 96 per cent. alcohol, the extract is evaporated in a flask to a syrupy consistence, 25 cc. alcoholic ether (2:3) added, the whole shaken vigorously and allowed to settle. The clear liquid is poured into a long-necked 50 cc. flask, washed with 10 cc. alcoholic ether, evaporated, and dried in a water oven.

—J. G. W.

The Estimation of Invert Sugar by Soldain's Solution.
Striegler. Zeits. Rübenzuckerind. 1892, 42, 457; Chem. Zeit. Rep. 1892, 16, 227.

SOME difficulty is experienced in the removal of calcium salts from syrups and molasses prior to the estimation of the invert sugar in them, potassium and sodium bicarbonates when used alone for this purpose presenting certain objections. The author recommends the use of a solution of sodium oxalate and bicarbonate prepared by dissolving 25 grms. oxalic acid in the smallest possible quantity of water, adding sodium carbonate until a heavy precipitate of sodium bicarbonate falls out, and making up to 500 cc. An excess of this reagent has no prejudicial action and in using it, it is only necessary to heat just to the boiling point.

The author also recommends the preliminary clarification of molasses with blood charcoal as otherwise a too great reduction of copper is obtained, due to matter which is not invert sugar, and which is removed by treatment with

charcoal. The use of lead acetate is, however, objected to, on the ground of its giving a precipitate with the invert sugar itself.

The following is his complete process:—Dissolve 20 grms. of the substance in 140–150 cc. water, add 10–30 cc. of the calcium precipitating solution, heat to boiling and allow to boil up a few times, cool, make up to 200 cc., shake up with blood charcoal, filter and treat 50 cc. with 100 cc. Soldani's solution, which is best prepared by dissolving 150 grms. KHCO_3 and 101.4 grms. K_2CO_3 in 600 cc. water at 50°C ., adding 100 cc. of a solution of 34.639 grms. CuSO_4 in 500 cc. water and making up to a litre.—J. G. W.

The Hops of the Year 1891. M. Levy. Chem. Zeit. 16, 1892, 839.

See under XVII., page 1019.

PATENT.

Improvement in Detection of Foreign Fats in Butter. W. Johnstone, London. Eng. Pat. 20,956, December 1, 1891.

THE invention is based on the fact, discovered by the patentee, that genuine butter does not contain triolein and tributyrin, but a peculiar fat called oleo-vaccio-butyrate of glycerin. The ratio between the liberated oleic and butyric acids is therefore constant, and any excess of the first is proof-positive of an admixture of animal fat, whilst an excess of the latter shows adulteration with a vegetable oil.

The inventor thus describes the actual process:—First, the amount of butyric acid is estimated by any suitable means and calculated to oleo-vaccio-butyrate of glycerin by multiplying by $\frac{650}{88}$. Second, the iodine absorption of the butter, or of its fatty acids, is ascertained by any suitable means, and this is also calculated to the said glycerin compound by multiplying first by $\frac{10}{9}$ and then by $\frac{650}{282}$. If the two estimations agree the butter is pure; if not there has been adulteration. The inventor claims great delicacy for his process, from three to five per cent. of foreign fat being readily detected.—L. de K.

ANALYTICAL AND SCIENTIFIC NOTES.

Slow Combustion of Gaseous Mixtures. P. Askenasy and V. Meyer. Annalen, 269, 49–72.

IN a paper published a short time ago (this Journal, 1891, 752), Krause and Meyer described experiments, the object of which was to try and determine the rate at which combination takes place between oxygen and hydrogen. In the present communication further experiments of the same kind are described, additional precautions having been taken to ensure the purity of the electrolytic gas. In order to try and obviate the influence of the glass surface, to which the irregularities in the earlier results were assigned, various devices were adopted; in some cases the glass bulbs were etched on the inside, in others the electrolytic gas was passed for many hours through the bulbs heated to 518°C . in order to try and obtain an unchangeable surface; experiments were also made with bulbs which had been protected from the light.

These attempts to eliminate the action of the glass surface were, however, entirely unsuccessful, the irregular character of the results being just as pronounced as in the earlier experiments. The effect of coating the inner surfaces of the bulbs with silver was then investigated; although when such bulbs are used combination takes place at a much lower temperature than in the case of the unsilvered vessels the same irregularities are observed, and it is impossible to establish any relationship between the duration of the heating and the quantity of water formed.

The conclusion to be drawn from these experiments is that, even when every imaginable precaution is taken to ensure equality of conditions, it is impossible to determine the relation between the amount of water produced from electrolytic gas and the duration of the heating; the cause of this is doubtless to be sought for in the action of the surface of the containing vessels.

Further experiments will be undertaken in order to try and arrive at a solution of this problem; in the first place the authors intend to modify their method of procedure by employing capillary tubes or silver vessels instead of the glass bulbs, and also to try the effect of heating the electrolytic gas under pressure.—F. S. K.

Photo-Chemical Notes. P. Askenasy and V. Meyer. Annalen, 269, 72–73.

WHEN pure, dry electrolytic gas is exposed to direct sunlight from May to October in sealed glass bulbs, it undergoes no change, as is proved by the fact that on opening the bulbs under water the original volume of the gas is found to have undergone no diminution. Even when moist electrolytic gas is exposed to the concentrated light of a July sun, and at the same time heated to 606°C ., no explosion occurs.

When chlorine and hydrogen are separately exposed to bright sunlight for 3 to 4 hours and then immediately mixed in the dark they do not combine; this experiment proves that Draper's statement to the contrary is untrue, and confirms the results obtained by Bunsen and Roscoe.—F. S. K.

The Resins of Ficus rubiginosa and F. Macrophylla. E. H. Rennie and G. Goyder, jun. Proc. Chem. Soc. 1892, 115, 146.

AN account is given of the results of an examination of the resin of *F. rubiginosa* by De la Rue and Müller, contained in a paper published in the Phil. Trans. of 1860, and the somewhat different results of the authors are then recorded. They have separated a crystalline substance from both resins externally closely resembling De la Rue and Müller's product, but giving numbers for carbon about 3 per cent., and for hydrogen about 1 per cent. higher; the numbers are most in accordance with the formula $\text{C}_{31}\text{H}_{54}\text{O}_2$. This substance is resolved by alkaline hydrolysis into acetic acid and a crystalline substance melting at 114° , of the formula $\text{C}_{32}\text{H}_{54}\text{O}$, very closely resembling the substance described by De la Rue and Müller, which they obtained in a similar way.—W. S.

New Books.

THE JEWELLER'S ASSISTANT IN THE ART OF WORKING IN GOLD. A practical Treatise for Masters and Workmen, compiled from the experience of thirty years' workshop practice. By GEORGE E. GEE. London: Crosby, Lockwood, & Son, 7, Stationers' Hall Court, Ludgate Hill, 1892. 7s. 6d.

THIS is an 8vo. volume bound in cloth, with Preface, Table of Contents, Subject-matter containing 228 pages, and Alphabetical Index. The book is divided into 17 chapters; I. The Chemical and Physical properties of Gold, deals shortly with Fine Gold, Action of Fluxes on Gold, Dissolving Gold, Testing Gold in solution, Granulating and parting alloyed Gold, Various Gold precipitants, Zinc and waste gold solutions. II. The Precipitation of Gold in waste

solutions. III. The Different Colours of Gold. IV. The Mixing and Melting of Gold. V. The Dry-Colouring of Gold. VI. The Wet-Colouring of Gold. VII. The Melting and Casting of Gold. VIII. Electro-Gilding. IX. Some other Modes of Gilding. X. Practical Manipulations, such as gilding plain surfaces, Frosting, metal work, &c. XI. Mixing Alloys. XII. Useful Imitation Alloys. XIII. Hints and Helps, Instructions upon Hall-marking, Gold-testing Needles, Gold Lacquer, Soldering fluid free from Acid, Gold and Silver Solders, Polishing Powder, Gilding Steel, Aluminium Silver, Gilders' Wax, &c. XIV. Collecting and Refining Scrap Gold, Lemel, Wet and Dry Processes for the Recovery of Gold, &c. XV. Sundry Gold Alloys. XVI. Choice Recipes. XVII. Gold Values and Alloys, giving tables of the relative Values of the different Carats of Fine Gold, the Proportions of Alloy and Fine Gold to make any Quality, &c.

A HANDY BOOK FOR BREWERS, BEING A PRACTICAL GUIDE TO THE ART OF BREWING AND MALTING. Embracing the Conclusions of Modern Research which bear upon the Practice of Brewing. By HERBERT EDWARDS WRIGHT, M.A. London: Crosby, Lockwood, and Co., 7, Stationers' Hall Court, Ludgate Hill, 1892. 12s. 6d.

Octavo volume bound in cloth, containing Preface, Table of Contents, text covering 563 pages, Alphabetical Index, and, just preceding it, a Synoptic Table of the various Processes in Malting and Brewing. The work is illustrated by a few engravings, and is subdivided into chapters devoted to the consideration of the following branches of the whole subject:—I. Introductory, Chemical Changes and Preliminary Processes. II. Barley, Malting, and Malt. III. Water for Brewing. IV. Hops and Sugars. V. The Brewing Room. VI. Chemistry as applied to Brewing. VII. The Laboratory, its requirements, and the methods. VIII. Mashing, Sparging, and Boiling. IX. Ferments in General. X. Fermentation with Commercial Yeast, its Science and Practice. XI. Culture from a Single Cell; Wild Yeasts. XII. Treatment of Beer. XIII. The Brewery and Plant. In the first part of the Appendix is given a list of the hop-growing parishes of Kent.

FARMYARD MANURE; ITS NATURE, COMPOSITION, AND TREATMENT. By C. M. AIKMAN, M.A., B.Sc., Lecturer on Agricultural Chemistry, West of Scotland Technical College, &c. William Blackwood and Sons, Edinburgh and London, 1892. 1s. 6d.

SMALL 8vo. volume, with Preface, Table of Contents, and 65 pages of subject-matter. The treatise opens with a brief introduction in a couple of pages, treating of—i. What Fertility of Soil depends on; and ii. The Function of Manures. FARMYARD MANURES.—Solid excreta and urine. Litter. Horse Manure. Cow Manure. Pig Manure. Sheep Manure. Methods of Calculating Amount of Manure produced on the Farm. Fermentation of Farmyard Manure. Conditions influencing Fermentation. Products of Fermentation. Analysis of Farmyard Manure. Comparison of Fresh and Rotten Manure. Methods of Application of Farmyard Manure to the Field. Value and Functions of Farmyard Manure. Appendix, relating to a variety of analyses and experimental trials.

CHEMISTRY OF THE ORGANIC DYE-STUFFS. By R. NIETZKI, Ph.D., Professor of the University of Basel. Translated, with additions, by A. Collin, Ph.D., and W. Richardson. London: Gurney & Jackson, 1, Paternoster Row, 1892. 15s.

This work is the English translation of the well-known German work of Nietzki, and consists of an octavo volume bound in cloth, and containing Author's preface, Translators'

Preface, Table of Contents, Introduction, and text occupying 271 pages. This is followed by a most useful and well-arranged Table of References on the different classes of Dyestuffs, covering 15½ pages, an Appendix containing information concerning the most recent colours, and Alphabetical Index.

The matter is classified as follows:—I. Colour. Chromophors, Chromogens, &c. II. Nitro-compounds. Azo-dyestuffs. Amido-azo-compounds. Oxy-azo-compounds. Azo-dyes from Diazo carbonic acids. Azo-dyes from carbonic acids and diazo compounds. Tetrazo- or Diazo dyes. III. Oxyquinones and Quinone-oximes. IV. Ketone imides and Hydrazides. V. Triphenylmethane Dyes. VI. Quinone-imide Dyes. VII. Azine Dyes. VIII. Aniline Black. IX. Indulines and Nigrosines. X. Quinoline and Acridine Dyes. XI. Indigo Dyes. XII. Euxanthic Acid and Galloflavine. XIII. Canarine. XIV. Murexide. XV. Dyes of Unknown Constitution.

CHEMICAL LECTURE EXPERIMENTS. NON-METALLIC ELEMENTS. By G. S. NEWTH, F.I.C., Chemical Lecture Demonstrator in the Royal College of Science, South Kensington. London and New York: Longmans, Green, & Co., 15, East 16th Street, 1892. 10s. 6d.

This work, as the Preface announces, is designed, firstly, to supply chemical lecturers and teachers with a useful repertoire of experiments, which may be undertaken on the lines laid down with confidence, as resting upon a foundation of solid experience; and secondly, to furnish the chemical student with a book to serve as a companion to the lectures he may attend. The volume is octavo in size, and though the concise table of contents following the preface might have served, yet an alphabetical index at the end forms an additional guide to all details of experiment. The text of the subject proper covers 276 pages. Then follows an article on lantern illustrations, and this is succeeded by an Appendix with useful tables for experimenters, which might be admirably reproduced and embodied in wall diagrams.

The work is illustrated by 224 well-executed woodcuts. Technologists may find specially interesting the experimental treatment of the following subjects:—Ammonia, Oxides of Nitrogen, Diffusion, Combustion, Phosphorus, Sulphur, Sulphur dioxide, Dissociation and Liquefaction of Gases.

MANUAL OF QUALITATIVE BLOW-PIPE ANALYSIS AND DETERMINATIVE MINERALOGY. By F. M. ENLICH, S.N.D., Mining Engineer and Metallurgist, late Mineralogist Smithsonian Institution, and United States Geological and Geographical Survey of the Territories. The Scientific Publishing Co., 27, Park Place, New York, 1892. 18s. (4.00 dollars).

This large and complete treatise is dedicated to Professor Theodor Richter, of Freiberg i.S., the former teacher of the author. It is as a book, large 8vo. in size, and contains Preface, Table of Contents, List of Illustrations, numbering some 26, List of Abbreviations, Introduction, Text, filling 436 pages, and a copious Alphabetical Index. A noteworthy sentence in the Introduction, referring to such matter as fills the pages of this volume, is this:—"No amount of memorising will impress the various reactions upon the student's mind in such a way that he will always recognise them when he sees them." "Practice alone can do this."

Pages 13—32 are devoted to an account of the Appliances and Reagents required for quantitative blow-pipe analysis. This includes a description of "Blast and Flames," pages 26—32. CHAPTER II. deals with the Methods of Qualitative Blow-pipe Analysis. i. Examination of Minerals without the application of heat or reagents. ii. Examination of Minerals with the Application of heat only. iii. Examination of Minerals with the blow-pipe with

Borax and Salt of Phosphorus. IV. Treatment with substances with Soda before the blow-pipe. V. Treatment of Minerals with Soda and Borax before the Blow-pipe, with Nitre, with Potassium Bisulphate, with Potassium Iodide and Sulphur, with Cobalt Solution, &c. Spectrum Analysis. CHAPTER III. Tables giving Reactions for the Oxides of the Earths and Metals. CHAPTER IV. Prominent Blow-pipe Reactions for the Elements and their Principal Mineral Compounds. CHAPTER V. Systematic Qualitative Determination of Compounds. CHAPTER VI. Determinative Tables and their Application. This latter portion of the work furnishes a complete and systematic method of determining minerals by means of blow-pipe and other dry, as well as so-called wet processes of qualitative mineralogical analysis.

PRINTERS' COLOURS, OILS, AND VARNISHES: a Practical Manual. By GEORGE H. HURST, F.C.S., Member of the Society of Chemical Industry; Lecturer on the Technology of Printers' Colours, Oils, and Varnishes at the Municipal Technical School, Manchester. London: Chas. Griffin & Co., Limited, Exeter Street, Strand, 1892. 12s. 6d.

THE writer states in his preface, "The information given as to the properties and preparation of pigments is either based on my own experience or drawn from the most trustworthy sources." His chapter on "Varnishes" has been revised by a personal friend practically engaged in their manufacture. The book is thus not a mere complement from other works. It is of 8vo. size, is handsomely bound in red cloth, and contains Preface, Table of Contents, and subject-matter filling 450 pages. An Alphabetical Index concludes the work. The text is embellished by some 67 wood engravings and contains various useful tables. The work is sub-divided as follows into chapters treating of the subjects of this industry:—

Introductory on Colour and Colour Theories. II. White Pigments. III. Red Pigments. IV. Yellow and Orange Pigments. V. Green Pigments. VI. Blue Pigments. VII. Brown Pigments. VIII. Black Pigments. IX. Lakes. X. Assay and Analysis of Pigments. XI. Colour and Paint Machinery. XII. Paint Vehicles. XIII. Driers. XIV. Varnishes.

DESTRUCTIVE DISTILLATION. A Manualette of the Paraffin, Coal Tar, Rosin Oil, Petroleum, and Kindred Industries. By EDMUND J. MILLS, D.Sc., F.R.S. 4th Edition. London: Gurney and Jackson, 1, Paternoster Row, 1892. 5s.

THIS 8vo. volume is bound in strong waterproof cloth, and so can be used safely on the laboratory table. The contents are the substance of a course of lectures delivered in Anderson's College, in 1875—6, but enlarged upon since that date. The subject-matter covers 183 pages. Then follows a diagram showing the various forms of shale retorts used since the old vertical type largely employed by Young's Paraffin Company, up to types used in 1889 (Stanrigg's), with an explanatory Appendix. Appendix B. comprises a Bibliography on Destructive Distillation, and the book concludes with an Alphabetical Index. The work is well illustrated with tables.

Trade Report.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

FERTILISERS IN THE WEST INDIES.

Jamaica.

The American Vice-Consul reports that there was imported into Jamaica during the year ended March 31st, 1891, fertilisers to the value of 2,758*l.*, of which 2,375*l.* in value came from the United Kingdom, 81*l.* from the United States; while for the year ended March 31st, 1892, the total importations amounted to 3,918*l.*, distributed as follows: From the United Kingdom, 3,905*l.*; from the United States, 49*l.*; and the remainder from the West Indies.

It will be seen from this, says the Consul, that although the use of imported American fertilisers is exceedingly small, it is on the increase.

The explanation of the practical monopoly of the United Kingdom in this trade is explained by the fact that the English manufacturers of commercial fertilisers hold themselves in readiness to analyse samples of the soil, in order to arrive at the chemical deficiencies thereof, and then compound the fertilisers to meet such deficiencies. Intelligent and practical users of fertilisers assure him that if American manufacturers will hold out the same inducements in regard to analysing the soils and manipulating the manure to supply the requirements thereof, and in addition thereto will sell at the same price fertilisers of the same commercial value, the item of freights being so much in favour of the United States, her manufacturers can turn the tide in their favour.

Although the area of Jamaica is only 4,193 square miles, it contains a great diversity of soils, and it would therefore require the honest and intelligent preparation of fertilisers on the part of American manufacturers to obtain and hold this trade. And he remarks that the principal crops (cane and bananas) being very exhaustive to the soil, it is a well recognised fact that in a few years at most fertilising must be largely resorted to, as the lands are virtually worn out, and the system of the past in turning out old lands and taking in new can be no longer resorted to, as the lands have all been under cultivation, that is, the kind adapted to the crops named, which as before stated, constitute the principal cultivated crops.

He has been unable to ascertain the chemical value of the fertilisers imported, the quantity, or their selling price.

Martinique.

There is annually imported 20,000 to 25,000 tons of nitrates, phosphates, and ammonia. About one half is in a prepared state, the rest in crude form, which is mixed here by a firm engaged in that business with a capital of 320,000 francs. The firm is entitled *Compagnie des Engrais de la Martinique*. The factory is in the city of St. Pierre.

The material is all imported from the United Kingdom, and is packed in strong bags or barrels. The finished product is used for sugar cane only. Its analysis is as follows:—

Cross's Special Cane Fertiliser.—Nitrogen, equal to 9 per cent. of non-volatile ammonia, 19 to 20 per cent. of soluble phosphates, and 3 to 5 per cent. of insoluble phosphates, besides 3 to 4 per cent. of soluble salts of potash and alkaline salts.

Cross's Early Potassic Cane Fertiliser.—Nitrogen in various forms equal to 6½ per cent. of ammonia; phosphoric acid, soluble equal to 15 to 16 per cent. of phosphate rendered soluble; phosphoric acid, soluble, in finely prepared form, equal to 5 per cent. of phosphate of lime; potash equal to 10 per cent. of sulphate of potash.

There are no duties on fertilisers, and wharfage is nominal. Small lots of sulphate of ammonia and nitrate of potash have been recently imported from the United States through a commission house.

The price laid down at Martinique is about 230 to 235 francs per ton of 2,240 lb. for Cross's and other English manufacturers' fertilisers.

The quantity used per acre varies. The soil in the uplands being loose and rains frequent, 250 lb. to the acre is used; the lowland being more compact and clayey, 200 lb. to the acre is all that is required. If subsoiling was more practised by planters, a less quantity would be necessary.

The terms on which the business is carried on are as follows:—Drafts of Colonial Bank of London agency at Martinique of New York or London at 5·25 francs to the dollar on delivery.

It would appear that, with cheap material in the United States and the short distance to transport the finished article, the United States should command the market, as they do for yellow pine lumber, flour, corn, lard, and meat products.

St. Thomas.

There is no demand for fertilisers.

The consular agent at Santa Cruz reports that—

Many years ago there were some guano and patent fertilisers imported from England; but of late years, owing to the low price of sugar, the planter has been satisfied if he could provide sufficient manure.

This island is non-productive, and very little cultivation is carried on in the island of St. John; but there may be a field for trade in fertilisers in the island of Santa Cruz if a proper canvass be made by dealers.

St. Christopher.

The greater part of the commercial fertilisers used on this island are imported from Great Britain for various reasons. The two strongest reasons are the following: First, nearly all the landowners reside in Great Britain and are largely controlled by home influence; second, a few years ago the English fertiliser companies sent out a chemist who analysed the soil and prepared a special formula of a fertiliser for the sugar-cane plant, which is very popular here and sells at the highest price, 12*l.* per ton.

In referring to prices, the showing is largely in favour of the United States; and the freights from New York to St. Christopher are only one-half of what they are from London. Now, with a little enterprise and industry on the part of fertiliser manufacturing companies in the United States, they could very soon have all this trade. They must not forget that the island of St. Christopher is apparently one sugar-cane farm. The different estates are not divided by any fences, simply turning rows and ditches.

Having travelled all around the island several times it seems to be nothing but sugar-cane plantations, all well cultivated.

The farms require a good sugar-cane fertiliser, and if our manufacturers will send down a chemist, analyse the soil, and prepare as good a fertiliser as the special fertiliser imported from London, they will control this trade, as the freights from New York, as heretofore stated, are only one-half what they are from London.

The freights should be very cheap from Savannah and Key West, as it is only 800 miles from the former and 600 miles from the latter place to this island.

The United States should establish a weekly mail from Key West to these islands. We are here over 600 miles from America, and cannot get a regular mail, owing to the employment of the Quebec line of Canadian vessels hailing from London, which is all the time fighting for freights and is perfectly indifferent about the United States mails. At times (twice) we have had two mails within 48 hours, at other times not a mail in a month.

Trinidad.

Pursuant to instructions contained in Department Circular, dated June 2, 1892, calling for a report upon the trade in commercial fertilisers in this consular district, it has been observed in respect to the three islands constituting the district, that the only substantial opening for American trade in fertilisers is in the island of Trinidad. The industry of Grenada is principally limited to cacao, and the sugar industry in both Grenada and Tobago is comparatively of not much importance.

Trinidad, however, imported in 1890 fertilisers (or manures, as is the Custom house designation) to the value of 40,892*l.* The importations last year (1891) were considerably less, being valued at 19,867*l.*

The value of importation for 1890 and 1891 was as follows:—

From	1890.	1891.
	£	£
United Kingdom	40,682	19,135
British West Indies.....	5	—
British Guiana.....	200	8
United States.....	5	558
France	—	166
Total	40,892	19,867

While it will be seen that the United States got somewhat of a foothold last year, it is still not fairly in the market. Within the last few months several American manufacturers of fertilisers have made inquiries of this consulate and have otherwise indicated a disposition to extend their trade to Trinidad, and it is reasonable to expect that, within a few years, the above figures will undergo a great change in favour of the United States.

The only crop of Trinidad worthy of consideration in this connection is the sugar-cane crop. Imported manure might be of service in promoting the growth of cacao trees and cocoa-nut trees; it has not transpired that any has been used for that purpose, except in the way of experimenting however.

About seven-eighths of the sugar-cane crop belongs to residents of the United Kingdom, who obtain their fertilisers through their own agents.

The largest local planter uses principally a mixture of his own, composed of two-thirds ground phosphate and one-third ammonia. Both ingredients are imported in casks. The first cost, net, of ammonia in London is, say, about 10*l.*, and delivered on wharf in Port of Spain (Trinidad), say, 12*l.*, including freight, casks, lighterage, and all other expenses. The ammonia is guaranteed to be 24½ per cent., which is understood here to be about as pure as is ever manufactured for fertilising purposes. The ground phosphate costs, net, in London about 1*l.* 18*s.* 2*d.*, and delivered here on wharf, including all expenses and charges, say 3*l.* 14*s.*

There are no tonnage or lighthouse dues at this port, and all manures are entered free of duty.

Bahamas.

There is no importation of fertilisers into this colony from Europe. A considerable quantity of guano or cave earth—a rich bat deposit found in caves on the out islands—exists in this colony. Prior to 1885 from 2,400*l.* to 3,000*l.* worth of this deposit was exported annually, most of it going to the United States to be mixed with other fertilisers. Since 185 the policy of the colonial government being opposed to the removal of any fertilisers from the islands, exportations of this guano have been prohibited by law, with a view to encourage its use by local agriculturists. It is not, however, much used, being, perhaps, too rich in its natural state.

Within the last three or four years, however, a demand has arisen for fertilisers in the cultivation of pine apples, and foreign fertilisers have been introduced with excellent results, the fruit being larger and of better flavour, and old, worn fields developing new life and vigour.

These fertilisers come entirely from the United States, and the trade is rapidly increasing. In 1891 fertilisers to the amount of 2,175 barrels, worth about 2,400*l.*, were imported from the United States and used during the year. There will probably be a decided increase in the amount imported in 1892.

There is no reason to anticipate that manufacturers of fertilisers will meet with any European competition here.

U.S. Consular Reports.

CHINESE IMPORTS OF GLASSWARE.

The German Consul at Chefoo writes that, although the manufacture of glass may have been known in China for centuries, it is far from having arrived at a state of perfection. Chinese glass is thin, defective, and not wholly transparent; window glasses are also imported from abroad. Decanters, bottles for wine and beer, also find a market, and are sold to the natives at very good prices.

ADULTERATION IN AGRICULTURE.

The Board of Agriculture, in March last, appointed a Departmental Committee to inquire into and to report upon the representations made by Chambers of Agriculture, and other bodies or persons, with reference to the adulteration of artificial manures and fertilisers and feeding stuffs used in agriculture. The committee consisted of Mr. J. S. Gathorne Hardy, M.P. (Chairman), Sir Jacob Wilson, Dr. James Bell, Mr. J. F. Rotton, Q.C., Mr. F. A. Channing, M.P., Mr. Peter McLagan, M.P., and Mr. Albert Pell. The Committee examined a number of witnesses, whose evidence, together with their own report, was issued yesterday. There is a preponderance of evidence to the effect that a considerable amount of fraudulent dealing (especially in the case of compound manures), exists, and that there is a system of selling unguaranteed and comparatively worthless articles at an excessive price. These frauds are, however, the Committee remark, less practised than formerly, and have a tendency to diminish. But, in view of this state of things, the Committee think that, in the interests of agriculture, some legislation is desirable which shall render it more easy for the purchaser to ascertain the real value of the article he is being supplied with. They recommend—That all home-manufactured artificial manures and fertilisers, both simple and compound, should be sold with a guaranteed analysis in writing stating the percentages of fertilising ingredients; that all imported artificial manures and fertilisers be sold with a copy of the import analysis, and that such import analysis be, within reasonable limits, binding on the seller; that the Board of Agriculture should issue clear and simple instructions for taking samples, and that no sample be taken for analysis except after due notice to the vendor, that he may be present by himself or his agent; that where there is any deficiency in any of the items guaranteed the vendor shall be held liable upon civil proceedings to pay the purchaser, in compensation, the value of the article deficient, setting against it, however, the value of any item which may be in excess of the guarantee; that any deficiency due to fraud be made an offence punishable upon summary conviction by fine or imprisonment; that no criminal prosecution be undertaken unless it is the opinion of an analyst appointed by the Board of Agriculture, or of an analyst authorised by them to act for this purpose, that the case is one for such proceedings to be taken; and that the Board of Agriculture, county councils, agricultural societies, chambers of agriculture, farmers' clubs, co-operative societies, and like bodies be empowered, if they think fit, to institute prosecutions under this clause.

With regard to feeding stuffs, the Committee find that the trade in oil cakes is a field in which the practice of adulteration is particularly prevalent, and that there is a large quantity of articles more or less impure or adulterated

sold as genuine or pure products. They recommended that all simple feeding cakes composed of one substance or the product of one seed, and called after the name of such substance or seed, be required to be sold under the distinctive name of such substance or seed, and be thereby guaranteed "pure and suitable for feeding purposes"; that all other cakes be sold as mixed or compound cakes, or by some designation fixed by the Board of Agriculture; but this should not exclude the use of any trade description or fancy name for such cakes, provided that one of the two words "mixed" or "compound," or some other term to be fixed by the Board of Agriculture, be affixed to such description or fancy name; that the presence of deleterious ingredients in any article sold for feeding stock be prohibited under a penalty; that the addition of any worthless material undeclared in any article sold for feeding stock be treated as an offence subject to a penalty; that any guarantee or analysis voluntarily given be binding on the vendor; and that the same penalties apply in the case of feeding stuffs as of manures.

Mr. Channing makes a supplementary report on feeding stuffs. He explains that he signed the report of the Committee both as regards manures and feeding stuffs, but while agreeing that the recommendations of the report as to feeding stuffs will give some protection to the purchaser, he dissents from certain paragraphs, and is of opinion that the frauds shown to be prevalent in the manufacture and sale of cakes and other feeding stuffs will be most effectually checked by a general system of sale under guaranteed analysis. He makes the following recommendations:—That all feeding cakes and stuffs be sold with a guaranteed analysis giving the percentages of the nutritive elements and the percentages of indigestible fibre, mineral elements (including sand), and moisture; that all simple feeding cakes composed of one substance or the product of one seed, and called after the name of such substance or seed, be sold under the distinctive name of such substance or seed, and guaranteed "pure and suitable for feeding purposes"; that all other cakes or feeding stuffs be sold either as "mixed" or "compound," or under designations to be fixed by order of the Board of Agriculture; that the presence of deleterious ingredients in any article sold for feeding stock be prohibited under a penalty; that the addition of any worthless material undeclared in any article sold for feeding stock, or wilful misrepresentation either as to the designation of any cake or stuff, or as to any of the percentages required to be stated in the guaranteed analysis, be treated as an offence subject to a penalty; that the Board of Agriculture should prescribe from time to time, by order, margins of deviation within which fraud shall not be presumed, and scales of indemnity for deficiencies, and also make regulations from time to time to secure uniformity of sampling and analysis; and that the same penalties apply in the case of feeding stuffs as of manures.

GENERAL TRADE NOTES.

THE PETROLEUM INDUSTRY AT BAKU.

The *Deutsches Handels Archiv* for November states that owing to the over-production of crude naphtha this industry is now passing through a severe crisis at Baku, several firms of producers and refiners having either stopped payment or come to some arrangement with their creditors.

The yield of oil from both old and new naphtha fields has been exceptionally plentiful, notwithstanding the prognostications as to their exhaustion. Quantities of crude naphtha are going to waste owing to the overflowing of the collecting reservoir. Some springs are yielding as much as half a million pounds per day (pound = 36 lb. avoirdupois), and as soon as one becomes exhausted fresh ones are discovered. At Bibi-Abad superfluous naphtha is allowed to flow into the sea.

Twelve months ago a pound of crude naphtha was worth from 8 to 10 copecks from 5*d.* to 5½*d.* per cwt.). The price is now fluctuating between 4 copecks and 1 copeck the pound, and naphtha is said to be even given away.

Apart from the more careful process of refining to which it is subjected, American petroleum (according to the report) is somewhat superior to Russian as regards quality, consequently Americans have been able to keep their prices somewhat in excess of those for Russian oil.

The Baku naphtha industry possesses an advantage over that of North America in consequence of the large proportion of valuable residues contained in Russian oils. Even now the Russian markets can absorb more than 1,600,000 tons of residues, the use of which as fuel is daily becoming more extended in industrial establishments. No profitable commodity are the residues that refined petroleum may be treated as a side product and sold at low prices for lighting purposes.

The average price at Baku of a pound of pure petroleum is 28 copecks. Russian naphtha yields about 33 per cent. of petroleum. Supposing the price of one pound of naphtha to be $2\frac{1}{2}$ copecks, the cost of manufacturing one pound of petroleum would be as follows:—

	Copecks.
3 pounds naphtha at $2\frac{1}{2}$ copecks	7.5
Cost of refining, acids, soda, chemicals.....	3.9
	10.5
Residue of $1\frac{1}{2}$ pounds, now worth about 3 copecks the pound value to be deducted	4.5
Cost of production of 1 pound of petroleum	6.0

When the price of residues is higher (it sometimes exceeds 6 copecks the pound), the cost of production of pure petroleum is still smaller.

America, however, possesses the great advantage of cheap sea freights, whereas the cost of transporting one pound of petroleum from Baku to Batoum is 19 copecks, apart from charges for frequent reloading, and finally sea freight. Meanwhile the proposal for laying down pipes between Baku and Batoum for conveying crude naphtha hardly seems likely to be carried out, although there can be no doubt as to its technical feasibility. Besides, the project of pumping naphtha to Batoum is opposed by the powerful interest of Baku refiners.

THE RUSSIAN OIL INDUSTRY.

The sittings of the eighth Congress of naphtha producers were recently concluded at Baku. Obligatory sorting of illuminating oils according to their degree of refinement, and the alteration of their classification for purposes of taxation, constituted two important subjects of discussion. A majority of the Congress approved of the suggestions of a special committee of members recommending that all illuminating oils sent out from the works at Baku should be tested as to the degree of their transparency, the extent of their purification by sulphuric acid and caustic soda, and the degree to which they become turbid when water is added. The recommendation of the committee as to the retention of the present temporary classification of oils for excise duty was also approved by the Congress.

The improvements of the conditions affecting the export of kerosene to the far East and the reduction of the flashing point of kerosene destined for export abroad, were questions which also engaged the attention of the Congress. In connection with the former it was proposed that pipes should be laid down for the conveyance of kerosene from Enzeli to the Persian Gulf. It is computed that by this means a saving of from 1s. to 1s. 6d. per cwt. would be effected in the delivery of this product in the far East. Russian kerosene would then be secured against competition with America, and a market for about 9,600,000 cwt. per annum obtained. This question has been referred to a committee, which will present its report at the next Congress.

The advocates for a lower flashing point for oils destined for export urged that the present compulsory high flashing point and specific gravity of Russian oils place them at a disadvantage with those of the United States. The proposal was, however, negatived in consequence of the evidence of representatives of the leading firms, who maintained that

the high flashing point which was so distinctive a characteristic of Russian oils, as compared with the dangerous products of America, was essential for ensuring the continued preference to the latter.—*Industries.*

RUSSIAN CHEMICAL MANUFACTURES.

The value of the native manufactures of such articles as oils, soap, lac, matches, alizarine-aniline dyes, white lead, barytes, oxide of zinc, dye extracts, ochre, &c., was 22,300,000 roubles in 1888, and the number of factories engaged in their manufacture was 1,046. The foundation of purely Russian industries has, however, been laid as regards soap, matches, bichromate of potash, and a number of mineral dyes. The new Customs tariff does not merely aim at the protection of Russian raw materials, but is also designed to foster those branches of the chemical industry which furnish the materials required in the primary and final stages of a flourishing industry. The soda factories which obtain soda from salt belong especially to this category, owing to the large quantities of valuable acids and alkalis obtained in the process. There is a great demand for these substances in Russia, especially in glass factories, kerosene refineries, soap-boiling and bleaching establishments.—*Ibid.*

LITHOGRAPHIC STONE DEPOSITS IN THE OURAL MOUNTAINS.

The *Journal de St. Petersburg* for the 15th October states that to the number of mineral riches of the Oural not yet worked are to be added important quarries of lithographic stone, situated in the district of Krasnoufimsk, province of Perm. These deposits have been known for fifteen years, and the lithographic stone which they yield has been recognised as excellent, but until recently nobody has ventured to work the quarries in question. Last winter the quarrying of the lithographic stone was commenced, and according to the *Novoe Vremya* it will be sold in depôts established in St. Petersburg for the purpose.

WRITING PENS MADE OF CELLULOID.

The *Hundels Museum* is responsible for the statement that in France pens for writing are now being made from celluloid, &c., in the following manner:—Thin sheets manufactured from celluloid, chonite, vulcanite, &c., corresponding with the outlines of a pen, are stamped out, punched, and finally laid in a softened condition in a press that has been heated, by which means they receive the desired shape. After being cooled in a water-bath the pens thus obtained are split with a knife.

MINERAL PRODUCTS OF THE UNITED STATES FOR 1891.

The United States Geological Survey, Division of Mining Statistics and Technology, has sent us an advance proof of the next edition of the chart showing the total mineral products of the United States, which will be issued in a short time. The figures for 1891 are here reproduced:—

PRODUCTS.	1891.	
	Quantity.	Value.
Metallic:		Dols.
Pig iron, value at Phil- Long tons	8,279,790	128,337,985
adelphei.		
Silver, coining value	58,500,000	75,416,565
Gold, coining value	1,004,840	33,175,060
Copper, value at New York City.	295,810,076	38,455,300
Lead, value at New York City.	202,406	17,609,322
Zinc, value at New York City.	80,337	8,032,700

PRODUCTS.		1891.	
		Quantity.	Value.
Quicksilver, value at San Francisco.	Flasks	22,004	Dols. 1,030,386
Nickel, value at Philadelphia.	Lb.	118,498	71,000
Aluminium, value at Pittsburg.	"	150,000	100,000
Tin	"	125,289	25,058
Antimony, value at San Francisco.	Short tons	278	17,007
Platinum, value (crude) at San Francisco.	Troy oz.	100	500
Total value metallic products .....	..	..	302,307,922
Non-metallic (spot values) :—		105,201,721	117,106,183
Bituminous coal	Long tons	45,236,392	73,941,735
Pennsylvania anthracite.	"	..	47,201,746
Building stone .....	..	..	32,575,188
Petroleum	Bbls.	51,201,980	35,000,000
Lime	"	60,000,000	18,000,000
Natural gas .....	..	..	6,080,951
Cement	Bbls.	8,222,792	4,716,121
Salt	"	9,987,945	3,051,150
Phosphate rock	Long tons	587,988	2,500,000
Limestone for iron flux ..	"	5,000,000	2,200,259
Mineral waters	Gallons sold	18,392,732	1,000,000
Zinc-white	Short tons	..	900,000
Potters' clay	Long tons	400,000	658,478
Mineral paints	"	47,052	869,700
Borax	Lb.	13,380,000	628,951
Gypsum	Short tons	208,126	176,113
Grindstones .....	..	..	193,068
Fibrous tale	Short tons	53,051	338,880
Pyrites	Long tons	119,329	243,981
Soapstone	Short tons	16,514	239,129
Manganese ore	Long tons	23,416	242,264
Asphaltum	Short tons	45,054	235,300
Precious stones .....	..	..	54,880
Bromine	Lb.	343,900	88,450
Corundum	Short tons	3,247	110,000
Barytes (crude)	Long tons	31,069	16,587
Graphite	Lb.	..	150,000
Millstones .....	..	..	67,500
Novaculite	Lb.	1,375,000	63,000
Marls	Short tons	135,000	78,330
Flint	Long tons	15,000	20,580
Fluorspar	Short tons	10,044	21,988
Chronic iron ore	Long tons	1,372	50,000
Infusorial earth	Short tons	..	100,000
Feldspar	Long tons	10,000	7,000
Mica	Lbs.	75,000	18,000
Ozokerite refined	"	50,000	20,000
Cobalt oxide	"	7,200	39,000
Slate, ground as pigment	Long tons	2,000	..
Sulphur	Short tons	1,200	..

PRODUCTS.		1891.	
		Quantity.	Value.
Asbestos	Short tons	66	Dols. 3,909
Rutile	Lb.	300	800
Lithographic stone	Short tons	..	..
Total value non-metallic products			356,216,915
Total value metallic products			302,307,922
Estimated value mineral products unspecified ..			10,000,000
Grand total			668,524,837

—*Engineering and Mining Journal.*

THE SCOTCH OIL TRADE.

The Standard Oil Company has intimated another reduction of $\frac{1}{4}d.$ per lb. in the price of paraffin scale, and producers have been obliged to follow the cut on all their scale products. Scotch hard scale is now no better than $1\frac{1}{4}d.$ to $1\frac{3}{4}d.$ per lb.; some sellers have offered to deal at the former figure without finding buyers. This latest reduction has been mainly brought about by the demoralization which exists in the candle trade by the underhand dealing which is alleged in that connection, and by the difficulty which some importers and some local concerns experience in getting rid of their stock of scale. Running contracts participate in the reduction, which came into force on December 9th. Since the break up of the producers' combination paraffin scale has been lowered $1\frac{1}{2}d.$ per lb., nearly 40 per cent. On the ton of scale that represents a loss of over 10*l.* per ton, and on the Scotch make alone the difference to the trade compared with what would have been the yield for one year had the price been maintained at its old level is between 200,000*l.* and 250,000*l.* Following on the reduction in the price of paraffin scale, the candle-makers have reduced their list prices for white candles by 6*d.* and the yellows by 3*d.*—each per dozen pounds. The reduction in whites is equal to double what has been taken off wax. One of the Scotch companies connected with the associated companies has taken $\frac{1}{4}d.$ per gallon off burning oil, although the demand at present is reported good.—*Chemical Trade Journal.*

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

	Month ending 30th November	
	1891.	1892.
	£	£
Metals	2,100,115	1,563,707
Chemicals and dyestuffs	400,844	531,374
Oils	628,083	658,902
Raw materials for non-textile industries.	3,484,450	3,395,244
Total value of all imports	43,861,389	38,898,373

SUMMARY OF EXPORTS.

	Month ending 30th November	
	1891.	1892.
	£	£
Metals (other than machinery)	2,733,043	2,649,183
Chemicals and medicines	743,032	716,187
Miscellaneous articles.....	2,488,026	2,478,398
Total value of all exports.....	18,790,949	18,549,310

IMPORTS OF METALS FOR MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
Copper:—			£	£
Ore..... Tons	10,192	6,891	76,236	35,233
Regulus	7,508	9,575	191,788	253,700
Unwrought	6,058	2,186	298,199	129,589
Iron:—				
Ore.....	218,904	277,855	181,806	190,097
Bolt, bar, &c....	8,830	6,524	83,497	57,857
Steel, unwrought..	745	768	7,070	7,578
Lead, pig and sheet ..	14,841	18,506	173,363	188,176
Pyrites	46,954	39,939	81,742	72,872
Quicksilver..... Lb.	57,494	75,380	5,863	6,533
Tin..... Cwt.	63,363	39,913	288,322	186,477
Zinc	5,356	8,999	122,630	174,162
Other articles ... Value £	..	..	581,899	276,493
Total value of metals	..	..	2,100,415	1,563,767

IMPORTS OF CHEMICALS AND DYE-STUFFS FOR MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Alkali..... Cwt.	6,099	6,633	3,078	4,640
Bark (tauners, &c.) ..	31,586	17,785	13,887	5,974
Brimstone	42,375	31,448	12,353	10,308
Chemicals..... Value £	..	..	124,805	154,870
Cochineal	773	1,098	4,860	6,761
Cutch and gambier Tons	838	2,350	26,390	48,576
Dyes:—				
Aniline..... Value £	..	..	19,249	12,642
Alizarine .....	..	..	29,535	38,406
Other .....	..	..	809	417
Indigo	550	3,223	8,264	48,928
Nitrate of soda....	50,206	128,199	22,912	57,052
Nitrate of potash .	15,025	28,822	14,267	25,292
Valonia..... Tons	1,647	1,183	27,180	19,212
Other articles... Value £	..	..	92,484	98,433
Total value of chemicals	..	..	409,844	531,374

IMPORTS OF OILS FOR MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Cocoa-nut..... Cwt.	8,326	6,880	9,952	7,517
Olive	1,129	1,243	45,182	45,206
Palm	95,058	85,551	109,754	86,857
Petroleum	12,772,516	14,472,116	230,141	267,512
Seed	2,692	2,068	73,554	51,145
Train, &c..... Tons	1,782	1,978	34,301	38,389
Turpentine	40,694	75,467	53,208	83,724
Other articles .. Value £	..	..	71,993	75,642
Total value of oils ...	..	..	628,085	658,992

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Bark, Peruvian .. Cwt.	7,839	9,125	17,065	19,607
Bristles..... Lb.	262,173	192,769	36,591	28,959
Caoutchouc..... Cwt.	23,539	27,557	273,355	338,281
Gum:—				
Arabic.....	5,865	7,816	13,090	21,439
Lac, &c.....	8,313	2,789	35,930	11,606
Gutta-percha	3,620	3,083	43,161	26,270
Hides, raw:—				
Dry.....	28,110	21,982	73,972	54,928
Wet	47,707	60,963	107,778	111,731
Ivory	770	1,041	41,326	49,135
Manure:—				
Guano..... Tons	390	1,890	2,868	11,856
Bones.....	6,219	5,628	29,434	25,946
Paraffin..... Cwt.	36,126	62,816	56,540	71,582
Linon rags..... Tons	3,424	250	34,209	2,841
Eaparto.....	17,981	13,591	85,439	71,160
Palp of wood	13,382	17,229	84,838	90,220
Rosin..... Cwt.	89,976	177,931	24,770	42,893
Tallow and stearin ..	80,022	84,428	105,352	108,519
Tar	11,407	215	7,940	68
Wood:—				
Hewn	162,346	161,679	349,530	333,521
Sawn	436,919	466,708	883,589	1,036,107
Staves	14,453	11,259	51,421	56,014
Mahogany	4,610	4,139	42,787	35,307
Other articles.... Value £	..	..	1,083,465	958,395
Total value .....	..	..	3,484,450	3,505,244

Besides the above, drugs to the value of 73,354, were imported, as against 73,356, in November 1891.

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR
MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Brass..... Cwt.	7,299	9,291	35,418	37,706
Copper:—				
Unwrought..... "	62,095	69,601	163,914	168,772
Wrought..... "	26,992	26,404	89,353	76,349
Mixed metal.... "	27,126	29,529	73,889	69,563
Hardware..... Value £	..	..	213,492	192,260
Implements..... "	..	..	108,960	108,405
Iron and steel.... Tons	221,315	230,618	1,802,447	1,753,669
Lead..... "	3,591	2,788	49,271	33,708
Plated wares... Value £	..	..	39,216	34,561
Telegraph wires, &c. "	..	..	25,143	39,993
Tin..... Cwt.	8,181	9,453	38,872	45,804
Zinc..... "	10,518	10,881	11,252	13,675
Other articles .. Value £	..	..	81,816	75,919
Total value .....	..	..	2,793,913	2,640,483

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH
ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Gunpowder..... Lb.	728,100	869,100	23,541	21,227
Military stores.. Value £	..	..	62,381	121,774
Candles..... Lb.	1,498,700	1,693,800	27,813	39,961
Caoutchouc..... Value £	..	..	102,996	107,565
Cement..... Tons	34,611	39,984	68,046	69,271
Products of coal Value £	..	..	114,676	119,299
Earthenware ... "	..	..	167,323	179,157
Stoneware..... "	..	..	9,769	9,924
Glass:—				
Plate..... Sq. Ft.	279,811	193,021	18,517	10,613
Flint..... Cwt.	9,275	7,167	21,327	19,779
Bottles..... "	55,212	55,629	25,719	26,116
Other kinds.... "	18,696	24,538	17,326	20,242
Leather:—				
Unwrought.... "	13,612	12,028	126,211	107,280
Wrought..... Value £	..	..	29,936	26,603
Seed oil..... Tons	5,377	5,723	111,505	106,375
Floorecloth..... Sq. Yds.	1,876,600	1,181,800	72,231	50,355
Painters' materials Val. £	..	..	116,105	126,393
Paper..... Cwt.	80,795	67,675	116,865	118,271
Rags..... Tons	4,799	5,911	34,884	42,747
Soap..... Cwt.	47,103	42,937	53,631	48,796
Total value .....	..	..	2,488,926	2,478,398

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING
30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Alkali..... Cwt.	547,185	543,717	199,895	183,848
Bleaching materials ..	151,738	131,747	54,223	53,358
Chemical manures. Tons	26,291	25,159	175,133	152,208
Medicines..... Value £	..	..	89,394	86,596
Other articles ... "	..	..	228,387	240,527
Total value .....	..	..	745,032	716,187

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

20,541. J. Whyte, H. Whyte, and A. W. Cooper. Improvements in evaporative condensers. November 14.

20,595. F. W. Scott, E. G. Scott, and F. W. Scott, jun. Improvements in or connected with evaporating or concentrating apparatus. November 14.

21,261. E. Hesketh and A. Marec. Improved apparatus for producing cold. November 22.

21,275. J. H. Lewis. Improvements in apparatus for the absorption of chlorine and other gases (applicable also to the washing or scrubbing of gases). November 22.

21,454. J. C. Caivert. Improvements in apparatus for controlling the flow of fluids under pressure. November 24.

21,495. C. Musker, A. Musker, and A. Webster. Improvements in apparatus for evaporating salt water or other liquid. November 25.

21,744. J. Laidlaw. Improvements in centrifugal machines for separating fluids of different densities. November 29.

22,005. J. J. Hicks and G. H. Zeal. Improvements in hydrometers and saccharometers. December 1.

22,157. J. J. Melville. Improvements in or relating to apparatus for treating solid, semi-solid, or liquid substances with gases. December 3.

22,407. D. G. Sinclair and J. V. Dunlop. Improvements in and relating to machinery for the manufacture of fuel briquettes, firebricks, silicious blocks, and the like. December 7.

22,531. W. Deighton. Improvements in and connected with furnaces or kilns using solid or gaseous fuel for burning or calcining limestone, ore, and like substances. December 8.

23,217. J. C. Eno and R. Jackson. Improvements connected with machinery for drying powdered substances particularly applicable for the manufacture of fruit salt. December 16.

23,281. T. Mudd. Improvements in condensers. December 17.

23,287. B. J. B. Mills.—From A. Gilliard, P. Monnet, and J. M. Cartier, France. Improvements in means or receivers for the preservation and application of chloride of ethyl and other volatile liquids, to be employed principally in the production of cold. December 17.

23,297. Sir Lowthian Bell, Bart. Improvements in evaporating brine and other solutions. December 17.

COMPLETE SPECIFICATIONS ACCEPTED.*

1891.

20,413. G. Bamberg. *See* Class XI.

22,639. E. S. Arrighi. Improvements in and in the manufacture of clinical and other thermometers, and in apparatus therefor. December 7.

1892.

541. L. Roumien. Filtering receptacle for substances from which oil or other liquid is to be expressed by hydraulic and other presses. December 14.

836. A. M. Strathern and A. S. Strathern. Apparatus for governing or regulating the pressure or flow of illuminating gas or other fluids. November 23.

845. H. E. Newton.—From R. N. Oakman, jun. Gas furnaces. November 23.

1172. A. T. Rapkin and F. Cossor. Thermometers. November 30.

1181. W. J. Lomax and C. J. Lomax. A combined refuse furnace and gas apparatus. November 30.

1991. J. Wright. Apparatus for heating water and fluids of all kinds; also applicable to ammoniacal and other liquids for distillation for steam boilers or any other purposes. December 14.

2790. J. W. Bowley. Apparatus for producing cold in or freezing liquids. December 21.

19,213. I. Levinstein. *See* Class VII.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

20,709. L. Van Vestrant and M. Graham. Improvements in apparatus for charging inclined gas retorts. November 16.

20,710. L. Van Vestrant. An improved apparatus for charging inclined gas retorts. November 16.

20,769. T. Bauer. Improvements in coke furnaces. Complete Specification. November 16.

20,783. T. F. Eunis and G. F. M. Eunis. Improvements in the manufacture of coal-gas. November 16.

20,860. J. Love. Improvements in apparatus for carburetted or enriching gas or air. November 17.

20,869. V. B. Lewes. Improvements in apparatus for the manufacture or production of gas. November 17.

21,008. J. D. Hall. Improvements in or connected with apparatus for producing illuminating gas. November 19.

21,028. W. S. Sutherland. Improvements in and appertaining to gas producers. November 19.

21,151. W. Henry and J. Henry. An improvement in the manufacture of Irish peat into fuel for steam and household purposes. November 21.

21,444. R. Adcock. An improved smoke consumer for destroying the carbon products of gas combustion and increasing the power of the gas light. November 24.

21,511. J. S. Muir. Improvements in and relating to the manufacture of cyanogen compounds. November 25.

21,647. P. Dvorkovitz. Improvements in apparatus for the manufacture of gas and of by-products from liquid hydrocarbons. November 26.

21,648. P. Dvorkovitz. Improvements in and apparatus for the manufacture of gas and of by-products from liquid hydrocarbons. November 26.

21,649. R. O. Paterson. Improvements in and apparatus for the manufacture of gas for illuminating or other purposes. November 26.

21,871. H. Fourness. Improvements in valves and apparatus employed in the manufacture of illuminating and heating gas. Complete Specification. November 30.

21,914. H. Pazolt. The manufacture of an improved artificial fuel. Complete Specification. November 30.

22,079. S. Y. Shoubridge. Improvements in apparatus for charging gas retorts. December 2.

22,174. H. E. Newton.—From R. N. Oakman, jun., United States. Improvements in gas-producing plant. December 3.

22,767. T. Cross. Improvements in distribution of liquor in ammonia scrubbers or washers. December 12.

22,780. G. Moss. Improvements in means for increasing the illuminating power of lamp flames. December 12.

22,941. W. Willis, E. J. Humphery, and W. H. Smith. Improvements relating to the production and use of light, and to apparatus therefor. December 13.

23,236. H. H. Lake.—From E. Clarenbach, Germany. Improvements relating to the smokeless combustion of fuel and to apparatus for effecting such combustion. December 16.

23,299. A. M. Chambers and T. Smith. An improved process and apparatus for separating fine coal slack from impurities. December 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

864. J. Ruscoe. Apparatus for charging gas retorts. November 30.

964. C. Allina. Solidifying petroleum and the carbohydrates contained in same for facilitating transportation and use as fuel, also reliquefying same. November 23.

1437. I. S. McDougall and J. T. McDougall. Treatment of oils for rendering them capable of transport or storage, and of use as fuel, or as illuminants with greater safety and convenience than hitherto. November 30.

1575. A. Klonne. Manufacture of illuminating and heating gas, and in apparatus therefor. November 30.

1647. J. Mitchell. Coke ovens. December 7.

2073. W. H. Wilson. Manufacture of illuminating gas. December 14.

5620. F. A. Tagliaferro, A. A. Moore, and R. Campion. Manufacture of fire-lighters and artificial fuel. December 7.

8949. T. J. Barnard. Manufacture of fuel, together with the means and combinations in connection therewith. December 14.

9114. R. N. Oakman, jun. Gas-producing plant. November 23.

9854. H. Birkbeck.—From E. B. Muller. Process for manufacturing compact pit coal out of pit coal dust, slack, or small pieces of pit coal. December 7.

14,862. C. R. Poulsen. New or improved apparatus for the production of ozone by means of phosphorus. December 7.

16,750. F. Grein. Charging machine for gas retorts. November 30.

17,484. P. Jensen.—From H. Stiemer and Ziegler. Process of and apparatus for preparing tar, oil, paraffin, pitch, heating and illuminating gases, and large coke from fibrous organic materials such as peat and lignite. December 21.

* *See* Note (*) on previous page.

19,477. R. Campion. The employment of certain ingredients and means for the manufacture of fire-lighters therefrom. December 7.

19,630. H. Galopin. Apparatus for using liquid fuel for lighting and heating purposes. December 21.

19,655. H. G. O'Neill. Improvements in and relating to a method of and means for heating by electricity. December 21.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATIONS.

21,343. W. J. Wisse and A. Schueller. New or improved treatment of hydrocarbons (or of analogous substances composed mainly of hydrogen and carbon) to decompose them and obtain various products. November 23.

21,809. G. J. Epstein. Improvements in the treatment of pitch or tar and like residues resulting from the manufacture of oils or fats, or wax, or from gas or the like. November 29.

COMPLETE SPECIFICATION ACCEPTED.

1892.

17,484. P. Jensen.—From H. Striener and M. Ziegler. See Class II.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

21,139. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in and relating to the manufacture and production of diphenyl-naphthylmethane dyes, and of materials therefor. November 21.

21,154. H. H. Lake.—From Wirth and Co., agents for A. Leonhardt and Co., Germany. Improvements in the manufacture of colouring matters. November 21.

21,166. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Application of non-sulphonated azo-colouring matters insoluble in water as body-colours, and in substitution for mineral colours for printing on textile fabrics. November 21.

21,167. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of blue colouring matters from orthodinitro-anthraquinone. November 21.

21,168. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in the production of blue colouring matters from amido-nitro-anthraquinone. November 21.

21,440. Read, Holliday, and Sons, and K. B. Elbel. Improvements in the manufacture of azo-colouring matters. November 24.

21,968. A. Lembach and C. J. Wolff. Improvements in and connected with the manufacture of oxyquinoline-phenolsulphonic-oxyquinoline and its homologues. Complete Specification. December 1.

22,443. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in the manufacture tetra-nitro-anthrachryson. December 7.

22,572. S. Pitt.—From L. Cassella and Co., Germany. A new group of basic colouring matters, and means for producing the same. December 8.

23,211. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new colouring matters. December 16.

23,212. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new basic colouring matters. December 16.

23,213. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new derivatives of triphenylmethane and diphenyl-naphthylmethane. December 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

802. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture of dyes of the rosaniline series and of leuco-compounds thereof. November 30.

1390. H. H. Lake.—From Wirth and Co., agents for Leonhardt and Co. Manufacture of colouring matters. November 30.

1657. B. Willeox.—From The Farbwerke vormals F. Bayer and Co. Manufacture of colouring matters derived from anthraquinone. December 14.

2408. C. D. Abel.—From The Actiengesellschaft für Anilin Fabrikation. New manufacture of bases and of colouring matters therefrom. December 7.

2617. O. Imray.—From The Farbwerke vormals Meister, Lucius, und Brüning. Manufacture of ethoxyphenylmethyl-pyrazalone and of para-ethoxy 1 phenyl-2,3 dimethyl-5 pyrazalone. December 21.

2789. S. Pitt.—From L. Cassella and Co. Production of azo dyes. December 21.

2953. C. D. Abel.—From The Actiengesellschaft für Anilin Fabrikation. Manufacture of new bases and colouring matters therefrom. December 14.

4109. A. Bang.—From G. A. Dahl. A new black azo dyestuff, and the production of the same. December 14.

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATIONS.

20,839. A. Ambler, S. Ambler, and F. Ambler. Improvements in the cleansing, treating, or washing of wool and like animal fibres, and in apparatus employed therein. November 17.

22,736. F. Lehner. Improvements in the process and machinery for producing a thread or filament similar to silk. December 10.

23,156. T. B. Greenwood. See Class VII.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

15,808. A. S. Oetzmann and S. J. Narracott. Manufacture of coverings for floors and other surfaces, and apparatus therefor. November 23.

20,625. W. Bottomley.—From G. E. Armstrong. Apparatus and processes for treating fibrous material. December 21.

22,303. F. Reddaway. Manufacture of oil baizes, American leather, cloth, and other waterproof fabrics. December 14.

1892.

10,834. A. Bayer and K. Herold. A process for freeing sheep's wool from pitch and other impurities. December 14.

19,776. F. Doller and R. Wolfenstein. Process and apparatus for waterproofing woven fabrics. December 7.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

20,553. C. S. Bedford. Improvements in dyeing. November 14.

21,049. C. D. Abel.—From R. Koepf and Co., Germany. Process for fixing mordants on fibre for dyeing. November 19.

21,189. R. B. Archibald. A machine for dyeing wool yarns and similar material. November 22.

21,714. F. W. Hayward, A. S. King, and A. W. Loveland. Improved means and apparatus for surfacing paper or other material with colour, gum, oil, varnish, or the like. November 28.

22,264. A. S. King. Improved means and apparatus for wholly or partially coating or surfacing sheets of paper and other material with colour, gum, oil, varnish, or the like. December 5.

22,293. A. F. St. George. A method of and apparatus for colouring and inlaying coloured designs upon and through floor and wall covering materials. December 6.

23,262. J. Robb and J. Grime. Improvements in and connected with the production of coloured patterns in combination with aniline black on woven fabrics. December 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

282. E. Woodcock, sen., N. O. Woodcock, and E. Woodcock, jun. Improved machine for dyeing, scouring, bleaching, sizing, carbonising, and drying. December 14.

1506. J. Dawson. Method and apparatus for utilising the heat of spent liquors or liquids for dyeing, manufacturing, and other like purposes. December 7.

19,079. F. Schreurs. A new process and apparatus for printing and dyeing fabrics. December 14.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

20,921. F. H. Gossage and J. Williamson. Improvements in the manufacture of sulphide of sodium or of sulphide of potassium from their respective sulphates. November 18.

21,275. J. H. Lewis. See Class I.

21,294. T. D. Owen. Improvements in tanks for containing hydrochloric acid. November 23.

21,298. A. McKenzie. A new or improved soldering flux or acid. November 23.

21,476. C. S. Ellery. Improvements in the manufacture of ammonium sulphate and other salts. November 24.

21,520. The Manchester Oxygen (Brin's Patent) Company, Limited, and W. M. Jackson. Improvements in the manufacture of carbonic acid, lime, magnesia, and other oxides. November 25.

21,702. E. Bouchaud-Praceiq. A process for utilising waste acid sodium sulphate. November 28.

21,723. H. H. Lake.—From L. Sternberg, United States. An improved process of obtaining ammonia and ammonia salts from nitrogenous organic matters. Complete Specification. November 28.

21,735. T. T. Best. Improvements in the manufacture of chlorate of soda. November 29.

21,807. S. Z. de Ferranti and J. H. Noad. Improvements in or appertaining to the manufacture of caustic soda and chlorine. November 29.

21,824. W. C. Sellar. Improvements in the production of cyanides of the alkali metals. November 29.

21,825. W. C. Sellar. Improvements in the production of cyanides of the alkali metals. November 29.

22,078. T. Hughes. The concentration of sulphuric acid. December 2.

22,139. J. Levinstein. Improvements in the manufacture of persalts of iron. December 3.

22,237. H. Cosnett, B. C. Bennison, S. Hayes, and P. Smallwood. New or improved means and apparatus for obtaining chlorine gas from the spent liquors produced in the manufacture of soda ash, and in means and apparatus for the manufacture of chloride of lime therefrom. December 5.

22,238. S. Walker and S. S. Walker. Improvements in the production of carbonic acid. December 5.

22,415. W. Mills. Improvements in the manufacture of soda, and apparatus therefor. December 7.

22,455. C. P. Taylor. Improvements in the manufacture of carbonate of soda, caustic soda, and chlorine, and in apparatus employed in the said manufacture. December 7.

22,523. F. H. Gossage and J. Williamson. An improvement in the manufacture of bicarbonate of soda and soda ash. December 8.

22,602. R. Dempster. Improvements in apparatus for the manufacture of sulphate of ammonia and liquid ammonia. December 9.

22,714. P. Marquart. Improvements in the manufacture of boric acid and borax. December 10.

22,817. E. Rotondi and C. M. Michela. A process for manufacture of acetic acid. Complete Specification. December 12.

22,819. E. Placet and J. Bonnet. Improvements in the preparation of chromic acid. December 12.

22,844. T. H. Copley. Improvements in treating waste substances for the production of potash, potash salts, water glass, founders' blacking and manure. December 12.

23,156. T. B. Greenwood. A new or improved infusion or solution for scouring and removing grease, size, or the like from textile fabrics. December 16.

23,201. J. C. Butterfield. Improvements in the treatment of brimstone and other sulphurised ores. December 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

21,464. F. M. Lyte. Production of chlorine in the purification of lead, in the recovery of precious or other metals with which the lead may be associated, and means or apparatus employed therein. November 30.

1892.

610. F. Valentiner. Process and apparatus for the manufacture of concentrated nitric acid. November 30.

1439. I. S. McDougall and J. T. McDougall. Treatment of certain corrosive or poisonous liquids to render them capable of being transported, stored, or used with less danger than hitherto. December 14.

1642. O. Imray.—From M. M. Rotten. Manufacture of sodium and potassium bichromates. December 7.

19,180. J. M. Milnes and A. Milnes. A new process or means for the production of chloride of lime. December 21.

19,213. I. Levinstein. Improvements in the method of and apparatus for concentrating sulphuric acid and other liquids. December 7.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

20,656. W. Oakes and J. Oakes. See Class IX.

21,945. E. P. Lee. Improvements in kilns for burning bricks, tiles, and other clay goods; also for burning sanitary ware and for salt-glazing. December 1.

21,951. W. Allen. Improvements in the manufacture of porous earthenware pottery articles for electrolytic purposes. December 1.

22,376. W. P. Thompson.—From R. S. Pease, United States. See Class X.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

20,115. L. West. Manufacture of plate and other glass, and apparatus therefor. November 23.

1892.

18,448. P. Sievert. Process and means for manufacturing glass pipes. November 30.

19,395. P. A. Moreau. Production of ornamental stones artificially coloured. December 7.

20,656. W. Oakes and J. Oakes. See Class IX.

23,181. J. Hamblet, jun. An improvement in paving bricks. December 16.

23,192. J. H. Blakesley. Improvements in fireproof floors, roofs, girders, joists, and the like. December 16.

23,235. O. J. Owen. Improvements in the utilisation of slate. December 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

50. P. A. Moreau. Manufacture of artificial marble. December 7.

736. T. J. Davey. Chamber oven for drying clay from slurry or any other materials of a similar nature in brick or cement works. November 23.

14,889. R. Kieffert and H. Thiron. Cements. December 21.

18,575. H. J. Haddan.—From F. D. Cummer. Process of drying and disintegrating clay and similar materials. November 23.

18,803. K. Alsdorff. Improvements in fireproof walls and ceilings. November 30.

19,813. O. Böklen. Process for making cement or cement mortar. December 7.

19,908. C. G. Pickling. Fireproof buildings. December 14.

19,947. W. Gutmann de Gelse. Process for preserving timber. December 14.

20,414. P. A. Moreau. Manufacture of variegated or veined artificial stone and imitations of natural marble. December 21.

20,656. W. Oakes and J. Oakes. Kilns for bricks, lime, and the like. November 23.

20,832. F. von Hünnersdorff. Bricks or blocks for building purposes. November 23.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

20,656. W. Oakes and J. Oakes. Improvements in kilns for bricks, lime, and the like. Complete Specification. November 15.

20,832. E. von Hünnersdorff. Improvements in bricks or blocks for building purposes. Complete Specification. November 17.

20,963. H. Pfähler. See Class X.

21,037. J. W. Stansfield. Improved composition suitable for paving slabs, path surfacing, and for blocks, also stair threads and the like. Complete Specification. November 19.

21,064. H. Lockwood. An improved composition for flooring or covering iron bridges, arches, tanks, and other structures. November 19.

21,105. P. J. Jackson. An improved system of street or floor paving. Complete Specification. November 21.

21,486. H. Parry. Improvements in kilns for burning lime. November 25.

21,640. K. S. Meyer. Process for the manufacture of artificial building and other stone. Complete Specification. November 26.

21,851. J. Ferguson. Improvements in or relating to fireproof building construction. November 30.

22,004. F. W. Löhrmann. Improvement in the manufacture of artificial building materials. December 1.

22,784. J. Gaskell and W. Robinson. Artificial stone, bricks, tiles, and the like. December 12.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

20,547. T. Harris and H. C. Saeré. See Class XIII.

20,608. J. H. S. Bradley and R. G. Henchley. A non-corrosive metal alloy. November 15.

20,715. A. Macdonald. A new or improved process for treating silver and lead ores. November 16.

20,879. C. King. Improvements in the extraction of gold and silver. November 17.

20,900. E. Bailey and J. D. Massey. An improved process of manufacturing and depositing spongy lead for secondary or storage batteries or receivers. November 17.

20,963. H. Pfähler. Improvements relating to binding metal for use in constructions of concrete, cement, or the like. November 18.

21,053. A. Guthrie and R. F. Macfarlane. Improvements in the treatment of complex metallic ores. November 19.

21,085. A. S. Ramage. Process for pickling metals, especially iron for galvanising and tinning, whereby no waste substance is produced and no iron lost. November 21.

21,108. C. Allen, J. Clark, and G. W. Clark. Improvements in or relating to the manufacture of aluminium and alloys thereof. November 21.

21,162. R. Haddan.—From F. Singer and H. Barthel, Germany. An improved method of soldering aluminium and other metals, and an improved solder therefor. November 21.

21,202. P. Robinson. Improvements in the manufacture or production of channelled or troughed iron, steel, and other metals. November 22.

21,228. W. Tatlow.—An improved method of recovering tin from tin scrap or waste tinned iron. November 22.

21,271. E. Norton. Improvements in the process of tinning iron and steel plates. Complete Specification. November 22.

21,826. H. L. Sulman. Improvements in or relating to the treatment of ores containing zinc and antimony. November 29.

21,828. W. H. D'Avidge Cleminson. Improvements in the manufacture of pig iron from iron ore. November 29.

22,324. A. E. Tucker. Improvements in iron and steel manufacture. December 6.

22,369. W. J. Freeman and E. Freeman. Improvements in the manufacture of soft metal castings. December 6.

22,376. W. P. Thompson.—From R. S. Pease, United States. Improvements in apparatus for handling or working molten substances, such as metal and glass. Complete Specification. December 6.

22,600. W. R. Renshaw. Improvements in the treatment and hardening of armour plates. December 9.

22,601. W. R. Renshaw.—From F. G. Bates, United States. Improvements in converting iron or low-grade steel into high-grade steel. December 9.

22,672. H. H. Lake.—From H. A. Harvey, United States. Improvements in the manufacture of armour plates. December 9.

22,778. R. A. Carrasco. Improvements in galvanising iron and other sheets and in apparatus therefor. December 12.

22,843. W. R. Taylor. Improved application of aluminium and its alloys. December 12.

22,907. S. Wood. Improvements in the method of and apparatus for hardening and tempering steel wire for cards and other purposes. December 13.

23,020. P. Fowler. An improvement in the manufacture of iron and steel. December 14.

23,062. J. Moseley. Improvements in and connected with the processes of hardening and tempering steel wire. December 15.

23,169. J. Johnson.—From T. S. Blair and T. S. Blair, jun., United States. Improvements in desulphurising iron and steel. December 16.

23,194. J. C. Butterfield. Improvements in the treatment of tinned iron for the recovery of the tin and other products. December 16.

23,288. A. Longsdon.—From F. A. Krupp and Co., Germany. A new or improved process and apparatus for or relating to the manufacture of armour plates. Complete Specification. December 16.

23,286. P. M. Justice.—From J. Meyer, Grand Duchy of Luxemburg. Improvements in the manufacture of steel or ingot iron. December 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

13,796. H. Pilot. Iron silver. November 23.

17,621. H. W. Wallis. Concentration of pyritic ores. December 21.

19,860. Compagnie des Hauts-Fourneaux Forges et Aciéries de la Marine et des Chemins de Fer. The manufacture of steel. December 21.

19,928. A. Figge. Manufacture of iron, steel, or copper, and a material to be used in the said manufacture. November 23.

21,950. W. P. Breeding.—From the Ajax Metal Co. Improvements in the cleaning and preparation of metallic sheets and other articles, and in the coating of same with lead or alloys of same. November 23.

22,501. I. S. McDougall. Furnaces for burning ores containing sulphur and sulphur compounds. November 30.

1892.

1273. W. Hutchinsonsoo. Manufacture of iron and steel. November 23.

1341. T. Twynnam and J. Colley. Manufacture of steel and iron. November 30.

1467. C. Moldenhauer. Process of recovering precious metals from their ores. November 30.

1530. G. W. Clark. Manufacture of steel. December 7.

1654. C. Hopfner. Extraction of silver. November 30.

1776. W. Hutchinsonsoo. Manufacture of iron and steel. November 30.

1901. T. C. Fawcett and T. C. Fawcett, jun. Cupolas or furnaces for melting iron. December 7.

1907. W. Muir. Extraction of tin and other products from the refuse slags and debris of tin-smelting furnaces. December 14.

2261. B. Rösing and H. Foerster, and K. Foerster. Extraction of lead and apparatus therefor. December 21.

3237. R. A. Hadfield. Manufacture of cast-steel projectiles. December 7.

11,297. J. P. Bayly.—From J. J. Naeff. Process of recovering tin from tin scraps. December 21.

18,082. C. D. Abel.—From Hoerder Bergwerks und Hütten-verein. Process for the removal of manganese from pig iron, ingot iron, and steel. November 23.

20,208. W. A. Briggs.—From J. W. Richards. An improved solder for aluminium. December 21.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

20,598. C. Therye and A. Oblasser. Improvements in and relating to the manufacture of electric accumulators. November 14.

20,900. E. Bailey and J. D. Massey. See Class X.

21,074. F. C. James. Improvements in galvanic batteries. November 19.

21,193. G. E. Cassal and F. A. Kjellin. An improved method of producing zinc from blende by means of electrolysis. Complete Specification. November 22.

21,348. W. Wright and J. B. Hamond. Improvements in the treatment of zinc produced by electrolysis. November 23.

21,554. R. E. Disher, R. H. C. Hall, and C. Crockford. Improved manufacture of battery plates, and employment of ingredients therefor. November 25.

21,696. T. L. Willson. Improvements in electric smelting of aluminous and other refractory ores or compounds. November 28.

21,701. T. L. Willson. Improvements in the reduction or treatment of refractory metallic compounds by electric smelting. November 28.

21,794. E. Andreoli. Improvements in the manufacture of electrodes for ozonisers. Complete Specification. November 29.

22,344. W. Walker and F. R. Wilkins. Improvements in galvanic batteries. December 6.

22,375. W. P. Thompson.—From C. L. Coffin, United States. Improvements in the method of welding or working metals electrically. Complete Specification. December 6.

22,657. J. G. Lorrain.—From M. Dumont, France. A new or improved electric accumulator. December 9.

22,760. J. A. Heap. Improvements in the method of and apparatus for electrolysing aqueous solutions of salts. December 12.

22,950. R. Haddan.—From R. Gabarro, Spain. An improved galvanic dry battery or cell, and a composition for use in such cells. Complete Specification. December 13.

22,987. P. M. Justice.—From W. W. Griseom, United States. Improvements in secondary battery plates or elements, and in the process of preparing same. Complete Specification. December 14.

23,007. W. Walker and F. R. Wilkins. Improvements in galvanic batteries. December 14.

23,051. E. A. Mitchell and G. T. Tagwell. Improvements in galvanic dry cells. December 15.

23,101. C. A. J. H. Schroeder and H. E. R. Schroeder. New primary batteries. December 15.

23,232. J. Y. Johnson.—From A. M. Michel, France. Improvements in and relating to secondary or storage batteries. Complete Specification. December 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

18,597. E. Andreoli. Electrolysis. December 7.

20,413. G. Bamberg. Electrolytic apparatus, more particularly applicable for manufacturing caustic soda and other products from salt, but also applicable to other purposes. November 23.

22,030. C. Hoepfner. Electrolytic treatment of copper and silver ores. December 14.

22,854. F. Placet and J. Bonnet. Electrolysis of metals. December 14.

22,855. E. Placet and J. Bonnet. A method of extracting chromium by the aid of electrolytic baths with a base of salts of chromium. November 23.

1892.

1061. E. Hermite. Bleaching and disinfecting starch and fecula by electrolysis. December 7.

1141. C. Vogt. Dry electrical elements. November 30.

1786. R. Pinna. Tanning by electricity. December 21.

16,262. C. A. Faure. Electrolytical decomposition of alkaline chlorides for the production of chlorine and alkalis, and apparatus therefor. December 7.

17,169. C. Kellner. Electrolytical decomposition of metallic salts, and apparatus therefor. December 14.

17,224. W. P. Thompson.—From C. L. Coffin. Apparatus for electrically heating and working metal. November 23.

18,516. E. N. A. Picard and J. A. Taudière. Electrodeposition of metals. December 14.

18,844. H. Koller. Improvements in dry cells or galvanic batteries. December 14.

19,655. H. G. O'Neill. See Class II.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

20,682. R. Haddan.—From J. W. Evans, United States. Improvements in percolators for extracting oil. Complete Specification. November 15.

21,414. J. Kennedy. An improved soap. November 24.

21,809. G. J. Epstein. See Class III.

21,817. J. D. Barnett. Improvements in the process of cleaning and extracting oil and grease from cotton waste and other fibrous materials. November 29.

21,996. E. Hunter. An improved compound to be applied to driving straps. December 1.

22,039. H. H. Lake.—From G. Schlicht, Austria. Improvements relating to the manufacture of soap. Complete Specification. December 1.

22,137. E. Görg. Process for the manufacture of soda-potash soap. December 3.

22,322. W. C. Shaw. Improvements in the method of and apparatus for refining or bleaching oils and varnishes. December 6.

22,605. P. Zacharias and J. Gruawald. Improvements in the manufacture of soap. Complete Specification. December 9.

22,681. S. Stanton.—From E. W. Stanton, United States. Improvements in petroleum or naphtha soap and in the method of and apparatus for producing the same. Complete Specification. December 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

22,413. W. Saint-Martin. See Class XVII.

1892.

11,173. E. Noppel, B. Grosche, and T. E. Tack. Apparatus for purifying oil and separating new oil from drippings. Applicable also as an oil tank. December 21.

18,527. J. Brown. Manufacture of soft soap. December 7.

18,533. J. Brown. Manufacture of hard soap. December 21.

20,682. R. Haddan.—From J. W. Evans. Improvements in percolators for extracting oil. November 23.

XIII.—PAINTS, PIGMENTS VARNISHES, AND RESINS.

APPLICATIONS.

20,547. T. Harris and H. C. Sacré. The utilisation of a certain waste oxide of iron in the manufacture of paints and pigments, and for other purposes. November 14.

20,891. R. Matthews and J. Noad. Improvements in the manufacture of white lead and coloured pigments. November 17.

21,240. W. B. Lawson and H. Schofield. An improvement in the manufacture of liquid black lead. November 22.

21,370. C. Carron. Improvements in apparatus for mixing and automatically weighing white lead and similar powdered substances. November 23.

21,424. F. G. Groenert. A new or improved cleaning and polishing composition specially applicable for cleaning and restoring furniture, leather and the like. November 24.

21,639. J. Horadam. Improvements in the manufacture of water colours. November 26.

21,932. J. S. P. Stutley. An improved composition paint. Complete Specification. November 30.

22,098. F. Crane.—From J. Crane, United States. Improvements in or relating to paints and driers therefor. December 2.

22,099. F. Crane. An improved manufacture of filler or coating for wood surfaces. December 2.

22,175. W. Baker. The manufacture of an improved composition for waterproofing and other purposes. December 3.

22,322. W. C. Shaw. See Class XII.

23,206. R. Ripley. An improved or new manufacture of black lead. December 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

22,391. R. B. Johnson and T. C. Palmer. Manufacture of white lead and apparatus therefor. November 30.

22,809. M. Williams. Manufacture of oil paints and paint medium. November 23.

1892.

790. W. Smith. Manufacture of white lead by the acetate of ammonia process, more especially in respect of the regeneration and recovery of acetate of ammonia from the weak liquors and washings furnished in the process. November 30.

1882. D. Swan. Obtaining pigments. December 7.

22,011. R. I. Clark. Manufacture of varnish. December 21.

13,240. H. Pfanne. An improved method of and apparatus for treating linseed oil to obtain a product applicable as a varnish. November 23.

14,888. R. Kieffert and H. Thirion. Paints. December 14.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

20,677. M. Heftler and G. Bénard. Improvements in or relating to the extraction of tanning and dyeing materials. Filed November 15. Date applied for May 17, 1892, being date of application in France.

21,551. T. Cowburn. Improved process of and apparatus for tanning and cleaning hides and skins. November 25.

22,480. A. Sinan and H. Sinan. A process for clarifying or decolorising tannic extracts. December 7.

23,233. J. M. E. Foutenilles and H. G. J. R. Baguenier-Desormeaux. Improvements in purifying and clarifying tannic liquids. December 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

838. S. Thorn. "Substitutes for tannin of an article in substitution of what is commonly known as tanned leather." November 30.

11,521. L. Munk. New or improved manufacture of material suitable for use as a substitute for whalebone. December 7.

XV.—AGRICULTURE AND MANURES.

COMPLETE SPECIFICATION ACCEPTED.

1892.

3806. E. Groe and E. Ramond. A composition for dressing vines and other trees. November 28.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

21,038. L. E. Asser and L. A. H. Hartogh. Improvements in the manufacture of starchy material. November 19.

21,217. W. P. Thompson.—From F. Soxhlet, Germany. Improvements in or relating to refining sugar. Complete Specification. November 22.

21,939. W. P. Thompson.—From F. Schiaffino, Italy. Improvements in the treatment of raw sugar for purifying and drying the same. Complete Specification. November 30.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

3241. A. G. Brookes.—From. F. Paetow. Refining or purifying sugar. December 14.

11,972. W. Hannah and F. Curtis. Improvements in the method of manufacturing sugar in cubes or other forms, and in means or apparatus to be employed therein. December 14.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

20,684. F. W. Wright. Improvements in and apparatus for effecting the raising and aerating of beer and other liquids. November 15.

20,773. A. Jenik. Improved construction of dephlegmators or apparatus for condensing and separating aqueous constituents and impurities from alcoholic vapours. November 16.

20,787. F. M. Polsky. Improvements in the manufacture of yeast. November 16.

20,825. H. Stock. Improvements in germinating apparatus. Complete Specification. November 17.

20,903. R. H. Leaker. Improvements in distilling and rectifying brandy, whisky, and other spirits, and oils, essences, and the like, and in machinery and apparatus therefor. Complete Specification. November 18.

21,284. H. H. Leigh.—From B. C. Batcheller, S. D. Schuyler, and W. M. Cramp, United States. Improvements in process and apparatus for drying brewers' grains. Complete Specification. November 22.

21,661. H. Reid. Yeast fermenting cakes. November 28.

21,897. C. S. Meacham. Improvements in means employed in the preservation of hops. November 30.

22,253. K. R. Geduld. Process for artificially acidifying yeast-mash. December 5.

22,495. W. Shreeve. An improved method or process of dressing and cleansing beer, wine, or other barrels or casks. December 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

22,413. W. Saint-Martin. Means or apparatus for maturing and improving fermented alcoholic liquids, applicable also for oxidising oleaginous and other liquids. November 30.

1892.

911. R. H. Leaker. Method and apparatus for kilning malt. November 30.

17,927. R. Ilges. Improvements in the method of and apparatus for distilling mash for the purpose of obtaining highly concentrated fusel oil and purified alcohol. December 21.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

21,091. J. Dudin. See Class XX.

21,111. P. F. Shaw and A. W. Orr. A new mode of preparing extracts of meats and like substances. November 21.

21,488. W. Paterson. A new or improved process in the manufacture of bread and the like with extract of malt. Complete Specification. November 25.

21,623. G. D. Dennis. An improved process of preserving dried vegetables. November 26.

21,637. G. Dierking. Improvements in or relating to the enriching of milk and other beverages. November 26.

22,068. J. J. Clark. Improvements in the manufacture of starchless flour and bread. December 2.

22,115. M. Julien and A. Brin. A process of enriching milk and producing cream and butter. December 2.

22,189. G. C. Legay. An improved process for the sterilisation of milk. December 3.

22,733. J. H. Cayless. Improvements in or relating to the manufacture of bread. December 10.

22,831. J. Swan. Improvements in preserving eggs. December 12.

22,922. A. J. Boulton.—From L. Fromm, Germany. A method of preserving farinaceous products. Complete Specification. December 13.

23,230. E. J. Daviond. Process for removing bad flavours and odours from vegetable or animal products without affecting their active or nutritious qualities. December 16.

B.—Sanitary Chemistry.

21,215. J. Swallow. Improvements in or relating to the means or process for treating and clarifying sewage and other impure or polluted waters. November 22.

21,291. A. O. Jones. Improvements in the treatment and utilisation of sewage and plant therefor. November 23.

22,458. J. Hanson. Improvements in apparatus for burning town refuse or like objectionable matter. December 7.

22,530. J. M. Allan. Improvements in the method of and apparatus for the treatment of sewage or the like. December 8.

22,766. T. Brown. An improved system of intercepting and separating solid from liquid sewage. December 12.

C.—Disinfectants.

20,785. S. Pitt.—From Schloessing Brothers, France. An improved insecticide and anticyptogamic composition for the treatment of plants. Complete Specification. November 16.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1891.

20,436. W. P. Thompson.—From Moser and Co. Improvements in and connected with the process of extracting cocoa or rendering it soluble for the preparation of soluble cocoa, or the manufacture of cocoa powder, chocolate, or the like preparations. November 23.

1892.

1150. K. G. Krikorian. A new or improved method of treating and roasting malt, and blending the same for infusion together with coffee. November 30.

1717. S. Saker and W. C. Glover. The manufacture of a compound for use in preparing infusions of tea. December 11.

C.—Disinfectants.

1891.

22,258. C. C. Leathers. A new or improved apparatus for disinfecting or odourising purposes. November 23.

1892.

5036. J. B. Dewhurst. An improved compound for disinfecting and other purposes. December 7.

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

21,485. E. Cadoret and E. Degraide. A new or improved process of manufacturing incombustible and inodorous celluloid. Complete Specification. November 25.

21,795. E. N. Cummings. Improvements in toilet and wrapping paper. Complete Specification. November 29.

21,948. J. P. H. Huesser. The new blotting and filtering paper. December 1.

COMPLETE SPECIFICATION ACCEPTED.

1892.

3103. F. T. Jefferson. Manufacture of paper for the copying books of manifold writers for making tracings and for other like purposes. December 14.

XX.—FINE CHEMICALS, ALKALOIDS ESSENCES, AND EXTRACTS.

APPLICATIONS.

20,548. F. Keller. Improvements in menthol cones. November 14.

20,903. R. H. Leaker. See Class XVII.

21,091. J. Dudin. Improved process or method for the manufacture of tea extract and apparatus therefor. November 21.

21,938. F. Krafft and A. Roos. A new process of preparing methyl-ether, ethyl-ether, and their homologues by the action of alcohols on benzenesulphonic acid and other sulphonic acids or their esters. Complete Specification. November 30.

22,442. O. Murray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of peptones free from albuminous matters. December 7.

22,757. J. F. F. von Mering. Improvements relating to the production of acetyl and propionyl compounds of *p*-oxyphenylurethanes or their ethers. December 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

1438. I. S. McDougall and J. T. McDougall. Treatment of solutions of arsenic or of salts of arsenic for diminishing the danger incidental to their transport. December 14.

1808. J. Berlinerblau. Manufacture of para-phenetol-carbamide and para-anisolecarbamide. December 14.

1946. H. Boisselier. A new combination of eucalyptus and its products. December 7.

2194. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. The treatment of amido-guanidine for the manufacture of a new compound and products derived therefrom. December 21.

3147. A. Bang.—From G. A. Dahl. An antipyretic and anti-nenralgic chinolin derivative, and processes for the production of the same. December 7.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

21,442. F. Hes. Improvements in toning photographic prints and negatives. November 24.

21,622. H. W. Vogel and J. Weinberg. A new or improved paste for the prevention of discoloration of photographs mounted upon Bristol-board. November 26.

22,576. J. Hauff. The employment of diamido-dioxybenzol in combination with sulphides of the alkalis for developing the latent image in layers containing halogen silver for photographic purposes. December 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

21,381. J. T. Sandell. Manufacture of sensitive plates for photographic purposes. November 23.

1892.

4498. J. Hauff. A process for developing photographic images. December 7.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

20,880. A. H. Durnford. An improvement in the manufacture of explosive and other compounds containing dissolved nitrated cellulose. November 17.

21,058. A. McDougall. Improvements in the manufacture of explosives. November 19.

22,023. A. Kramer. The "gigantic" explosive. December 1.

22,739. H. Kolf. Improvements in the manufacture of gunpowder. December 10.

22,992. H. C. Seddon. Improvements in percussion fuses for projectiles. December 14.

23,105. O. Inray.—From C. Glaser and Co., Germany. Process for manufacturing powder suitable for practice ammunition, sporting cartridges, and similar purposes. December 15.

COMPLETE SPECIFICATION ACCEPTED.

1892.

6258. O. Inray.—From M. M. Rotten and Co. Manufacture of explosives. December 7.

XXIII.—ANALYTICAL CHEMISTRY.

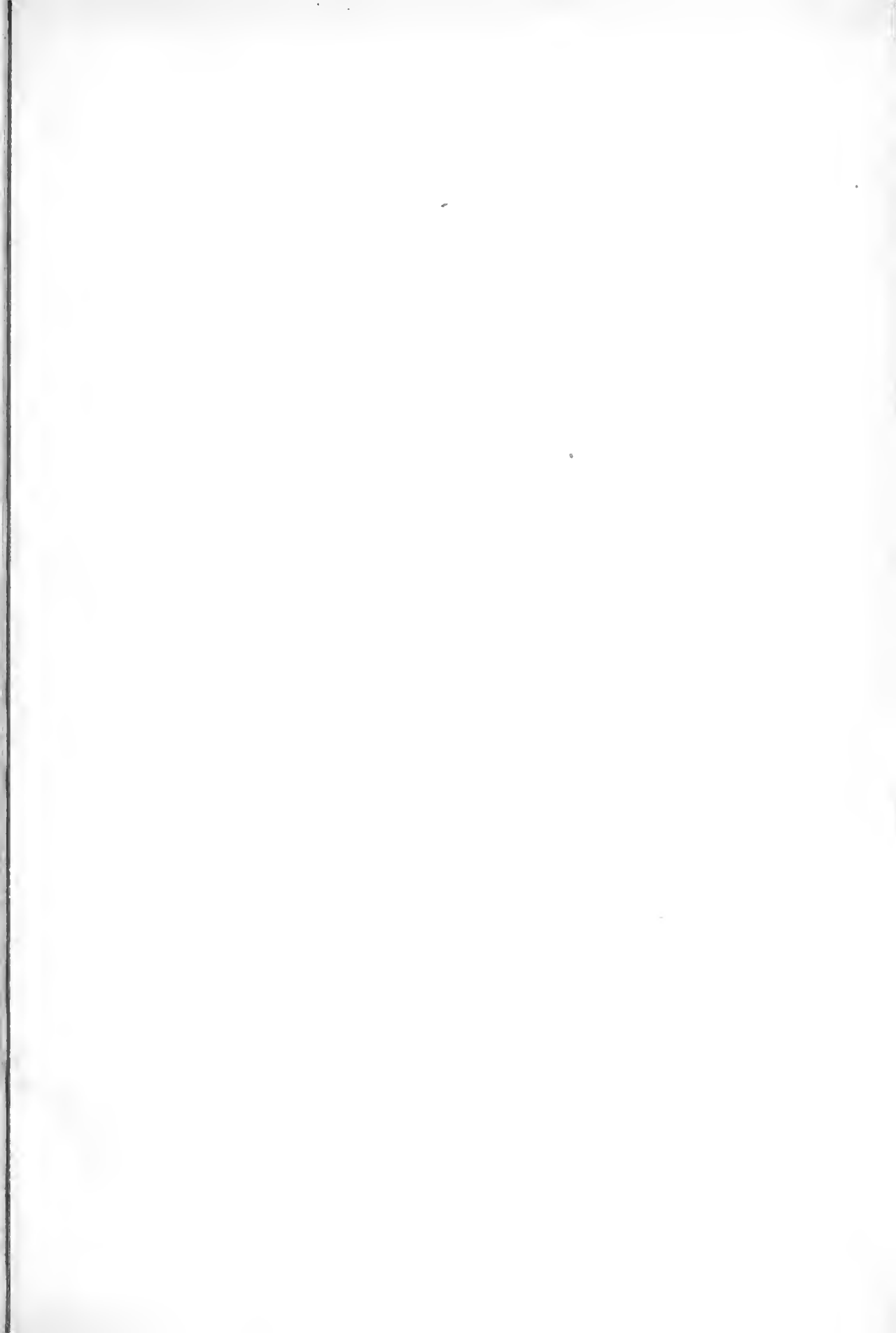
APPLICATION.

23,109. W. Belgrove. An improved means of testing the quality of milk. December 15.

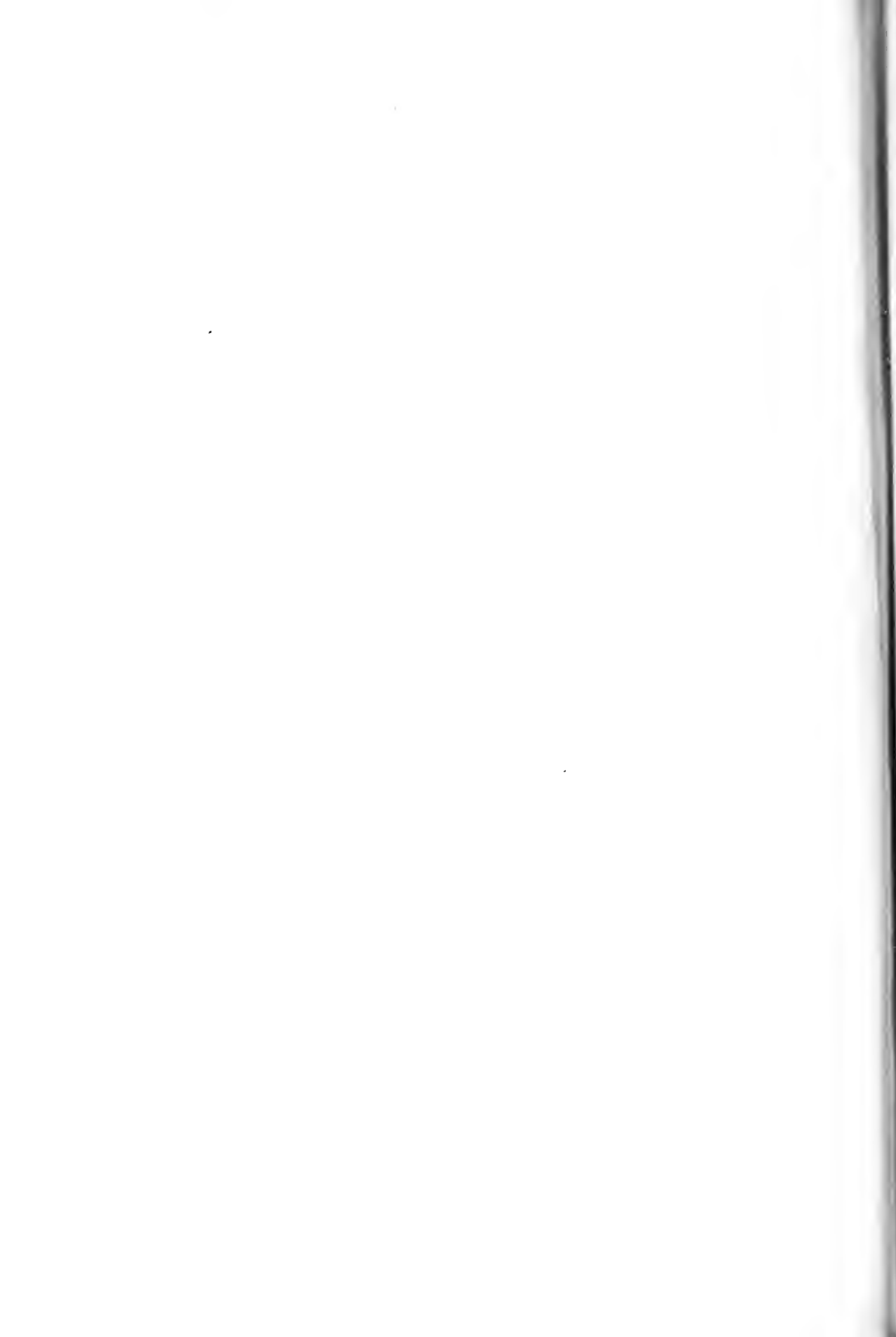
PATENT UNCLASSIFIABLE.

APPLICATION.

21,452. W. F. Greene. Improvements in the preservation of perishable articles. November 24.







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